

Project Manual

University of South Carolina Softball Stadium Construction

Columbia, SC

Architect's Project Number: 11.122.00 State Project Number: H27-6088-MJ

BID SET

03.16.12

Volume 1

Quackenbusharchitects.com

PROJECT DIRECTORY

Owner	University of South Carolina Facilities Management Center 743 Greene Street Columbia, SC 29208 (803) 777-3126 FAX (803) 777-8739
Architect-of-Record	Quackenbush Architects + Planners 1217 Hampton Street Columbia, SC 29201 (803) 771-2999 FAX (803) 771-2858 Barbara Haller, AIA
Project Consultants	
Sports Architect	CHA Sports 111 Winners Circle Albany, NY 12205 (518) 453-4500
Civil Engineer	BP Barber / URS 101 Research Drive Columbia, SC 29202-1116 (803) 254-4400 Chris Smith
Structural Engineer	CHA 111 Winners Circle Albany, NY 12205 (518) 453-4500
Plumbing / Mech./ Fire Protection / Electrical Engineer	RMF Engineering 194 Seven Farms Drive, Suite G Charleston, SC 29492 (843) 971-9639

Architect's Project No. 11.122.00 State Project No. H27-6088-MJ 03/16/12

DOCUMENT 000107 - SEALS PAGE

1.1 DESIGN PROFESSIONALS OF RECORD

ARCHITECT

Quackenbush Architects + Planners

Divisions 01 - 49~Sections except where indicated as prepared by other design professionals of record



Sports Architect

CHA Sports 07 13 26, 07 19 00, 09 65 66, 12 63 00

STRUCTURAL

ENGINEER

CHA

05 40 00

Architect's Project No. 11.122.00 State Project No. H27-6088-MJ 03/16/12



TE OF AUTH

Sports Architect/ Engineer

CHA Sports 26 56 10, 32 18 13

Architect's Project No. 11.122.00 State Project No. H27-6088-MJ 03/16/12

CIVIL ENGINEER URS/BP Barber The following Sections: 01 71 23, 03 30 05, Divisions 31, 32, 33, except : (31 31 16 prepared by Architect) (32 14 00 prepared by Architect) (32 18 13 prepared byCHA)



Architect's Project No. 11.122.00 State Project No. H27-6088-MJ 03/16/12

FIRE-PROTECTION, PLUMBING, MECHANICAL

RMF Engineering The following Sections: Division 21 Division 22 Division 23

ELECTRICAL ENGINEER **RMF Engineering The following Sections:** Division 26, 27, 28

FIRE PROTECTION, MECHANICAL, ELECTRICAL AND PLUMBING **RMF Engineering** Corporate Seal

END OF DOCUMENT 000107



SECTION 00 01 00 - TABLE OF CONTENTS

The complete Project Manual for this project consists of this entire bound volume which is not to be separated for any reason. The Architect and Owner will not be responsible for any assumptions made by a Contractor or Subcontractor who does not receive a complete bound Project Manual containing all sections and documents listed in the Table of Contents.

The following listed documents comprise the Project Manual for University of South Carolina Softball Stadium Construction. Where numerical sequence of Sections or Divisions is interrupted, such interruptions are intentional.

PROJECT NUMB	ER: H27-6088-MJ	
Section No.	Section Title	Number of Pages

VOLUME 1

DIVISION 00 – BIDDING AND CONTRACT REQUIREMENTS

INTRODUCTO	RY INFORMATION	
	Cover Page	1
	Project Directory	1
	Seals Pages	4
	Project Manual Table of Contents	6
BIDDING REQ	UIREMENTS	
	Invitation to Bids (Request for Advertisement SE-310)	1
	Instructions to Bidders (AIA Document A701 – 1997 Edition) 00201-OSE Standard Supplementary Instructions to Bidders (2011 Ed)	1 10
	Bid Bond (AIA Document A301)	1
	Standard Bid Form (SE-330-2011 Edition)	6
CONTRACTIN	G REQUIREMENTS	
	Standard Form of Agreement between Owner and Contractor (AIA	
	Document A101-2007 Edition)	1
	00501-OSE Standard Modifications to Agreement Between Owner and	
	Contractor AIA A101-201 (2011 Edition)	3
	General Conditions of the Contract for Construction	
	(AIA Document A201-2007 Edition)	1
	00811 – Standard Supplementary Conditions (2011 Edition)	
	(Supplement to AIA Document A201-2007 Edition General Conditions	
	of the Contract)	25
	USC Supplemental General Conditions for Construction Projects	3
	Performance Bond (SE-355-2011 Edition)	2
	Labor and Material Payment Bond (SE-357-2011 Edition)	2
	Construction Change Order (SE-480 2011 Edition)	1
	Contractor's One Year Guarantee	1

Contractor's One Year Guarantee

00 01 15	List of Drawing Sheets	4
00 31 32	Geotechnical Data	1
	GS2 Report Dated October 31, 2011	49
DIVISION 1	CENEDAL DECLIDEMENTS	
	- GENERAL REQUIREMENTS	11
01 21 00	Allowances	11
01 21 00 01 23 00	Alternates	3
01 25 00	Substitution Procedures	2
01 25 00	Contract Modification Procedures	4
01 20 00	Payment Procedures	5
01 29 00	Project Management and Coordination	10
01 31 00	Construction Progress Documentation	10
01 32 00 01 32 00	Submittel Procedures	9 12
01 33 00	Baguest for Electronic Drawing Files	12
01 40 00	Quality Dequirements	1
01 40 00	Quanty Requirements Solomia Requirements — Quality Accurance Plan	9 1
	Seismic Requirements – Quanty Assurance Plan	1
	Statement of Spacial Inspections	1
01 42 00	Statement of Special Inspections	ے 15
01 42 00	References	15
01 50 00	Temporary Facilities and Controls	9
01 60 00	Field Engineering	5
01 71 23	Field Engineering	l 10
01 73 00	Execution	10
01 77 00	Closeout Procedures	6
01 78 23	Operation and Maintenance Data	1
01 78 39	Project Record Documents	4
01 79 00	Demonstration and Training	4
DIVISION 2	- EXISTING CONDITIONS	
02 41 16	Structure Demolition	7
	Hazardous Material Test Reports	16
DIVISION 3	– CONCRETE	
02 20 00	Cast In Diace Consulta	17
03 30 00	Cast-In-Place Concrete	1/
03 30 05	Cast-In-Place Concrete for Sitework	16
DIVISION 4	– MASONRY	
04 20 00	Unit Masonry	20
04 72 00	Cast Stone Masonry	7
DIVISION 5	- METALS	
05 21 00	Structural Steel	9
05 31 00	Steel Deck	4
05 40 00	Cold Formed Metal Framing	3
05 50 00	Metal Fabrications	10
05 51 00	Metal Stairs	8
05 52 13	Pipe and Tube Railings	10
57 00 00	Decorative Metal	10
2,0000		10

DIVISION 6 -	WOOD & PLASTICS	
06 10 53	Miscellaneous Rough Carpentry	5
06 16 00	Sheathing	6
06 41 13	Wood-Veneer-Faced Architectural Cabinets	8
DIVISION 7 –	THERMAL & MOISTURE PROTECTION	
07 11 13	Bituminous Dampproofing	3
07 13 26	Self-Adhering Sheet Waterproofing	6
07 13 26.1	Self-Adhering Sheet Waterproofing (Walls)	6
07 19 00	Concrete Sealers and Water Repellents	4
07 21 00	Thermal Insulation	6
07 24 13	Polymer-Based Exterior Finish System (DEFS)	7
07 25 00	Weather Barriers	3
07 26 00	Under Slab Vapor Barrier	3
07 41 13.16	Standing Seam Metal Roof Panels	12
07 42 13.23	Metal Composite Material Wall Panels	9
07 52 16	Styrene-Butadiene-Styrene (SBS) Modified Bituminous Membrane Roofing	13
07 54 19	Polyvinyl-chloride (PVC) Roofing	10
07 62 00	Sheet Metal Flashing and Trim	12
07 81 00	Applied Fireproofing	6
07 84 46	Fire-Resistive Joint Systems	6
07 92 00	Joint Sealants	11
DIVISION 8 -	DOORS & WINDOWS	
08 11 13	Hollow Metal Doors and Frames	10
08 14 16	Flush Wood Doors	7
08 31 13	Access Doors and Frames	4
08 33 13	Coiling Counter Doors	5
08 33 23	Overhead Coiling Doors	9
08 36 13	Sectional Doors	10
08 43 13	Aluminum-Framed Entrances and Storefront	11
08 51 13`	Aluminum Windows	6
08 56 00	Ticket Windows	6
08 71 00	Door Hardware	28
08 80 00	Glazing	13
08 90 00	Louvers and Vents	8
DIVISION 9 –	FINISHES	
09 21 16.23	Gypsum Board Shaft Wall Assemblies	4
09 22 16	Non-Structural Metal Framing	6
09 29 00	Gypsum Board	8
09 30 00	Tiling	11
09 51 13	Acoustical Panel Ceilings	9
09 65 13	Resilient Base and Accessories	6
09 91 13	Exterior Painting	9
09 91 23	Interior Painting	9

DIVISION 1	0 – SPECIALTIES	
10 11 00	Visual Display Surfaces	6
10 21 13	Toilet Compartments	5
10 21 16	Shower and Dressing Compartments	6
10 28 00	Toilet and Bath Accessories	5
10 44 13	Fire Extinguisher Cabinets	7
10 44 16	Fire Extinguishers	4
10 51 13	Metal Lockers	8
10 73 00	Aluminum Walkway Covers	7
10 75 00	Flagpoles	5
DIVISION 1	1 – EQUIPMENT	
113200	Softball Facility Sound System	6
114000	Food Service Equipment	4
116660	Sports Equipment	7
VOLUME	2	
DIVISION 12	2 – FURNISHINGS	
12 24 13	Roller Window Shades	5
12 36 61	Simulated Stone Countertops	3
12 63 00	Stadium Seating	7
DIVISION 13	3 – SPECIAL CONSTRUCTION	
13 34 19	Metal Building Systems	16
DIVISION 14	4 – CONVEYING SYSTEMS	
14 24 00	Hydraulic Elevators	11
DIVISION 2	1 – FIRE SUPPRESSION	
21 13 13	Fire Protection Sprinkler System	13
	Fire Sprinkler Specification Sheet	1
DIVISION 2	2 – PLUMBING	
22 05 13	Common Motor Requirements for Plumbing Equipment	3
22 05 17	Sleeves and Seals for Plumbing Piping	4
22 05 18	Escutcheons for Plumbing Piping	2
22 05 19	Meters and Gages for Plumbing Piping	6
22 05 23	General-Duty Valves for Plumbing Piping	11
22 05 29	Hangers and Supports for Plumbing Piping	12
22 05 33	Heat Tracing for Plumbing Piping	4
22 05 48	Vibration and Seismic Controls for Plumbing Piping and Equipment	11
22 05 53	Identification for Plumbing Piping and Equipment	6
22 07 16	Plumbing Equipment Insulation	24
22 07 19	Plumbing Piping Insulation	23
22 11 16	Domestic Water Piping	15
22 11 19	Domestic Water Piping Specialties	16
22 11 23	Domestic Water Pumps	5
22 13 16	Sanitary Waste and Vent Piping	14

University of South Softball Stadium Co BID SET	Carolina	Architect's Project No. 11.122.00 State Project No. H27-6088-MJ 03/16/12	
22 13 19	Sanitary Waste Piping Specialties		14
22 14 13	Facility Storm Drainage Piping		12
22 14 23	Storm Drainage Piping Specialties		5
22 33 00	Electrical. Domestic-Water Heaters		6
22 40 00	Plumbing Fixtures		19
DIVISION 23 – H	EATING VENTING AND AIR CONDITIONING	G (HVAC)	
23 05 00	Mechanical and Electrical General Provisions		21
23 05 13	Common Motor Requirements for HVAC Equipme	ent	3
23 05 29	Hangers and Supports for HVAC Piping and Equip	ment	6
23 05 48	Vibration and Seismic Controls for HVAC Piping a	and Equipment	10
23 05 53	Identification for HVAC Piping and Equipment		6
23 05 93	Testing, Adjusting, and Balancing for HVAC Syste	ems	15
23 07 13	Duct Insulation		20
23 09 10	Automatic Temperature Control Instrumentation		24
23 23 00	Refrigerant Piping		8
23 31 13	Metal Ducts		19
23 33 00	Air Duct Accessories		19
23 34 23	HVAC Power Ventilators		7
23 37 13	Diffusers, Registers, and Grilles		6
23 81 26	Heating and Air Conditioning Equipment		15
23 82 39	Unit Heaters		7
DIVISION 26 – El	LECTRICAL		
26 05 19	Low-Voltage Electrical Power Conductors and Cab	bles	4
26 05 26	Grounding and Bonding for Electrical Systems		3
26 05 29	Hangers and Supports for Electrical Systems		5
26 05 33	Raceway and Boxes for Electrical Systems		8
26 05 43	Underground Ducts and Raceways for Electrical Sy	vstems	8
26 05 48	Vibration and Seismic Controls for Electrical Syste	ms	7
26 05 53	Identification for Electrical Systems		10
26 05 73	Overcurrent Protective Device Coordination Study		7
26 22 00	Low-Voltage Transformers		5
26 24 13	Switchboards		10
26 24 16	Panelboards		7
26 27 26	Wiring Devices		6
26 28 13	Fuses		4
26 28 16	Enclosed Switches and Circuit Breakers		6
26 36 00	Transfer Switches		2
26 51 00	Interior Lighting		9
26 56 00	Exterior Lighting		7
26 56 10	Softball Field Lighting System		12
DIVISION 27 – C	OMMUNICATIONS		
27 05 36	Cable Trays for Communication Systems		6
DIVISION 28 – El	LECTRONIC SAFETY AND SECURITY		
28 31 11	Digital, Addressable Fire-Alarm System		15

DIVISION 31 – EARTHWORK

31 11 00	Clearing and Grubbing	1
31 22 00	Site Grading	7
31 22 00.1	Playing Field Earthwork	5
31 23 16.16	Excavating, Backfilling for Structures	8
31 23 33	Trenching, Backfilling for Utilities	8
31 25 13	Erosion and Sediment Control	3
31 31 16	Termite Control	4
DIVISION 32 -	- EXTERIOR IMPROVEMENTS	
32 11 23	Stone Base Course	4
32 11 25	Synthetic Turf Base Course	5
32 31 13.25	Color Chain Link Fence System	6
32 31 19	Decorative Metal Fences and Gates	4
32 92 13	Grassing	4
32 92 30	Synthetic Turf	10
32 92 31	Playing Field Materials and Mixtures	4

DIVISION 33 – UTILITIES

33 01 00	Sewers: Sanitary, Gravity	7
33 11 00	Water Distribution System	11
33 41 00	Sewers: Storm Drainage	8

END OF SECTION

SE-310 **REQUEST FOR ADVERTISEMENT**

PROJECT NAME: Softball Stadium Construction

PROJECT NUMBER: H27-6088-MJ

PROJECT LOCATION: Columbia, South Carolina

Contractor may be subject to performance appraisal at close of project

BID SECURITY REQUIRED? Yes No

PERFORMANCE & PAYMENT BONDS REQUIRED? Yes 🛛 No 🗌

CONSTRUCTION COST RANGE: \$5,000,000-\$10,000,000

DESCRIPTION OF PROJECT: The project consists of approx. 1300-seat stadium. The construction includes concrete footings, concrete structure, steel structure, metal building structure, masonry, alum. storefront, alum. composite panels, roofing, associated plumbing, electrical, fire protection, & HVAC work, and associated interior finishes, casework & stadium specialty items. Field lighting, fencing & minor site development work are included (field is exisiting). Small and minority business participation is encouraged.

A/E NAME: Quackenbush Architects + Planners

A/E CONTACT: Barbara Haller, AIA

A/E ADDRESS: Street/PO Box:1217 Hampton Street

City: Columbia

State: SC ZIP: 29201-

EMAIL: bhaller@quackenbusharchitects.com

TELEPHONE: 803-771-2999

FAX: 803-771-2858

All questions & correspondence concerning this Invitation shall be addressed to the A/E.

BIDDING DOCUMENTS/PLANS MAY BE OBTAINED FROM: http://purchasing.sc.edu Facilities/Construction PLAN DEPOSIT AMOUNT: <u>\$0.00</u> IS DEPOSIT REFUNDABLE: Yes No Solicitations & Awards

Only those Bidding Documents/Plans obtained from the above listed source(s) are official. Bidders rely on copies of Bidding Documents/Plans obtained from any other source at their own risk.

BIDDING DOCUMENTS/PLANS ARE ALSO ON FILE FOR VIEWING PURPOSES ONLY AT (list name and location for each plan room or other entity):

N/A

PRE-BID CONFERENCE? Yes 🛛 No 🗌 MANDATORY ATTENDANCE? Yes 🗌 No 🖾 DATE: 4/19/2012 TIME: 10:00AM PLACE: 743 Greene Street, Columbia, SC 29208 - Conference Room 53

AGENCY: University of South Carolina

NAME OF AGENCY PROCUREMENT OFFICER: Kay Keisler, Procurement Specialist

ADDRESS: Street/PO Box:743 Greene Street City: Columbia

State: SC ZIP: 29208-

EMAIL: kkeisler@fmc.sc.edu

TELEPHONE: 803-777-5812

FAX: 803-777-7334

BID CLOSING DATE: 5/3/2012 TIME: 2:00PM LOCATION: 743 Greene Street, Columbia, SC 29208 - Conf Room 53 BID DELIVERY ADDRESSES:

HAND-DELIVERY:

Attn: Kay Keisler

USC Facilities Management Center

743 Greene Street

Columbia, SC 29208

MAIL SERVICE: Attn: Kay Keisler USC Facilities Management Center

743 Greene Street

Columbia, SC 29208

wan

IS PROJECT WITHIN AGENCY CONSTRUCTION CERTIFICATION? (Agency MUST check one) Yes 🗌 No 🖂

APPROVED BY (Office of State Engineer):

DATE: 4212

DOCUMENT 002113 - INSTRUCTIONS TO BIDDERS

1.1 INSTRUCTIONS TO BIDDERS

- A. AIA Document A701, (1997 Edition) "Instructions to Bidders," is hereby incorporated into the Procurement and Contracting Requirements by reference.
 - 1. A copy of AIA Document A701, "Instructions to Bidders," is not included, but may be viewed at the Architect's office (Quackenbush Architects + Planners, 1217 Hampton Street, Columbia, SC 29201) or purchased from the American Institute of Architects.

END OF DOCUMENT 002113

OWNER: <u>University of South Carolina</u> PROJECT NUMBER: <u>H27-6088-MJ</u> PROJECT NAME: <u>Softball Stadium Construction</u> PROJECT LOCATION: <u>University of South Carolina, Columbia, SC</u>

PROCUREMENT OFFICER: Kay Keisler

1. STANDARD SUPPLEMENTAL INSTRUCTIONS TO BIDDERS

1.1. These Standard Supplemental Instructions To Bidders amend or supplement Instructions To Bidders (AIA Document A701-1997) and other provisions of Bidding and Contract Documents as indicated below.

1.2. Compliance with these Standard Supplemental Instructions is required by the Office of State Engineer (OSE) for all State projects when competitive sealed bidding is used as the method of procurement.

1.3. All provisions of A701-1997, which are not so amended or supplemented, remain in full force and effect.

1.4. Bidders are cautioned to carefully examine the Bidding and Contract Documents for additional instructions or requirements.

2. MODIFICATIONS TO A701-1997

2.1. Delete Section 1.1 and insert the following:

1.1 Bidding Documents, collectively referred to as the **Invitation for Bids**, include the Bidding Requirements and the proposed Contract Documents. The Bidding Requirements consist of the Advertisement, Instructions to Bidders (A-701), Supplementary Instructions to Bidders, the bid form (SE-330), the Intent to Award Notice (SE-370), and other sample bidding and contract forms. The proposed Contract Documents consist of the form of Agreement between the Owner and Contractor, Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications, all Addenda issued prior to execution of the Contract, and other documents set forth in the Bidding Documents. Any reference in this document to the Agreement between the Owner and Contractor, AIA Document A101, or some abbreviated reference thereof, shall mean the AIA A101, 2007 Edition as modified by OSE Form 00501 – Standard Modification to Agreement Between Owner and Contractor. Any reference in this document to the General Conditions of the Contract for Construction, AIA Document A201, or some abbreviated reference thereof, shall mean the AIA A101, or some abbreviated reference thereof, shall mean the AIA Document A201, or some abbreviated reference thereof.

2.2. In Section 1.8, delete the words "and who meets the requirements set forth in the Bidding Documents".

2.3. In Section 2.1, delete the word "making" and substitute the word "submitting."

2.4. In Section 2.1.1:

After the words "Bidding Documents," delete the word "or" and substitute the word "and."

Insert the following at the end of this section:

Bidders are expected to examine the Bidding Documents and Contract Documents thoroughly and should request an explanation of any ambiguities, discrepancies, errors, omissions, or conflicting statements. Failure to do so will be at the Bidder's risk. Bidder assumes responsibility for any patent ambiguity that Bidder does not bring to the Owner's attention prior to bid opening.

2.5. In Section 2.1.3, insert the following after the term "Contract Documents" and before the period:

and accepts full responsibility for any pre-bid existing conditions that would affect the Bid that could have been ascertained by a site visit. As provided in Regulation 19-445.2042(B), A bidder's failure to attend an advertised prebid conference will not excuse its responsibility for estimating properly the difficulty and cost of successfully performing the work, or for proceeding to successfully perform the work without additional expense to the State.

2.6. Insert the following Sections 2.2 through 2.6:

2.2 CERTIFICATION OF INDEPENDENT PRICE DETERMINATION

GIVING FALSE, MISLEADING, OR INCOMPLETE INFORMATION ON THIS CERTIFICATION MAY RENDER YOU SUBJECT TO PROSECUTION UNDER SECTION 16-9-10 OF THE SOUTH CAROLINA CODE OF LAWS AND OTHER APPLICABLE LAWS.

(a) By submitting an bid, the bidder certifies that—

(1) The prices in this bid have been arrived at independently, without, for the purpose of restricting competition, any consultation, communication, or agreement with any other bidder or competitor relating to—

(i) Those prices;

- (ii) The intention to submit an bid; or
- (iii) The methods or factors used to calculate the prices offered.

(2) The prices in this bid have not been and will not be knowingly disclosed by the bidder, directly or indirectly, to any other bidder or competitor before bid opening (in the case of a sealed bid solicitation) or contract award (in the case of a negotiated solicitation) unless otherwise required by law; and

(3) No attempt has been made or will be made by the bidder to induce any other concern to submit or not to submit an bid for the purpose of restricting competition.

(b) Each signature on the bid is considered to be a certification by the signatory that the signatory—

(1) Is the person in the bidder's organization responsible for determining the prices being offered in this bid, and that the signatory has not participated and will not participate in any action contrary to paragraphs (a)(1) through (a)(3) of this certification; or

(2)(i) Has been authorized, in writing, to act as agent for the bidder's principals in certifying that those principals have not participated, and will not participate in any action contrary to paragraphs (a)(1) through (a)(3) of this certification [As used in this subdivision (b)(2)(i), the term "principals" means the person(s) in the bidder's organization responsible for determining the prices offered in this bid];

(ii) As an authorized agent, does certify that the principals referenced in subdivision (b)(2)(i) of this certification have not participated, and will not participate, in any action contrary to paragraphs (a)(1) through (a)(3) of this certification; and

(iii) As an agent, has not personally participated, and will not participate, in any action contrary to paragraphs (a)(1) through (a)(3) of this certification.

(c) If the bidder deletes or modifies paragraph (a)(2) of this certification, the bidder must furnish with its offer a signed statement setting forth in detail the circumstances of the disclosure.

2.3 DRUG FREE WORKPLACE

By submitting a bid, the Bidder certifies that Bidder will maintain a drug free workplace in accordance with the requirements of Title 44, Chapter 107 of South Carolina Code of Laws, as amended.

2.4 CERTIFICATION REGARDING DEBARMENT AND OTHER RESPONSIBILITY MATTERS

(a) (1) By submitting an Bid, Bidder certifies, to the best of its knowledge and belief, that (i) Bidder and/or any of its Principals-

(A) Are not presently debarred, suspended, proposed for debarment, or declared ineligible for the award of contracts by any state or federal agency;

(B) Have not, within a three-year period preceding this bid, been convicted of or had a civil judgment rendered against them for: commission of fraud or a criminal offense in

connection with obtaining, attempting to obtain, or performing a public (Federal, state, or local) contract or subcontract; violation of Federal or state antitrust statutes relating to the submission of bids; or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, tax evasion, or receiving stolen property; and

(C) Are not presently indicted for, or otherwise criminally or civilly charged by a governmental entity with, commission of any of the offenses enumerated in paragraph (a)(1)(i)(B) of this provision.

(ii) Bidder has not, within a three-year period preceding this bid, had one or more contracts terminated for default by any public (Federal, state, or local) entity.

(2) "Principals," for the purposes of this certification, means officers; directors; owners; partners; and, persons having primary management or supervisory responsibilities within a business entity (e.g., general manager; plant manager; head of a subsidiary, division, or business segment, and similar positions).

(b) Bidder shall provide immediate written notice to the Procurement Officer if, at any time prior to contract award, Bidder learns that its certification was erroneous when submitted or has become erroneous by reason of changed circumstances.

(c) If Bidder is unable to certify the representations stated in paragraphs (a)(1), Bid must submit a written explanation regarding its inability to make the certification. The certification will be considered in connection with a review of the Bidder's responsibility. Failure of the Bidder to furnish additional information as requested by the Procurement Officer may render the Bidder nonresponsible.

(d) Nothing contained in the foregoing shall be construed to require establishment of a system of records in order to render, in good faith, the certification required by paragraph (a) of this provision. The knowledge and information of an Bidder is not required to exceed that which is normally possessed by a prudent person in the ordinary course of business dealings.

(e) The certification in paragraph (a) of this provision is a material representation of fact upon which reliance was placed when making award. If it is later determined that the Bidder knowingly or in bad faith rendered an erroneous certification, in addition to other remedies available to the State, the Procurement Officer may terminate the contract resulting from this solicitation for default.

2.5 ETHICS CERTIFICATE

By submitting a bid, the bidder certifies that the bidder has and will comply with, and has not, and will not, induce a person to violate Title 8, Chapter 13 of the South Carolina Code of Laws, as amended (ethics act). The following statutes require special attention: Section 8-13-700, regarding use of official position for financial gain; Section 8-13-705, regarding gifts to influence action of public official; Section 8-13-720, regarding offering money for advice or assistance of public official; Sections 8-13-755 and 8-13-760, regarding restrictions on employment by former public official; Section 8-13-775, prohibiting public official with economic interests from acting on contracts; Section 8-13-790, regarding recovery of kickbacks; Section 8-13-1150, regarding statements to be filed by consultants; and Section 8-13-1342, regarding restrictions on contributions by contractor to candidate who participated in awarding of contract. The state may rescind any contract and recover all amounts expended as a result of any action taken in violation of this provision. If contractor participates, directly or indirectly, in the evaluation or award of public contracts, including without limitation, change orders or task orders regarding a public contract, contractor shall, if required by law to file such a statement, provide the statement required by Section 8-13-1150 to the procurement officer at the same time the law requires the statement to be filed.

2.6 RESTRICTIONS APPLICABLE TO BIDDERS & GIFTS

Violation of these restrictions may result in disqualification of your bid, suspension or debarment, and may constitute a violation of the state Ethics Act. (a) After issuance of the solicitation, *bidder agrees not to discuss this procurement activity in any way with the Owner or its employees, agents or officials.* All communications must be solely with the Procurement Officer. This restriction may be lifted by express written permission from the Procurement Officer. This restriction expires once a contract has been formed. (b) Unless otherwise approved in writing by the Procurement

Officer, *bidder agrees not to give anything to the Owner, any affiliated organizations, or the employees, agents or officials of either, prior to award.* (c) Bidder acknowledges that the policy of the State is that a governmental body should not accept or solicit a gift, directly or indirectly, from a donor if the governmental body has reason to believe the donor has or is seeking to obtain contractual or other business or financial relationships with the governmental body. Regulation 19-445.2165(C) broadly defines the term donor.

2.7. *Delete Section 3.1.1 and substitute the following:*

3.1.1 Bidders may obtain complete sets of the Bidding Documents from the issuing office designated in the Advertisement in the number and for the deposit sum, if any, stated therein. If so provided in the Advertisement, the deposit will be refunded to all plan holders who return the Bidding Documents in good condition within ten days after receipt of Bids. The cost of replacement of missing or damaged documents will be deducted from the deposit. A Bidder receiving a Contract award may retain the Bidding Documents and the Bidder's deposit will be refunded.

- **2.8.** Delete the language of Section 3.1.2 and insert the word "Reserved."
- **2.9.** In Section 3.1.4, delete the words "and Architect may make" and substitute the words "has made."

2.10. Insert the following Section 3.1.5

3.1.5 All persons obtaining Bidding Documents from the issuing office designated in the Advertisement shall provide that office with Bidder's contact information to include the Bidder's name, telephone number, mailing address, and email address.

2.11. In Section 3.2.2:

Delete the words "and Sub-bidders"

Delete the word "seven" and substitute the word "ten"

2.12. In Section 3.2.3:

In the first Sentence, insert the word "written" before the word "Addendum."

Insert the following at the end of the section:

As provided in Regulation 19-445.2042(B), nothing stated at the pre-bid conference shall change the Bidding Documents unless a change is made by written Addendum.

2.13. Insert the following at the end of Section 3.3.1:

Reference in the Bidding Documents to a designated material, product, thing, or service by specific brand or trade name followed by the words "or equal" and "or approved equal" shall be interpreted as establishing a standard of quality and shall not be construed as limiting competition.

2.14. Delete Section 3.3.2 and substitute the following:

3.3.2 No request to substitute materials, products, or equipment for materials, products, or equipment described in the Bidding Documents and no request for addition of a manufacturer or supplier to a list of approved manufacturers or suppliers in the Bidding Documents will be considered prior to receipt of Bids unless written request for approval has been received by the Architect at least ten days prior to the date for receipt of Bids established in the Invitation for Bids. Any subsequent extension of the date for receipt of Bids by addendum shall not extend the date for receipt of such requests unless the addendum so specifies. Such requests shall include the name of the material or equipment for which it is to be substituted and a complete description of the proposed substitution including drawings, performance and test data, and other information necessary for an evaluation. A statement setting forth changes in other materials, equipment or other portions of the Work, including changes in the work of other contracts that incorporation of the proposed substitution would require, shall be included. The burden of proof of the merit of the proposed substitution is upon the proposer. The Architect's decision of approval or disapproval of a proposed substitution shall be final.

2.15. Delete Section 3.4.3 and substitute the following:

3.4.3 Addenda will be issued no later than 120 hours prior to the time for receipt of Bids except an Addendum withdrawing the request for Bids or one which includes postponement of the date for receipt of Bids.

2.16. *Insert the following Sections 3.4.5 and 3.4.6:*

3.4.5 When the date for receipt of Bids is to be postponed and there is insufficient time to issue a written Addendum prior to the original Bid Date, Owner will notify prospective Bidders by telephone or other appropriate means with immediate follow up with a written Addendum. This Addendum will verify the postponement of the original Bid Date and establish a new Bid Date. The new Bid Date will be no earlier than the fifth (5th) calendar day after the date of issuance of the Addendum postponing the original Bid Date.

3.4.6. If an emergency or unanticipated event interrupts normal government processes so that bids cannot be received at the government office designated for receipt of bids by the exact time specified in the solicitation, the time specified for receipt of bids will be deemed to be extended to the same time of day specified in the solicitation on the first work day on which normal government processes resume. In lieu of an automatic extension, an Addendum may be issued to reschedule bid opening. If state offices are closed at the time a pre-bid or pre-proposal conference is scheduled, an Addendum will be issued to reschedule the conference. Useful information may be available at: http://www.scemd.org/scgovweb/weather_alert.html

- **2.17.** In Section 4.1.1, delete the word "forms" and substitute the words "SE-330 Bid Form."
- **2.18.** Delete Section 4.1.2 and substitute the following:

4.1.2 Any blanks on the bid form to be filled in by the Bidder shall be legibly executed in a non-erasable medium. Bids shall be signed in ink or other indelible media.

- 2.19. Delete Section 4.1.3 and substitute the following:4.1.3 Sums shall be expressed in figures.
- **2.20.** Insert the following at the end of Section 4.1.4:

Bidder shall not make stipulations or qualify his bid in any manner not permitted on the bid form. An incomplete Bid or information not requested that is written on or attached to the Bid Form that could be considered a qualification of the Bid, may be cause for rejection of the Bid.

2.21. Delete Section 4.1.5 and substitute the following:

4.1.5 All requested Alternates shall be bid. The failure of the bidder to indicate a price for an Alternate shall render the Bid non-responsive. Indicate the change to the Base Bid by entering the dollar amount and marking, as appropriate, the box for "ADD TO" or "DEDUCT FROM". If no change in the Base Bid is required, enter "ZERO" or "No Change." For add alternates to the base bid, Subcontractor(s) listed on page BF-2 of the Bid Form to perform Alternate Work may be used for both Alternates and Base Bid Work if Alternates are accepted.

2.22. Delete Section 4.1.6 and substitute the following:

4.1.6 Pursuant to Title 11, Chapter 35, Section 3020(b)(i) of the South Carolina Code of Laws, as amended, Section 7 of the Bid Form sets forth a list of subcontractor specialties for which Bidder is required to list only the subcontractors Bidder will use to perform the work of each listed specialty. Bidder must follow the Instructions in the Bid Form for filling out this section of the Bid Form. Failure to properly fill out Section 7 may result in rejection of Bidder's bid as non-responsive.

2.23. Delete Section 4.1.7 and substitute the following:

4.1.7 Each copy of the Bid shall state the legal name of the Bidder and the nature of legal form of the Bidder. Each copy shall be signed by the person or persons legally authorized to bind the Bidder to a contract. A Bid submitted by an agent shall have a current power of attorney attached certifying the agent's authority to bind the Bidder.

2.24. Delete Section 4.2.1 and substitute the following:

4.2.1 If required by the Invitation for Bids, each Bid shall be accompanied by a bid security in an amount of not less than five percent of the Base Bid. The bid security shall be a bid bond or a certified cashier's check. The Bidder pledges to enter into a Contract with the Owner on the terms stated in the Bid and will, if required, furnish bonds covering the faithful performance of the Contract and payment of all obligations arising thereunder. Should the Bidder refuse to enter into such Contract or fail to furnish such bonds if required, the amount of the bid security shall be forfeited to the Owner as liquidated damages, not as a penalty.

2.25. *Delete Section 4.2.2 and substitute the following:*

- **4.2.2** If a surety bond is required, it shall be written on AIA Document A310, Bid Bond, and the attorney-in-fact who executes the bond on behalf of the surety shall affix to the bond a certified and current copy of the power of attorney. The bid bond shall:
 - .1 Be issued by a surety company licensed to do business in South Carolina;
 - .2 Be issued by a surety company having, at a minimum, a "Best Rating" of "A" as stated in the most current publication of "Best's Key Rating Guide, Property-Casualty", which company shows a financial strength rating of at least five (5) times the contract price.
 - .3 Be enclosed in the bid envelope at the time of Bid Opening, either in paper copy or as an electronic bid bond authorization number provided on the Bid Form and issued by a firm or organization authorized by the surety to receive, authenticate and issue binding electronic bid bonds on behalf the surety.

2.26. Delete Section 4.2.3 and substitute the following:

4.2.3 By submitting a bid bond via an electronic bid bond authorization number on the Bid Form and signing the Bid Form, the Bidder certifies that an electronic bid bond has been executed by a Surety meeting the standards required by the Bidding Documents and the Bidder and Surety are firmly bound unto the State of South Carolina under the conditions provided in this Section 4.2.

2.27. Insert the following Section 4.2.4:

4.2.4 The Owner will have the right to retain the bid security of Bidders to whom an award is being considered until either (a) the Contract has been executed and performance and payment bonds, if required, have been furnished, or (b) the specified time has elapsed so that Bids may be withdrawn or (c) all Bids have been rejected.

2.28. Delete Section 4.3.1 and substitute the following:

4.3.1 All copies of the Bid, the bid security, if any, and any other documents required to be submitted with the Bid shall be enclosed in a sealed opaque envelope. The envelope shall, unless hand delivered by the Bidder, be addressed to the Owner's designated purchasing office as shown in the Invitation for Bids. The envelope shall be identified with the Project name, the Bidder's name and address and, if applicable, the designated portion of the Work for which the Bid is submitted. If the Bid is sent by mail or special delivery service (UPS, Federal Express, etc.), the envelope should be labeled "BID ENCLOSED" on the face thereof. Bidders hand delivering their Bids shall deliver Bids to the place of the Bid Opening as shown in the Invitation for Bids. Whether or not Bidders attend the Bid Opening, they shall give their Bids to the Owner's procurement officer or his/her designee as shown in the Invitation for Bids prior to the time of the Bid Opening.

2.29. Insert the following Section 4.3.6 and substitute the following:

4.3.5 The official time for receipt of Bids will be determined by reference to the clock designated by the Owner's procurement officer or his/her designee. The procurement officer conducting the Bid Opening will determine and announce that the deadline has arrived and no further Bids or bid modifications will be accepted. All Bids and bid modifications in the possession of the procurement officer at the time the announcement is completed will be timely, whether or not the bid envelope has been date/time stamped or otherwise marked by the procurement officer.

2.30. Delete Section 4.4.2 and substitute the following:

4.4.2 Prior to the time and date designated for receipt of Bids, a Bid submitted may be withdrawn in person or by written notice to the party receiving Bids at the place designated for receipt of Bids. Withdrawal by written notice shall be in writing over the signature of the Bidder.

2.31. In Section 5.1, delete everything following the caption "OPENING OF BIDS" and substitute the following:

5.1.1 Bids received on time will be publicly opened and will be read aloud. Owner will not read aloud Bids that Owner determines, at the time of opening, to be non-responsive.

5.1.2 At bid opening, Owner will announce the date and location of the posting of the Notice of Intended Award.

5.1.3 Owner will send a copy of the final Bid Tabulation to all Bidders within ten (10) working days of the Bid Opening.

5.1.4 If Owner determines to award the Project, Owner will, after posting a Notice of Intended Award, send a copy of the Notice to all Bidders.

5.1.5 If only one Bid is received, Owner will open and consider the Bid.

2.32. In Section 5.2, insert the section number "5.2.1" before the words of the "The Owner" at the beginning of the sentence.

2.33. *Insert the following Sections 5.2.2 and 5.2.3:*

5.2.2 The reasons for which the Owner will reject Bids include, but are not limited to:

- .1 Failure by a Bidder to be represented at a Mandatory Pre-Bid Conference or site visit;
- .2 Failure to deliver the Bid on time;
- .3 Failure to comply with Bid Security requirements, except as expressly allowed by law;
- .4 Listing an invalid electronic Bid Bond authorization number on the bid form;
- .5 Failure to Bid an Alternate, except as expressly allowed by law;
- .6 Failure to list qualified Subcontractors as required by law;
- .7 Showing any material modification(s) or exception(s) qualifying the Bid;
- .8 Faxing a Bid directly to the Owner or their representative; or
- .9 Failure to include a properly executed Power-of-Attorney with the bid bond.

5.2.3 The Owner may reject a Bid as nonresponsive if the prices bid are materially unbalanced between line items or sub-line items. A bid is materially unbalanced when it is based on prices significantly less than cost for some work and prices which are significantly overstated in relation to cost for other work, and if there is a reasonable doubt that the bid will result in the lowest overall cost to the Owner even though it may be the low evaluated bid, or if it is so unbalanced as to be tantamount to allowing an advance payment.

2.34. *Delete Section 6.1 and substitute the following:*

6.1 CONTRACTOR'S RESPONSIBILITY

Owner will make a determination of Bidder's responsibility before awarding a contract. Bidder shall provide all information and documentation requested by the Owner to support the Owner's evaluation of responsibility. Failure of Bidder to provide requested information is cause for the Owner, at its option, to determine the Bidder to be non-responsible

- 2.35. Delete the language of Section 6.2 and insert the word "Reserved."
- 2.36. Delete the language of Sections 6.3.2, 6.3.3, and 6.3.4 and insert the word "Reserved" after each Section Number.

2.37. Insert the following Section 6.4

6.4 CLARIFICATION

Pursuant to Section 11-35-1520(8), the Procurement Officer may elect to communicate with a Bidder after opening for the purpose of clarifying either the Bid or the requirements of the Invitation for Bids. Such communications may be conducted only with Bidders who have submitted a Bid which obviously conforms in all material aspects to the Invitation for Bids and only in accordance with Appendix D (Paragraph A(6)) to the Manual for Planning and Execution of State Permanent Improvement, Part II. Clarification of a Bid must be documented in writing and included with the Bid. Clarifications may not be used to revise a Bid or the Invitation for Bids. [Section 11-35-1520(8); R.19-445.2080]

2.38. Delete Section 7.1.2 and substitute the following:

7.1.2 The performance and payment bonds shall conform to the requirements of Section 11.4 of the General Conditions of the Contract. If the furnishing of such bonds is stipulated in the Bidding Documents, the cost shall be included in the Bid.

- **2.39.** Delete the language of Section 7.1.3 and insert the word "Reserved."
- **2.40.** In Section 7.2, insert the words "CONTRACT, CERTIFICATES OF INSURANCE" into the caption after the word "Delivery."

2.41. *Delete Section 7.2.1 and substitute the following:*

7.2.1 After expiration of the protest period, the Owner will tender a signed Contract for Construction to the Bidder and the Bidder shall return the fully executed Contract for Construction to the Owner within seven days thereafter. The Bidder shall deliver the required bonds and certificate of insurance to the Owner not later than three days following the date of execution of the Contract. Failure to deliver these documents as required shall entitle the Owner to consider the Bidder's failure as a refusal to enter into a contract in accordance with the terms and conditions of the Bidder's Bid and to make claim on the Bid Security for re-procurement cost.

2.42. Delete the language of Section 7.2.2 and insert the word "Reserved."

2.43. *Delete the language of Article 8 and insert the following:*

Unless otherwise required in the Bidding Documents, the Agreement for the Work will be written on South Carolina Modified AIA Document A101, 2007, Standard Form of Agreement Between Owner and Contractor as modified by OSE Form 00501 – Standard Modification to Agreement Between Owner and Contractor.

2.44. *Insert the following Article 9:*

ARTICLE 9 MISCELLANEOUS

9.1 NONRESIDENT TAXPAYER REGISTRATION AFFIDAVIT INCOME TAX WITHHOLDING IMPORTANT TAX NOTICE - NONRESIDENTS ONLY

Withholding Requirements for Payments to Nonresidents: Section 12-8-550 of the South Carolina Code of Laws requires persons hiring or contracting with a nonresident conducting a business or performing personal services of a temporary nature within South Carolina to withhold 2% of each payment made to the nonresident. The withholding requirement does not apply to (1) payments on purchase orders for tangible personal property when the payments are not accompanied by services to be performed in South Carolina, (2) nonresidents who are not conducting business in South Carolina, (3) nonresidents for contracts that do not exceed \$10,000 in a calendar year, or (4) payments to a nonresident who (a) registers with either the S.C. Department of Revenue or the S.C. Secretary of State and (b) submits a Nonresident Taxpayer Registration Affidavit - Income Tax Withholding, Form I-312 to the person letting the contract.

For information about other withholding requirements (e.g., employee withholding), contact the Withholding Section at the South Carolina Department of Revenue at 803-898-5383 or visit the Department's website at: <u>www.sctax.org</u>

This notice is for informational purposes only. This Owner does not administer and has no authority over tax issues. All registration questions should be directed to the License and Registration Section at 803-898-5872 or to the South Carolina Department of Revenue, Registration Unit, Columbia, S.C. 29214-0140. All withholding questions should be directed to the Withholding Section at 803-898- 5383.

PLEASE SEE THE "NONRESIDENT TAXPAYER REGISTRATION AFFIDAVIT INCOME TAX WITHHOLDING" FORM (FORM NUMBER I-312) LOCATED AT: http://www.sctax.org/Forms+and+Instructions/withholding/default.htm .

9.2 CONTRACTOR LICENSING

Contractors and Subcontractors listed in Section 7 of the Bid Form who are required by the South Carolina Code of Laws to be licensed, must be licensed at the time of bidding.

9.3 SUBMITTING CONFIDENTIAL INFORMATION

For every document Bidder submits in response to or with regard to this solicitation or request, Bidder must separately mark with the word "CONFIDENTIAL" every page, or portion thereof, that Bidder contends contains information that is exempt from public disclosure because it is either (a) a trade secret as defined in Section 30-4-40(a)(1), or (b) privileged & confidential, as that phrase is used in Section 11-35-410. For every document Bidder submits in response to or with regard to this solicitation or request, Bidder must separately mark with the words "TRADE SECRET" every page, or portion thereof, that Bidder contends contains a trade secret as that term is defined by Section 39-8-20 of the Trade Secrets Act. For every document Bidder submits in response to or with regard to this solicitation or request, Bidder submits in response to or with regard to this solicitation or request, Bidder submits in response to or with regard to this solicitation or request, Bidder submits in response to or with regard to this solicitation or request, Bidder submits in response to or with regard to this solicitation or request, Bidder submits in response to or with regard to this solicitation or request, Bidder must separately mark with the word "PROTECTED" every page, or portion thereof, that Bidder contends is protected by Section 11-35-1810. All markings must be conspicuous; use color, bold, underlining, or some other method in order to conspicuously distinguish the mark from the other text. Do not mark your entire bid as confidential, trade secret, or protected! If your bid, or any part thereof, is improperly marked as confidential or trade

secret or protected, the State may, in its sole discretion, determine it nonresponsive. If only portions of a page are subject to some protection, do not mark the entire page. By submitting a response to this solicitation, Bidder (1) agrees to the public disclosure of every page of every document regarding this solicitation or request that was submitted at any time prior to entering into a contract (including, but not limited to, documents contained in a response, documents submitted to clarify a response, & documents submitted during negotiations), unless the page is conspicuously marked "TRADE SECRET" or "CONFIDENTIAL" or "PROTECTED", (2) agrees that any information not marked, as required by these bidding instructions, as a "Trade Secret" is not a trade secret as defined by the Trade Secrets Act, & (3) agrees that, notwithstanding any claims or markings otherwise, any prices, commissions, discounts, or other financial figures used to determine the award, as well as the final contract amount, are subject to public disclosure. In determining whether to release documents, the State will detrimentally rely on Bidders's marking of documents, as required by these bidding instructions, as being either "Confidential" or "Trade Secret" or "PROTECTED". By submitting a response, Bidder agrees to defend, indemnify & hold harmless the State of South Carolina, its officers & employees, from every claim, demand, loss, expense, cost, damage or injury, including attorney's fees, arising out of or resulting from the State withholding information that Bidder marked as "confidential" or "trade secret" or "PROTECTED".

9.4 POSTING OF INTENT TO AWARD

Notice of Intent to Award, SE-370, will be posted at the following location:

Room or Area of Posting: Reception Area

Building Where Posted: Facilities Planning and Construction

Address of Building: 743 Greene Street, Columbia, South Carolina 29208

WEB site address (if applicable): <u>http://purchasing.sc.edu</u>

Posting date will be announced at bid opening. In addition to posting the notice, the Owner will promptly send all responsive bidders a copy of the notice of intent to award and the final bid tabulation

9.5 PROTEST OF SOLICITATION OR AWARD

Any prospective bidder, offeror, contractor, or subcontractor who is aggrieved in connection with the solicitation of a contract shall protest within fifteen days of the date of issuance of the applicable solicitation document at issue. Any actual bidder, offeror, contractor, or subcontractor who is aggrieved in connection with the intended award or award of a contract shall protest within ten days of the date notification of intent to award is posted in accordance with Title 11, Chapter 35, Section 4210 of the South Carolina Code of Laws, as amended. A protest shall be in writing, shall set forth the grounds of the protest and the relief requested with enough particularity to give notice of the issues to be decided, and must be received by the State Engineer within the time provided.

Any protest must be addressed to the CPO, Office of State Engineer, and submitted in writing:

- (a) by email to protest-ose@mmo.sc.gov,
- (b) by facsimile at 803-737-0639, or
- (c) by post or delivery to 1201 Main Street, Suite 600, Columbia, SC 29201.

By submitting a protest to the foregoing email address, you (and any person acting on your behalf) consent to receive communications regarding your protest (and any related protests) at the e-mail address from which you sent your protest.

9.6 SOLICITATION INFORMATION FROM SOURCES OTHER THAN OFFICIAL SOURCE

South Carolina Business Opportunities (SCBO) is the official state government publication for State of South Carolina solicitations. Any information on State agency solicitations obtained from any other source is unofficial and any reliance placed on such information is at the bidder's sole risk and is without recourse under the South Carolina Consolidated Procurement Code.

9.7 BUILDER'S RISK INSURANCE

Bidder's are directed to Article 11.3 of the South Carolina Modified AIA Document A201, 2007 Edition, which, unless provided otherwise in the bid documents, requires the contractor to provide builder's risk insurance on the project.

9.8 TAX CREDIT FOR SUBCONTRACTING WITH MINORITY FIRMS

Pursuant to Section 12-6-3350, taxpayers, who utilize certified minority subcontractors, may take a tax credit equal to 4% of the payments they make to said subcontractors. The payments claimed must be based on work performed directly for a South Carolina state contract. The credit is limited to a maximum of fifty thousand dollars annually. The taxpayer is eligible to claim the credit for 10 consecutive taxable years beginning with the taxable year in which the first payment is made to the subcontractor that qualifies for the credit. After the above ten consecutive taxable years, the taxpayer is no longer eligible for the credit. The credit may be claimed on Form TC-2, "Minority Business Credit." A copy of the subcontractor's certificate from the Governor's Office of Small and Minority Business (OSMBA) is to be attached to the contractor's income tax return. Taxpayers must maintain evidence of work performed for a State contract by the minority subcontractor. Questions regarding the tax credit and how to file are to be referred to: SC Department of Revenue, Research and Review, Phone: (803) 898-5786, Fax: (803) 898-5888. The subcontractor must be certified as to the criteria of a "Minority Firm" by the Governor's Office of Small and Minority Business Assistance (OSMBA). Certificates are issued to subcontractors upon successful completion of the certification process. Questions regarding subcontractor certification are to be referred to: Governor's Office of Small and Minority Business Assistance (NBA). 734-0657, Fax: (803) 734-2498. Reference: SC §11-35-5010 – Definition for Minority Subcontractor & SC §11-35-5230 (B) – Regulations for Negotiating with State Minority Firms.

§ 9.9 OTHER SPECIAL CONDITIONS OF THE WORK

1.4 BID DOCUMENT DISTRIBUTION

A. The documents (in "pdf" format) will be posted on USC Web site: http://purchasing.sc.edu under Facilities / Construction Solicitations & Awards. All addenda will also be posted on this website. Digital copies of documents on websites other than this are not legitimate and not authorized. Bidders using alternate websites to access drawings accept full responsibility for any differences. Hardcopies of the documents will not be distributed. All Bidders are advised that review of partial sets of documents is not recommended and bidders will be responsible for any discrepancies which might have been avoided had a full set of documents been reviewed.

B. Five complete printed sets of documents will be provided to the successful bidder.

END OF DOCUMENT

Architect's Project No. 11.122.00 State Project No. H27-6088-MJ 03/16/12

BID BOND

BID BOND is the AIA document A301, published by the American Institute of Architects.

The A301 document is not included, but may be viewed at the Architect's office (Quackenbush Architects + Planners, 1217 Hampton Street, Columbia, SC 29201) or purchased from the American Institute of Architects.

END OF SECTION

Bidders shall submit bids on only Bid Form SE-330.

OFFER

§ 1. In response to the Invitation for Construction Bids and in compliance with the Instructions to Bidders for the above-named Project, the undersigned Bidder proposes and agrees, if this Bid is accepted, to enter into a Contract with the Owner on the terms included in the Bidding Documents, and to perform all Work as specified or indicated in the Bidding Documents, for the prices and within the time frames indicated in this Bid and in accordance with the other terms and conditions of the Bidding Documents.

§ 2. Pursuant to Section 11-32-3030(1) of the SC Code of Laws, as amended, Bidder has submitted Bid Security as follows in the amount and form required by the Bidding Documents:

Bid Bond with Power of Attorney	Electronic Bid Bond	Cashier's Check
(Bidder	check one)	

§ 3. Bidder acknowledges the receipt of the following Addenda to the Bidding Documents and has incorporated the effects of said Addenda into this Bid:

ADDENDUM No:

§ 4. Bidder accepts all terms and conditions of the Invitation for Bids, including, without limitation, those dealing with the disposition of Bid Security. Bidder agrees that this Bid, including all Bid Alternates, if any, may not be revoked or withdrawn after the opening of bids, and shall remain open for acceptance for a period of <u>60</u> Days following the Bid Date, or for such longer period of time that Bidder may agree to in writing upon request of the Owner.

§ 5. Bidder herewith offers to provide all labor, materials, equipment, tools of trades and labor, accessories, appliances, warranties and guarantees, and to pay all royalties, fees, permits, licenses and applicable taxes necessary to complete the following items of construction work:

§ 6.1 BASE BID WORK_(as indicated in the Bidding Documents and generally described as follows): The project consists of approx.1300-seat stadium. The construction includes concrete footings, concrete structure, steel structure, metal building structure, masonry, aluminum storefront, aluminum composite panels, roofing, associated plumbing, electrical, fire protection, and HVAC work, and associated interior finishes, casework and stadium specialty items. Field lighting, fencing and minor site development work are included (field is exisitng).

____, which sum is hereafter called the Base Bid.

(Bidder - insert Base Bid Amount on line above)

§ 6.2 BID ALTERNATES - as indicated in the Bidding Documents and generally described as follows:

ALTERNATE # 1 (Brief Description): Seating - Revise bench seating to individual seating as indicated on the Drawings and Specifications. (All seating to be individual seating.)

ADD TO or DEDUCT FROM BASE BID:

(Bidder to Mark appropriate box to clearly indicate the price adjustment offered for each alternate)

ALTERNATE # 2 (Brief Description): Ticket Building & Plaza - Provide and install the elevated plaza and associated ticket building in their entirety as indicated on the Drawings and Specifications. Includes masonry, roofing, windows, finishes, structural steel, and associated mechanical and electrical work.

(Bidder to Mark appropriate box to clearly indicate the price adjustment offered for each alternate)

ALTERNATE # 3 (Brief Description): Expanded Batting Cage - Provide and install all necessary components to expand the Batting Cage as shown on the Drawings. Include two additional motorized coiling doors as indicated.

(Bidder to Mark appropriate box to clearly indicate the price adjustment offered for each alternate)

§ 7. LISTING OF PROPOSED SUBCONTRACTORS PURSUANT TO SECTION 3020(b)(i), CHAPTER 35, TITLE 11 OF THE SOUTH CAROLINA CODE OF LAWS, AS AMENDED – (See Instructions on the following page BF-2A)

Bidder shall use the below-listed Subcontractors in the performance of the Subcontractor Specialty work listed:

SUBCONTRACTOR SPECIALTY By License Classification and/or Subclassification (Completed by Owner)	SUBCONTRACTOR'S PRIME CONTRACTOR'S NAME (Must be completed by Bidder) BASE BID	SUBCONTRACTOR'S PRIME CONTRACTOR'S SC LICENSE NUMBER
Mechanical Contractor "Air Conditioning" or "Packaged Equipment"		
Mechanical Contractor - "Electrical"		
Mechanical Contractor "Plumbing"		
	ALTERNATE 1	
	ALTERNATE 2	
	ALTERNATE 3	

If a Bid Alternate is accepted, Subcontractors listed for the Bid Alternate shall be used for the work of both the Alternate and the Base Bid work.

INSTRUCTIONS FOR SUBCONTRACTOR LISTING

1. Section 7 of the Bid Form sets forth a list of subcontractor specialties for which bidder is required to identify by name the subcontractor(s)Bidder will use to perform the work of each listed specialty. Bidder must identify only the subcontractor(s) who will perform the work and no others.

2. For purposes of subcontractor listing, a Subcontractor is an entity who will perform work or render service to the prime contractor to or about the construction site. Material suppliers, manufacturers, and fabricators that will not perform physical work at the site of the project but will only supply materials or equipment to the bidder or proposed subcontractor(s) are not subcontractors and Bidder should not insert their names in the spaces provided on the bid form. Likewise, Bidder should not insert the names of sub-subcontractors in the spaces provided on the bid form but only the names of those entities with which bidder will contract directly.

3. Bidder must only insert the names of subcontractors who are qualified to perform the work of the listed specialties as specified in the Bidding Documents and South Carolina Licensing Laws.

4. If under the terms of the Bidding Documents, Bidder is qualified to perform the work of a specialty listed and Bidder does not intend to subcontract such work but to use Bidder's own employees to perform such work, the Bidder must insert its own name in the space provided for that specialty.

5. If Bidder intends to use multiple subcontractors to perform the work of a single specialty listing, Bidder must insert the name of each subcontractor Bidder will use, preferably separating the name of each by the word **"and"**. If Bidder intends to use both his own employees to perform a part of the work of a single specialty listing and to use one or more subcontractors to perform the remaining work for that specialty listing, bidder must insert his own name and the name of each subcontractor, preferably separating the name of each with the word **"and"**.

6. Bidder may not list subcontractors in the alternative nor in a form that may be reasonably construed at the time of bid opening as a listing in the alternative. A listing that requires subsequent explanation to determine whether or not it is a listing in the alternative is non-responsive. If bidder intends to use multiple entities to perform the work for a single specialty listing, bidder must clearly set forth on the bid form such intent. Bidder may accomplish this by simply inserting the word "**and**" between the name of each entity listed for that specialty. Owner will reject as non-responsive a listing that contains the names of multiple subcontractors separated by a blank space, the word "or", a virgule (that is a /), or any separator that the Owner may reasonably interpret as a listing in the alternative.

7. If Bidder is awarded the contract, bidder must, except with the approval of the owner for good cause shown, use the listed entities to perform the work for which they are listed.

8. If bidder is awarded the contract, bidder will not be allowed to substitute another entity as subcontractor in place of a subcontractor listed in Section 7 of the Bid except for one or more of the reasons allowed by the SC Code of Laws.

9. Bidder's failure to insert a name for each listed specialty subcontractor will render the Bid non-responsive.

§ 8. LIST OF MANUFACTURERS, MATERIAL SUPPLIERS, AND SUBCONTRACTORS OTHER THAN SUBCONTRACTORS LISTED IN SECTION 7 ABOVE (*FOR INFORMATION ONLY*): Pursuant to instructions in the Invitation for Bids, if any, Bidder will provide to Owner upon the Owner's request and within 24 hours of such request, a listing of manufacturers, material suppliers, and subcontractors, other than those listed in Section 7 above, that Bidder intends to use on the project. Bidder acknowledges and agrees that this list is provided for purposes of determining responsibility and not pursuant to the subcontractor listing requirements of SC Code Ann § 11-35-3020(b)(i).

§ 9. TIME OF CONTRACT PERFORMANCE AND LIQUIDATED DAMAGES

a. CONTRACT TIME: Bidder agrees that the Date of Commencement of the Work shall be established in a Notice to Proceed to be issued by the Owner. Bidder agrees to substantially complete the Work within <u>285</u> calendar days from the Date of Commencement, subject to adjustments as provided in the Contract Documents.

b. LIQUIDATED DAMAGES: Bidder further agrees that from the compensation to be paid, the Owner shall retain as Liquidated Damages the sum of \$1,000.00 for each calendar day the actual construction time required to achieve Substantial Completion exceeds the specified or adjusted time for Substantial Completion as provided in the Contract Documents. This sum is intended by the parties as the predetermined measure of compensation for actual damages, not as a penalty for nonperformance.

§ 10. AGREEMENTS

a. Bidder agrees that this bid is subject to the requirements of the law of the State of South Carolina.

b. Bidder agrees that at any time prior to the issuance of the Notice to Proceed for this Project, this Project may be canceled for the convenience of, and without cost to, the State.

c. Bidder agrees that neither the State of South Carolina nor any of its agencies, employees or agents shall be responsible for any bid preparation costs, or any costs or charges of any type, should all bids be rejected or the Project canceled for any reason prior to the issuance of the Notice to Proceed.

§ 11. ELECTRONIC BID BOND

By signing below, the Principal is affirming that the identified electronic bid bond has been executed and that the Principal and Surety are firmly bound unto the State of South Carolina under the terms and conditions of the AIA Document A310, Bid Bond, included in the Bidding Documents.

Electronic Bid Bond Number: _____

Signature and Title:	
8	

BIDDER'S TAXPAYER IDENTIFICATION

FEDERAL EMPLOYER'S IDENTIFICATION NUMBER:

OR

SOCIAL SECURITY NUMBER:

CONTRACTOR'S CLASSIFICATIONS AND SUBCLASSIFICATIONS WITH LIMITATIONS

Classification(s)& Limits: _____

Subclassification(s) & Limits:

SC Contractor's License Number(s):_____

BY SIGNING THIS BID, THE PERSON SIGNING REAFFIRMS ALL REPRESENTATIONS AND CERTIFICATIONS MADE BY BOTH THE PERSON SIGNING AND THE BIDDER, INCLUDING WITHOUT LIMITATION, THOSE APPEARING IN ARTICLE 2 OF THE INSTRUCTIONS TO BIDDER. THE INVITATION FOR BIDS, AS DEFINED IN THE INSTRUCTIONS TO BIDDERS, IS EXPRESSLY INCORPORATE BY REFERENCE.

SIGNATURE

BIDDER'S LEGAL NAME:	
ADRESS:	
(Signature)	DATE:
TITLE:	
TELEPHONE:	
EMAIL:	
FORM OF AGREEMENT

FORM OF AGREEMENT is the AIA Document A101 – 2007 Edition, published by the American Institute of Architects.

The A101 document is not included, but may be viewed at the Architect's office (Quackenbush Architects + Planners, 1217 Hampton Street, Columbia, SC 29201) or purchased from the American Institute of Architects.

END OF SECTION

Attachments: OSE Form 00501 Standard Modifications to Agreement Between Owner and Contractor. AIA A101-2007 (2011 Edition).

OSE FORM 00501 STANDARD MODIFICATIONS TO AGREEMENT BETWEEN OWNER AND CONTRACTOR

OWNER: <u>University of South Carolina</u> PROJECT NUMBER: <u>H27-6088-MJ</u> PROJECT NAME: <u>Softball Stadium Construction</u>

1. STANDARD MODIFICATIONS TO AIA A101-2007

1.1. These Standard Modifications amend or supplement the *Standard Form of Agreement Between Owner and Contractor* (AIA Document A101-2007) and other provisions of Bidding and Contract Documents as indicated below.

1.2. All provisions of A101-2007, which are not so amended or supplemented, remain in full force and effect.

2. MODIFICATIONS TO A101

2.1. *Insert the following at the end of Article 1:*

Any reference in this document to the Agreement between the Owner and Contractor, AIA Document A101, or some abbreviated reference thereof, shall mean the AIA A101, 2007 Edition as modified by OSE Form 00501 – Standard Modification to Agreement Between Owner and Contractor. Any reference in this document to the General Conditions of the Contract for Construction, AIA Document A201, or some abbreviated reference thereof, shall mean the AIA A201, 2007 Edition as modified by OSE Form 00811 – Standard Supplementary Conditions.

2.2. Delete Section 3.1 and substitute the following:

3.1 The Date of Commencement of the Work shall be the date fixed in a Notice to Proceed issued by the Owner. The Owner shall issue the Notice to Proceed to the Contractor in writing, no less than seven days prior to the Date of Commencement. Unless otherwise provided elsewhere in the contract documents, and provided the contractor has secured all required insurance and surety bonds, the contractor may commence work immediately after receipt of the Notice to Proceed.

2.3. Delete Section 3.2 and substitute the following:

3.2 The Contract Time shall be measured from the Date of Commencement as provided in Section 9(a) of the Bid Form (SE-330) for this Project. Contractor agrees that if the Contractor fails to achieve Substantial Completion of the Work within the Contract Time, the Owner shall be entitled to withhold or recover from the Contractor liquidated damages in the amounts set forth in Section 9(b) of the Bid Form (SE-330, subject to adjustments of this Contract Time as provided in the Contract Documents.

- 2.4. In Section 5.1.1, insert the words "and Owner" after the phrase "Payment submitted to the Architect."
- **2.5.** Delete Section 5.1.3 and substitute the following:

5.1.3 The Owner shall make payment of the certified amount to the Contractor not later than 21 days after receipt of the Application for Payment.

2.6. In Section 5.1.6, Insert the following after the phrase "Subject to other provisions of the Contract Documents":

and subject to Title 12, Chapter 8, Section 550 of the South Carolina Code of Laws, as amended (Withholding Requirements for Payments to Non-Residents)

In the spaces provided in Sub-Sections 1 and 2 for inserting the retainage amount, insert "three and onehalf percent (3.5%)."

OSE FORM 00501 Rev. 7/11/2011 STANDARD MODIFICATIONS TO AGREEMENT BETWEEN OWNER AND CONTRACTOR

2.7. In Section 5.1.8, delete the word "follows" and the colon and substitute the following:

set forth in S.C. Code Ann. § 11-35-3030(4).

- **2.8.** In Section 5.1.9, delete the words "Except with the Owner's prior approval, the" before the word "Contractor."
- **2.9.** In Section 5.2.2, delete the number 30 and substitute the number 21, delete everything following the words "Certificate for Payment" and place a period at the end of the resulting sentence.
- **2.10.** Delete the language of Sections 6.1 and 6.2 and substitute the word "Reserved" for the deleted language of each Section .
- **2.11.** Delete the language of Section 8.2 and substitute the word "Reserved."
- **2.12.** In Section 8.3, make the word "Representative" in the title plural, delete everything following the title, and substitute the following:

8.3.1 Owner designates the individual listed below as its Senior Representative ("Owner's Senior Representative"), which individual has the responsibility for and, subject to Section 7.2.1 of the General Conditions, the authority to resolve disputes under Section 15.6 of the General Conditions:

Name: Tom Opal Title: Senior Project Manger Address: 743 Greene Street, Columbia, SC 29208 Telephone: 803-777-7076 FAX: 803-777-8739 Email: tnopal@fmc.sc.edu

8.3.2 Owner designates the individual listed below as its Owner's Representative, which individual has the authority and responsibility set forth in Section 2.1.1 of the General Conditions:

Name: <u>Ann Derrick</u> Title: <u>Project Manager</u> Address: <u>743 Greene Street, Columbia, SC 29208</u> Telephone: <u>803-777-5811</u> FAX: <u>803-777-8739</u> Email: <u>aderrick@fmc.sc.edu</u>

2.13. In Section 8.4, make the word "Representative" in the title plural, delete everything following the title, and substitute the following:

8.4.1 Contractor designates the individual listed below as its Senior Representative ("Contractor's Senior Representative"), which individual has the responsibility for and authority to resolve disputes under Section 15.6 of the General Conditions:

Name:		
Title:		
Address:		
Telephone:	FAX:	
Email:		

OSE FORM 00501 STANDARD MODIFICATIONS TO AGREEMENT BETWEEN OWNER AND CONTRACTOR

8.4.2 Contractor designates the individual listed below as its Contractor's Representative, which individual has the authority and responsibility set forth in Section 3.1.1 of the General Conditions:

Name:	
Title:	
Address:	
Telephone:	FAX:
Email:	

2.14. *Add the following Section 8.6.1:*

8.6.1 The Architect's representative:

Name: <u>Barbara Haller</u> Title: <u>Project Manager, Quackenbush Architects + Planners</u> Address: <u>1217 Hampton Street, Columbia, SC, 29201</u> Telephone: <u>803-771-2999</u>FAX: <u>803-771-2858</u> Email: <u>bhaller@quackenbusharchitects.com</u>

2.15. In Section 9.1.7, Sub-Section 2, list the following documents in the space provided for listing documents:

Invitation for Construction Bids (SE-310) Instructions to Bidders (AIA Document A701-1997) Standard Supplemental Instructions to Bidders (OSE Form 00201) Contractor's Bid (Completed SE-330) Notice of Intent to Award (Completed SE-370) Certificate of procurement authority issued by the SC Budget & Control Board

2.16. *In Article 10, delete everything after the first sentence.*

END OF DOCUMENT

GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION

GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION is the AIA document A201-2007 Edition, published by the American Institute of Architects and the attached "SUPPLEMENTARY CONDITIONS."

The A201 document is not included, but may be viewed at the Architect's office (Quackenbush Architects + Planners, 1217 Hampton Street, Columbia, SC 29201) or purchased from the American Institute of Architects.

END OF SECTION

Attachment: OSE Form 00811 Standard Supplementary Conditions

OWNER: <u>University of South Carolina</u> PROJECT NUMBER: <u>H27-6088-MJ</u> PROJECT NAME: <u>Softball Stadium Construction</u>

1 GENERAL CONDITIONS

The *General Conditions of the Contract for Construction*, AIA Document A201, 2007 Edition, Articles 1 through 15 inclusive, is a part of this Contract and is incorporated as fully as if herein set forth. For brevity, AIA Document A201 is also referred to in the Contract Documents collectively as the "General Conditions."

2 STANDARD SUPPLEMENTARY CONDITIONS

- **2.1** The following supplements modify, delete and/or add to the General Conditions. Where any portion of the General Conditions is modified or any paragraph, Section or clause thereof is modified or deleted by these Supplementary Conditions, the unaltered provisions of the General Conditions shall remain in effect.
- **2.2** Unless otherwise stated, the terms used in these Standard Supplementary Conditions which are defined in the General Conditions have the meanings assigned to them in the General Conditions.

3 MODIFICATIONS TO A201-2007

3.1 *Insert the following at the end of Section 1.1.1:*

Any reference in this document to the Agreement between the Owner and Contractor, AIA Document A101, or some abbreviated reference thereof, shall mean the AIA A101, 2007 Edition as modified by OSE Form 00501 – Standard Modification to Agreement Between Owner and Contractor. Any reference in this document to the General Conditions of the Contract for Construction, AIA Document A201, or some abbreviated reference thereof, shall mean the AIA A201, 2007 Edition as modified by OSE Form 00811 – Standard Supplementary Conditions.

- **3.2** Delete the language of Section 1.1.8 and substitute the word "Reserved."
- **3.3** Add the following Section 1.1.9:

1.1.9 NOTICE TO PROCEED

Notice to Proceed is a document issued by the Owner to the Contractor, with a copy to the Architect, directing the Contractor to begin prosecution of the Work in accordance with the requirements of the Contract Documents. The Notice to Proceed shall fix the date on which the Contract Time will commence.

3.4 *Insert the following at the end of Section 1.2.1:*

In the event of patent ambiguities within or between parts of the Contract Documents, the contractor shall 1) provide the better quality or greater quantity of Work, or 2) comply with the more stringent requirement, either or both in accordance with the Architect's interpretation.

3.5 Delete Section 1.5.1 and substitute the following:

1.5.1 The Architect and the Architect's consultants shall be deemed the authors and owners of their respective Instruments of Service and will retain all common law, statutory and other reserved rights, including copyrights. The Contractor, Subcontractors, Sub-subcontractors, and material or equipment suppliers shall not own or claim a copyright in the Instruments of Service. Submittal or distribution to meet official regulatory requirements or for other purposes in connection with this Project is not to be construed as a violation of the Architect's or Architect's consultants' reserved rights.

3.6 Delete Section 2.1.1 and substitute the following:

2.1.1 The Owner is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Owner shall designate in writing a representative who shall have express authority to bind the Owner with respect to all matters requiring the Owner's approval or authorization, except as provided in Section 7.1.2. Except as otherwise provided in Section 4.2.1, the Architect does not have such authority. The term "Owner" means the Owner or the Owner's Representative. [Reference § 8.2 of the Agreement.]

3.7 Delete Section 2.1.2 and substitute the following:

2.1.2 The Owner shall furnish to the Contractor within fifteen days after receipt of a written request, information necessary and relevant for the Contractor to post Notice of Project Commencement pursuant to Title 29, Chapter 5, Section 23 of the South Carolina Code of Laws, as amended..

3.8 Delete Section 2.2.3 and substitute the following:

2.2.3 The Owner shall furnish surveys describing physical characteristics, legal limitations and utility locations for the site of the Project, and a legal description of the site. Subject to the Contractor's obligations, including those in Section 3.2, the Contractor shall be entitled to rely on the accuracy of information furnished by the Owner pursuant to this Section but shall exercise proper precautions relating to the safe performance of the Work.

3.9 *Replace the period at the end of the last sentence of Section 2.2.4 with a semicolon and insert the following after the inserted semicolon:*

"however, the Owner does not warrant the accuracy of any such information requested by the Contractor that is not otherwise required of the Owner by the Contract Documents. Neither the Owner nor the Architect shall be required to conduct investigations or to furnish the Contractor with any information concerning subsurface characteristics or other conditions of the area where the Work is to be performed beyond that which is provide in the Contract Documents."

3.10 Delete Section 2.2.5 and substitute the following:

2.2.5 Unless otherwise provided in the Contract Documents, the Owner shall furnish to the Contractor with ten copies of the Contract Documents. The Contractor may make reproductions of the Contract Documents pursuant to Section 1.5.2. All copies of the drawings and specifications, except the Contractor's record set, shall be returned or suitably accounted for to the Owner, on request, upon completion of the Work.

3.11 Add the following Sections 2.2.6 and 2.2.7:

2.2.6 The Owner assumes no responsibility for any conclusions or interpretation made by the Contractor based on information made available by the Owner.

2.2.7 The Owner shall obtain, at its own cost, general building and specialty inspection services as required by the Contract Documents. The Contractor shall be responsible for payment of any charges imposed for reinspections.

3.12 Delete Section 2.4 and substitute the following:

2.4 If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails within a ten-day period after receipt of written notice from the Owner to commence and continue correction of such default or neglect, including but not limited to providing necessary resources, with diligence and promptness, the Owner may, without prejudice to other remedies the Owner may have, correct such deficiencies. In such case an appropriate Change Directive shall be issued deducting from payments then or thereafter due the Contractor the reasonable cost of correcting such deficiencies, including Owner's expenses and compensation for the Architect's additional services made necessary by such default, neglect or failure. If payments then or thereafter due the Contractor are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner.

3.13 *Insert the following at the end of Section 3.2.1:*

The Contractor acknowledges that it has investigated and satisfied itself as to the general and local conditions which can affect the work or its cost, including but not limited to (1) conditions bearing upon transportation, disposal, handling, and storage of materials; (2) the availability of labor, water, electric power, and roads; (3) uncertainties of weather, river stages, tides, or similar physical conditions at the site; (4) the conformation and conditions of the ground; and (5) the character of equipment and facilities needed preliminary to and during work performance. The Contractor also acknowledges that it has satisfied itself as to the character, quality, and quantity of surface and subsurface materials or obstacles to be encountered insofar as this information is reasonably ascertainable from an inspection of the site, including all exploratory work done by the Owner, as well as from the drawings and specifications made a part of this contract. Any failure of the Contractor to take the actions described and acknowledged in this paragraph will not relieve the Contractor from responsibility for estimating properly the difficulty and cost of successfully performing the work, or for proceeding to successfully perform the work without additional expense to the Owner.

- 3.14 In the third sentence of Section 3.2.4, insert the word "latent" before the word "errors."
- 3.15 In the last sentence of Section 3.3.1, insert the words "by the Owner in writing" after the word "instructed."
- **3.16** Delete the third sentence of Section 3.5 and substitute the following sentences:

Work, materials, or equipment not conforming to these requirements shall be considered defective. Unless caused by the Contractor or a subcontractor at any tier, the Contractor's warranty excludes remedy for damage or defect caused by abuse, alterations to the Work not executed by the Contractor, improper or insufficient maintenance, improper operation, or normal wear and tear and normal usage.

3.17 *Insert the following at the end of Section 3.6:*

The Contractor shall comply with the requirements of Title 12, Chapter 9 of the South Carolina Code of Laws, as amended, regarding withholding tax for nonresidents, employees, contractors and subcontractors.

3.18 In Section 3.7.1, delete the words "the building permit as well as for other" and insert the following sentence at the end of this section:

Pursuant to Title 10, Chapter 1, Section 180 of the South Carolina Code of Laws, as amended, no local general or specialty building permits are required for state buildings.

3.19 Delete the last sentence of Section 3.7.5 and substitute the following:

Adjustments in the Contract Sum and Contract Time arising from the existence of such remains or features may be made as provided in Article 7.3.3.

3.20 Delete the last sentence of Section 3.8.2.3 and substitute the following:

The amount of the Change Order shall reflect the difference between actual costs, as documented by invoices, and the allowances under Section 3.8.2.1.

3.21 In Section 3.9.1, insert a comma after the word "superintendent" in the first sentence and insert the following after the inserted comma:

acceptable to the Owner,

3.22 Delete Section 3.9.2 and substitute the following:

3.9.2 The Contractor, as soon as practicable after award of the Contract, shall furnish in writing to the Owner the name and qualifications of a proposed superintendent. The Owner may reply within 14 days to the Contractor in writing stating (1) whether the Owner has reasonable objection to the proposed superintendent or (2) that the

Owner requires additional time to review. Failure of the Owner to reply within the 14-day period shall constitute notice of no reasonable objection.

3.23 After the first sentence in Section 3.9.3, insert the following sentence:

The Contractor shall notify the Owner, in writing, of any proposed change in the superintendent, including the reason therefore, prior to making such change.

3.24 *Delete Section 3.10.3 and substitute the following:*

3.10.3 Additional requirements, if any, for the constructions schedule are as follows: *(Check box if applicable to this Contract))*

 \boxtimes The construction schedule shall be in a detailed precedence-style critical path management (CPM) or primavera-type format satisfactory to the Owner and the Architect that shall also (1) provide a graphic representation of all activities and events that will occur during performance of the work; (2) identify each phase of construction and occupancy; and (3) set forth dates that are critical in ensuring the timely and orderly completion of the Work in accordance with the requirements of the Contract Documents (hereinafter referred to as "Milestone Dates"). Upon review and acceptance by the Owner and the Architect of the Milestone Dates, the construction schedule shall be deemed part of the Contract Documents and attached to the Agreement as Exhibit "A." If not accepted, the construction schedule shall be promptly revised by the Contractor in accordance with the recommendations of the Owner and the Architect and resubmitted for acceptance. The Contactor shall monitor the progress of the Work for conformance with the requirements of the construction schedule and shall promptly advise the Owner of any delays or potential delays. Whenever the approved construction schedule no longer reflects actual conditions and progress of the work or the Contract Time is modified in accordance with the terms of the Contract Documents, the Contractor shall update the accepted construction schedule to reflect such conditions. In the event any progress report indicates any delays, the Contractor shall propose an affirmative plan to correct the delay, including overtime and/or additional labor, if necessary. In no event shall any progress report constitute an adjustment in the Contract Time, any Milestone Date, or the Contract Sum unless any such adjustment is agreed to by the Owner and authorized pursuant to Change Order.

3.25 Add the following Section 3.10.4:

3.10.4 Owner's review and acceptance of Contractor's schedule is not conducted for the purpose of either determining its accuracy and completeness or approving the construction means, methods, techniques, sequences or procedures. The Owner's approval shall not relieve the Contractor of any obligations. Unless expressly addressed in a Modification, the Owner's approval of a schedule shall not change the Contract Time.

3.26 Add the following Section 3.12.5.1:

3.12.5.1 The fire sprinkler shop drawings shall be prepared by a licensed fire sprinkler contractor and shall accurately reflect actual conditions affecting the required layout of the fire sprinkler system. The fire sprinkler contractor shall certify the accuracy of his shop drawings prior to submitting them for review and approval. The fire sprinkler shop drawings shall be reviewed and approved by the Architect's engineer of record who, upon approving the sprinkler shop drawings will submit them to the State Fire Marshal or other authorities having jurisdiction for review and approval. The Architect's engineer of record will submit a copy of the State Fire Marshal's approval letter to the Contractor, Architect, and OSE. Unless authorized in writing by OSE, neither the Contractor nor subcontractor at any tier shall submit the fire sprinkler shop drawings directly to the State Fire Marshal or other authorities having jurisdiction for approval.

3.27 In the fourth sentence of Section 3.12.10, after the comma following the words "licensed design professional," insert the following:

who shall comply with reasonable requirements of the Owner regarding qualifications and insurance and

3.28 In Section 3.13, insert the section number "3.13.1" before the before the opening words "The Contractors shall."

3.29 Add the following Sections 3.13.2 and 3.13.3:

3.13.2 Protection of construction materials and equipment stored at the Project site from weather, theft, vandalism, damage, and all other adversity is solely the responsibility of the Contractor. The Contractor shall perform the work in a manner that affords reasonable access, both vehicular and pedestrian, to the site of the Work and all adjacent areas. The Work shall be performed, to the fullest extent reasonably possible, in such a manner that public areas adjacent to the site of the Work shall be free from all debris, building materials, and equipment likely to cause hazardous conditions.

3.13.3 The Contractor and any entity for whom the Contractor is responsible shall not erect any sign on the Project site without the prior written consent of the Owner.

3.30 In the first sentence of Section 3.18.1, after the parenthetical "...(other than the Work itself),..." and before the word "...but...", insert the following:

including loss of use resulting therefrom,

3.31 Delete Section 4.1.1 and substitute the following:

4.1.1 The Architect is that person or entity identified as the Architect in the Agreement and is referred to throughout the Contract Documents as if singular in number.

3.32 Insert the following at the end of Section 4.2.1:

Any reference in the Contract Documents to the Architect taking action or rendering a decision with a "reasonable time" is understood to mean no more than fourteen days, unless otherwise specified in the Contract Documents or otherwise agreed to by the parties.

3.33 Delete the first sentence of Section 4.2.2 and substitute the following:

The Architect will visit the site as necessary to fulfill its obligation to the Owner for inspection services, if any, and, at a minimum, to assure conformance with the Architect's design as shown in the Contract Documents and to observe the progress and quality of the various components of the Contractor's Work, and to determine if the Work observed is being performed in a manner indicating that the Work, when fully completed, will be in accordance with the Contract Documents.

3.34 Delete the first sentence of Section 4.2.3 and substitute the following:

On the basis of the site visits, the Architect will keep the Owner informed about the progress and quality of the portion of the Work completed, and report to the Owner (1) deviations from the Contract Documents and from the most recent construction schedule submitted by the Contractor, and (2) defects and deficiencies observed in the Work.

3.35 In Section 4.2.5, after the words "evaluations of the" and before the word "Contractor's," insert the following:

Work completed and correlated with the

3.36 Delete the first sentence of Section 4.2.11 and substitute the following:

4.2.11 The Architect will, in the first instance, interpret and decide matters concerning performance under, and requirements of, the Contract Documents on written request of either the Owner or Contractor. Upon receipt of such request, the Architect will promptly provide the non-requesting party with a copy of the request.

3.37 Insert the following at the end of Section 4.2.12:

If either party disputes the Architects interpretation or decision, that party may proceed as provided in Article 15. The Architect's interpretations and decisions may be, but need not be, accorded any deference in any review conducted pursuant to law or the Contract Documents.

3.38 Delete Section 4.2.14 and substitute the following:

The Architect will review and respond to requests for information about the Contract Documents so as to avoid delay to the construction of the Project. The Architect's response to such requests will be made in writing with reasonable promptness. If appropriate, the Architect will prepare and issue supplemental Drawings and Specifications in response to the requests for information. Any response to a request for information must be consistent with the intent of, and reasonably inferable from, the Contract Documents and will be in writing or in the form of drawings. Unless issued pursuant to a Modification, supplemental Drawings or Specifications will not involve an adjustment to the Contract Sum or Contract Time.

3.39 Delete Section 5.2.1 and substitute the following:

5.2.1 Unless otherwise stated in the Contract Documents or the bidding requirements, the Contractor, within fourteen days after posting of the Notice of Intent to Award the Contract, shall furnish in writing to the Owner through the Architect the names of persons or entities (excluding Listed Subcontractors but including those who are to furnish materials or equipment fabricated to a special design) proposed for each principal portion of the Work. The Owner may reply within 14 days to the Contractor in writing stating (1) whether the Owner has reasonable objection to any such proposed person or entity. Failure of the Owner to reply within the 14 day period shall constitute notice of no reasonable objection.

3.40 Delete Section 5.2.2 and substitute the following:

5.2.2 The Contractor shall not contract with a proposed person or entity to whom the Owner has made reasonable and timely objection. The Owner shall not direct the Contractor to contract with any specific individual or entity for supplies or services unless such supplies and services are necessary for completion of the Work and the specified individual or entity is the only source of such supply or services.

- **3.41** *In the first sentence of Section 5.2.3, delete the words "…or Architect…" in the two places they appear.*
- **3.42** Delete the words "...or Architect..." in the in the first sentence of Section 5.2.4 and insert the following sentence at the end of Section 5.2.4:

The Contractor's request for substitution must be made to the Owner in writing accompanied by supporting information.

3.43 Add the following Section 5.2.5:

5.2.5 A Subcontractor identified in the Contractor's Bid in response the specialty subcontractor listing requirements of Section 7 of the Bid Form (SE-330) may only be substituted in accordance with and as permitted by the provisions of Title 11, Chapter 35, Section 3021 of the South Carolina Code of Laws, as amended. A proposed substitute for a Listed Subcontractor shall be subject to the Owner's approval as set forth is Section 5.2.3.

3.44 In Section 5.3, delete everything following the heading "SUBCONTRACTUAL RELATIONS" and insert the following Sections 5.3.1, 5.3.2, 5.3.3, and 5.3.4:

5.3.1 By appropriate written agreement, the Contractor shall require each Subcontractor, to the extent of the Work to be performed by the Subcontractor, to be bound to the Contractor by terms of the Contract Documents, and to assume toward the Contractor all the obligations and responsibilities, including the responsibility for safety of the Subcontractor's Work, which the Contractor, by these Documents, assumes toward the Owner and Architect. Each subcontract agreement shall preserve and protect the rights of the Owner and Architect under the Contract Documents with respect to the Work to be performed by the Subcontractor so that subcontracting thereof will not

prejudice such rights, and shall allow to the Subcontractor, unless specifically provided otherwise herein or in the subcontract agreement, the benefit of all rights, remedies and redress against the Contractor that the Contractor, by the Contract Documents, has against the Owner. Where appropriate, the Contractor shall require each Subcontractor to enter into similar agreements with Sub-subcontractors. The Contractor shall make available to each proposed Subcontractor, prior to the execution of the subcontract agreement, copies of the Contract Documents to which the Subcontractor will be bound, and, upon written request of the Subcontractor, identify to the Subcontractor terms and conditions of the proposed subcontract agreement that may be at variance with the Contract Documents. Subcontractors will similarly make copies of applicable portions of such documents available to their respective proposed Sub-subcontractors.

§ 5.3.2 Without limitation on the generality of Section 5.3.1, each Subcontract agreement and each Sub-subcontract agreement shall include, and shall be deemed to include, the following Sections of these General Conditions: 3.2, 3.5, 3.18, 5.3, 5.4, 6.2.2, 7.3.3, 7.5, 7.6, 13.1, 13.12, 14.3, 14.4, and 15.1.6.

§ 5.3.3 Each Subcontract Agreement and each Sub-subcontract agreement shall exclude, and shall be deemed to exclude, Sections 13.2.1 and 13.6 and all of Article 15, except Section 15.1.6, of these General Conditions. In the place of these excluded sections of the General Conditions, each Subcontract Agreement and each Sub-subcontract may include Sections 13.2.1 and 13.6 and all of Article 15, except Section 15.1.6, of AIA Document A201-2007, Conditions of the Contract, as originally issued by the American Institute of Architects.

§ 5.3.4 The Contractor shall assure the Owner that all agreements between the Contractor and its Subcontractor incorporate the provisions of Subparagraph 5.3.1 as necessary to preserve and protect the rights of the Owner and the Architect under the Contract Documents with respect to the work to be performed by Subcontractors so that the subcontracting thereof will not prejudice such rights. The Contractor's assurance shall be in the form of an affidavit or in such other form as the Owner may approve. Upon request, the Contractor shall provide the Owner or Architect with copies of any or all subcontracts or purchase orders.

- **3.45** Delete the last sentence of Section 5.4.1.
- **3.46** Add the following Sections 5.4.4, 5.4.5 and 5.4.6:

§ 5.4.4 Each subcontract shall specifically provide that the Owner shall only be responsible to the subcontractor for those obligations of the Contractor that accrue subsequent to the Owner's exercise of any rights under this conditional assignment.

§ 5.4.5 Each subcontract shall specifically provide that the Subcontractor agrees to perform portions of the Work assigned to the Owner in accordance with the Contract Documents.

§ 5.4.6 Nothing in this Section 5.4 shall act to reduce or discharge the Contractor's payment bond surety's obligations to claimants for claims arising prior to the Owner's exercise of any rights under this conditional assignment.

- **3.47** Delete the language of Section 6.1.4 and substitute the word "Reserved."
- **3.48** *Insert the following at the end of Section 7.1.2:*

If the amount of a Modification exceeds the limits of the Owner's Construction Change Order Certification (reference Section 9.1.7.2 of the Agreement), then the Owner's agreement is not effective, and Work may not proceed, until approved in writing by the Office of State Engineer.

3.49 Delete Section 7.2.1 and substitute the following:

7.2.1 A Change Order is a written instrument prepared by the Architect (using State Form SE-480 "Construction Change Order") and signed by the Owner, Contractor and Architect stating their agreement upon all of the following:

.1 The change in the Work;

- .2 The amount of the adjustment, if any, in the Contract Sum; and
- .3 The extent of the adjustment, if any, in the Contract Time.

3.50 Add the following Sections 7.2.2, 7.2.3, 7.2.4, and 7.2.5:

7.2.2 If a Change Order provides for an adjustment to the Contract Sum, the adjustment must be calculated in accordance with Section 7.3.3.

7.2.3 At the Owner's request, the Contractor shall prepare a proposal to perform the work of a proposed Change Order setting forth the amount of the proposed adjustment, if any, in the Contract Sum; and the extent of the proposed adjustment, if any, in the Contract Time. Any proposed adjustment in the Contract sum shall be prepared in accordance with Section 7.2.2. The Owner's request shall include any revisions to the Drawings or Specifications necessary to define any changes in the Work. Within fifteen days of receiving the request, the Contractor shall submit the proposal to the Owner and Architect along with all documentation required by Section 7.6.

7.2.4 If the Contractor requests a Change Order, the request shall set forth the proposed change in the Work and shall be prepared in accordance with Section 7.2.3. If the Contractor requests a change to the Work that involves a revision to either the Drawings or Specifications, the Contractor shall reimburse the Owner for any expenditures associated with the Architects' review of the proposed revisions, except to the extent the revisions are accepted by execution of a Change Order.

7.2.5 Agreement on any Change Order shall constitute a final settlement of all matters relating to the change in the Work that is the subject of the Change Order, including, but not limited to, any adjustments to the Contract Sum or the Contract Time.

3.51 *Delete* 7.3.3 *and substitute the following:*

7.3.3 PRICE ADJUSTMENTS

§ 7.3.3.1 If any Modification, including a Construction Change Directive, provides for an adjustment to the Contract Sum, the adjustment shall be based on whichever of the following methods is the most valid approximation of the actual cost to the contractor, with overhead and profit as allowed by Section 7.5:

- .1 Mutual acceptance of a lump sum;
- .2 Unit prices stated in the Contract Documents, except as provided in Section 7.3.4, or subsequently agreed upon;
- .3 Cost attributable to the events or situations under applicable clauses with adjustment of profits or fee, all as specified in the contract, or subsequently agreed upon by the parties, or by some other method as the parties may agree; or
- .4 As provided in Section 7.3.7.

§ 7.3.3.2Consistent with Section 7.6, costs must be properly itemized and supported by substantiating data sufficient to permit evaluation before commencement of the pertinent performance or as soon after that as practicable. All costs incurred by the Contractor must be justifiably compared with prevailing industry standards. Except as provided in Section 7.5, all adjustments to the Contract Price shall be limited to job specific costs and shall not include indirect costs, overhead, home office overhead, or profit.

3.52 Delete Section 7.3.7 and substitute the following:

7.3.7 If the Contractor does not respond promptly or disagrees with the method for adjustment in the Contract Sum, the Architect shall make an initial determination, consistent with Section 7.3.3, of the method and the adjustment on the basis of reasonable expenditures and savings of those performing the Work attributable to the change, including, in case of an increase in the Contract Sum, an amount for overhead and profit as set forth in Section 7.5. In such case, and also under Section 7.3.3.1.3, the Contractor shall keep and present, in such form as the Architect may prescribe, an itemized accounting together with appropriate supporting data. Unless otherwise provided in the Contract Documents, costs for the purposes of this Section 7.3.7 shall be limited to the following:

- .1 Costs of labor, including social security, old age and unemployment insurance, fringe benefits required by agreement or custom, and workers' compensation insurance;
- .2 Costs of materials, supplies and equipment, including cost of transportation, whether incorporated or consumed;
- .3 Rental costs of machinery and equipment, exclusive of hand tools, whether rented from the Contractor or others; and
- .4 Costs of premiums for all bonds and insurance, permit fees, and sales, use or similar taxes related to the Work.
- **3.53** Delete Section 7.3.8 and substitute the following:

7.3.8 Using the percentages stated in Section 7.5, any adjustment to the Contract Sum for deleted work shall include any overhead and profit attributable to the cost for the deleted Work.

3.54 Add the following Sections 7.5 and 7.6:

7.5 AGREED OVERHEAD AND PROFIT RATES

7.5.1 For any adjustment to the Contract Sum for which overhead and profit may be recovered, other than those made pursuant to Unit Prices stated in the Contract Documents, the Contractor agrees to charge and accept, as full payment for overhead and profit, the following percentages of costs attributable to the change in the Work. The percentages cited below shall be considered to include all indirect costs including, but not limited to: field and office managers, supervisors and assistants, incidental job burdens, small tools, and general overhead allocations. The allowable percentages for overhead and profit are as follows:

.1 To the Contractor for work performed by the Contractor's own forces, 17% of the Contractor's actual costs.

.2 To each Subcontractor for work performed by the Subcontractor's own forces, 17% of the subcontractor's actual costs.

.3 To the Contractor for work performed by a subcontractor, 10% of the subcontractor's actual costs (not including the subcontractor's overhead and profit).

7.6 PRICING DATA AND AUDIT

§ 7.6.1 Cost or Pricing Data.

Upon request of the Owner or Architect, Contractor shall submit cost or pricing data prior to execution of a Modification which exceeds \$500,000. Contractor shall certify that, to the best of its knowledge and belief, the cost or pricing data submitted is accurate, complete, and current as of a mutually determined specified date prior to the date of pricing the Modification. Contractor's price, including profit, shall be adjusted to exclude any significant sums by which such price was increased because Contractor furnished cost or pricing data that was inaccurate, incomplete, or not current as of the date specified by the parties. Notwithstanding Subparagraph 9.10.4, such adjustments may be made after final payment to the Contractor.

§ 7.6.2 Cost or pricing data means all facts that, as of the date specified by the parties, prudent buyers and sellers would reasonably expect to affect price negotiations significantly. Cost or pricing data are factual, not judgmental; and are verifiable. While they do not indicate the accuracy of the prospective contractor's judgment about estimated future costs or projections, they do include the data forming the basis for that judgment. Cost or pricing data are more than historical accounting data; they are all the facts that can be reasonably expected to contribute to the soundness of estimates of future costs and to the validity of determinations of costs already incurred.

§ 7.6.3 Records Retention.

As used in Section 7.6, the term "records" means any books or records that relate to cost or pricing data that Contractor is required to submit pursuant to Section 7.6.1. Contractor shall maintain records for three years from the date of final payment, or longer if requested by the chief procurement officer. The Owner may audit Contractor's records at reasonable times and places.

3.55 Delete Section 8.2.2 and substitute the following:

8.2.2 The Contractor shall not knowingly commence operations on the site or elsewhere prior to the effective date of surety bonds and insurance required by Article 11 to be furnished by the Contractor and Owner. The date of commencement of the Work shall not be changed by the effective date of such surety bonds or insurance.

3.56 *Delete Section 8.3.1 and substitute the following:*

8.3.1 If the Contractor is delayed at any time in the commencement or progress of the Work by an act or neglect of the Owner or Architect, or of an employee of either, or of a separate contractor employed by the Owner; or by changes ordered in the Work; or by labor disputes, fire, unusual delay in deliveries, unavoidable casualties or other causes beyond the control of the Contractor and any subcontractor at any tier; or by delay authorized by the Owner pending dispute resolution; or by other causes that the Architect determines may justify delay, then to the extent such delay will prevent the Contractor from achieving Substantial Completion within the Contract Time and provided the delay (1) is not caused by the fault or negligence of the Contractor or a subcontractor at any tier and (2) is not due to unusual delay in the delivery of supplies, machinery, equipment, or services were obtainable from other sources in sufficient time for the Contractor to meet the required delivery, the Contract Time shall be extended by Change Order for such reasonable time as the Architect may determine.

3.57 *Insert the following at the end of Section 9.1:*

All changes to the Contract Sum shall be adjusted in accordance with Section 7.3.3.

3.58 Delete Section 9.2 and substitute the following:

9.2 SCHEDULE OF VALUES

9.2.1 The Contractor shall submit to the Architect, within ten days of full execution of the Agreement, a schedule of values allocating the entire Contract Sum to the various portions of the Work and prepared in such form and supported by such data to substantiate its accuracy as the Architect may require. This schedule, unless objected to by the Architect, shall be used as a basis for reviewing the Contractor's Applications for Payment. As requested by the Architect, the Contractor and each Subcontractor shall prepare a trade payment breakdown for the Work for which each is responsible, such breakdown being submitted on a uniform standardized format approved by the Architect and Owner. The breakdown shall be divided in detail, using convenient units, sufficient to accurately determine the value of completed Work during the course of the Project. The Contractor shall update the schedule of values as required by either the Architect or Owner as necessary to reflect:

- .1 the description of Work (listing labor and material separately);
- .2 the total value;
- .3 the percent and value of the Work completed to date;
- .4 the percent and value of previous amounts billed; and
- .5 the current percent completed and amount billed.

9.2.2 Any schedule of values or trade breakdown that fails to include sufficient detail, is unbalanced, or exhibits "front-loading" of the value of the Work shall be rejected. If a schedule of values or trade breakdown is used as the basis for payment and later determined to be inaccurate, sufficient funds shall be withheld from future Applications for Payment to ensure an adequate reserve (exclusive of normal retainage) to complete the Work.

3.59 Delete Section 9.3.1 and substitute the following:

Monthly, the Contractor shall submit to the Architect an itemized Application for Payment prepared in accordance with the schedule of values, if required under Section 9.2., for completed portions of the Work. Such application shall be notarized, if required, and supported by such data substantiating the Contractor's right to payment as the Owner or Architect may require (such as copies of requisitions from Subcontractors and material suppliers) and shall reflect retainage and any other adjustments provided in Section 5 of the Agreement. If required by the Owner or Architect, the Application for Payment shall be accompanied by a current construction schedule.

3.60 In Section 9.3.2, add the following words to the end of the second sentence:

provided such materials or equipment will be subsequently incorporated in the Work

Insert the following at the end of Section 9.3.2:

The Contractor shall 1) protect such materials from diversion, vandalism, theft, destruction, and damage, 2) mark such materials specifically for use on the Project, and 3) segregate such materials from other materials at the storage facility. The Architect and the Owner shall have the right to make inspections of the storage areas at any time.

3.61 In Section 9.4.2, in the first sentence, after the words "Work has progressed to the point indicated," insert the following:

in both the Application for Payment and, if required to be submitted by the Contractor, the accompanying current construction schedule

In the last sentence, delete the third item starting with "(3) reviewed copies" and ending with "Contractor's right to payment,"

3.62 In Section 9.5.1, in the first sentence, delete the word "may" after the opening words "The Architect" and substitute the word "shall."

In Section 9.5.1, insert the following sentence after the first sentence:

The Architect shall withhold a Certificate of Payment if the Application for Payment is not accompanied by the current construction schedule required by Section 3.10.1.

3.63 In Section 9.6.2, delete the word "The..." at the beginning of the first sentence and substitute the following:

Pursuant to Chapter 6 of Title 29 of the South Carolina Code of Laws, as amended, the

3.64 *Delete Section 9.7 and substitute following:*

9.7 FAILURE OF PAYMENT

If the Architect does not issue a Certificate for Payment to the Owner, through no fault of the Contractor, within seven days after receipt of the Contractor's Application for Payment, or if the Owner does not pay the Contractor within seven days after the time established in the Contract Documents the amount certified by the Architect or awarded by a final dispute resolution order, then the Contractor may, upon seven additional days' written notice to the Owner and Architect, stop the Work until payment of the amount owing has been received. The Contract Time shall be extended appropriately and the Contract Sum shall be increased, in accordance with the provisions of Section 7.3.3, by the amount of the Contractor's reasonable costs of shut-down, delay and start-up, plus interest as provided for in the Contract Documents.

3.65 Insert the following words at the end of the sentence in Section 9.8.1:

and when all required occupancy permits, if any, have been issued and copies of same have been delivered to the Owner.

- **3.66** In Section 9.8.2, insert the word "written" after the word "comprehensive" and before the word "list."
- **3.67** Delete Section 9.8.3 and substitute the following:

9.8.3.1 Upon receipt of the Contractor's list, the Architect, with the Owner and any other person the Architect or the Owner choose, will make an inspection on a date and at a time mutually agreeable to the Architect, Owner, and Contractor, to determine whether the Work or designated portion thereof is substantially complete. The Contractor shall furnish access for the inspection and testing as provided in this Contract. The inspection shall include a

demonstration by the Contractor that all equipment, systems and operable components of the Work function properly and in accordance with the Contract Documents. If the Architect's inspection discloses any item, whether or not included on the Contractor's list, which is not sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work or designated portion thereof for its intended use, the Contractor shall, before issuance of the Certificate of Substantial Completion, complete or correct such item upon notification by the Architect. In such case, the Contractor shall then submit a request for another inspection by the Architect to determine Substantial Completion. If more than one Substantial Completion inspection is required, the Contractor shall reimburse the Owner for all costs of reinspections or, at the Owner's option, the costs may be deducted from payments due to the Contractor.

9.8.3.2 If the Architect and Owner concur in the Contractor's assessment that the Work or a portion of the Work is safe to occupy, the Owner and Contractor may arrange for a Certificate of Occupancy Inspection by OSE. The Owner, Architect, and Contractor shall be present at OSE's inspection. Upon verifying that the Work or a portion of the Work is substantially complete and safe to occupy, OSE will issue, as appropriate, a Full or Partial Certificate of Occupancy.

3.68 In the second sentence of Section 9.8.5, delete the words "and consent of surety, if any."

- **3.69** In the first sentence of Section 9.9.1, delete the words "Section 11.3.1.5" and substitute the words "Section 11.3.1.3."
- **3.70** Delete Section 9.10.1 and substitute the following:

9.10.1 Unless the parties agree otherwise in the Certificate of Substantial Completion, the Contractor shall achieve Final Completion no later than thirty days after Substantial Completion. Upon receipt of the Contractor's written notice that the Work is ready for final inspection and acceptance and upon receipt of a final Application for Payment, the Architect, with the Owner and any other person the Architect or the Owner choose, will make an inspection on a date and at a time mutually agreeable to the Architect, Owner, and Contractor, and, when the Architect finds the Work acceptable under the Contract Documents and the Contract fully performed, the Architect will promptly issue a final Certificate for Payment stating that to the best of the Architect's knowledge, information and belief, and on the basis of the Architect's on-site visits and inspections, the Work has been completed in accordance with terms and conditions of the Contract Documents and that the entire balance found to be due the Contractor and noted in the final Certificate is due and payable. The Architect's final Certificate for Payment will constitute a further representation that conditions listed in Section 9.10.2 as precedent to the Contractor's being entitled to final payment have been fulfilled. If more than one Final Completion inspection is required, the Contractor shall reimburse the Owner for all costs of reinspections or, at the Owner's option, the costs may be deducted from payments due to the Contractor. If the Contractor does not achieve final completion within thirty days after Substantial Completion or the timeframe agreed to by the parties in the Certificate of Substantial Completion, whichever is greater, the Contractor shall be responsible for any additional Architectural fees resulting from the delay.

3.71 Delete the first sentence of Section 9.10.2 and substitute the following:

Neither final payment nor any remaining retained percentage shall become due until the Contractor submits to the Architect (1) an affidavit that payrolls, bills for materials and equipment, and other indebtedness connected with the Work for which the Owner or the Owner's property might be responsible or encumbered (less amounts withheld by Owner) have been paid or otherwise satisfied, (2) a certificate evidencing that insurance required by the Contract Documents to remain in force after final payment is currently in effect and will not be canceled or allowed to expire until at least 30 days' prior written notice has been given to the Owner, (3) a written statement that the Contractor knows of no substantial reason that the insurance will not be renewable to cover the period required by the Contract Documents, (4) consent of surety, if any, to final payment (5), if required by the Owner, other data establishing payment or satisfaction of obligations, such as receipts, releases and waivers of liens, claims, security interests or encumbrances arising out of the Contract Documents and manuals, (8) any certificates of testing, inspection or approval required by the Contract Documents and not previously provided (9) all warranties and guarantees required under or pursuant to the Contract Documents, and (10) one copy of the Documents required by Section 3.11.

3.72 Delete the first sentence of Section 9.10.3 and substitute the following:

If, after Substantial Completion of the Work, final completion thereof is delayed 60 days through no fault of the Contractor or by issuance of Change Orders affecting final completion, and the Architect so confirms, the Owner shall, upon application by the Contractor and certification by the Architect, and without terminating the Contract, make payment of the balance due for that portion of the Work fully completed and accepted.

3.73 *Delete Section 9.10.5 and substitute the following:*

§9.10.5 Acceptance of final payment by the Contractor, a Subcontractor or material supplier shall constitute a waiver of claims by that payee except those specific claims in stated amounts that have been previously made in writing and identified by that payee as unsettled at the time of final Application for Payment.

3.74 Add the following Section 9.10.6:

9.10.6 If OSE has not previously issued a Certificate of Occupancy for the entire Project, the Parties shall arrange for a representative of OSE to participate in the Final Completion Inspection. Representatives of the State Fire Marshal's Office and other authorities having jurisdiction may be present at the Final Completion Inspection or otherwise inspect the completed Work and advise the Owner whether the Work meets their respective requirements for the Project.

3.75 Delete Section 10.3.1 and substitute the following:

10.3.1 If the Contractor encounters a hazardous material or substance which was not discoverable as provided in Section 3.2.1 and not required by the Contract Documents, and if reasonable precautions will be inadequate to prevent foreseeable bodily injury or death to persons or serious loss to real or personal property resulting from such material or substance encountered on the site by the Contractor, the Contractor shall, upon recognizing the condition, immediately stop Work in the affected area and report the condition to the Owner and Architect in writing. Hazardous materials or substances are those hazardous, toxic, or radioactive materials or substances subject to regulations by applicable governmental authorities having jurisdiction, such as, but not limited to, the S.C. Department of Health and Environmental Control, the U.S. Environmental Protection Agency, and the U.S. Nuclear Regulatory Commission.

3.76 *Insert the following at the end of Section 10.3.2:*

In the absence of agreement, the Architect will make an interim determination regarding any delay or impact on the Contractor's additional costs. The Architect's interim determination of cost shall adjust the Contract Sum on the same basis as a Change Order, subject to the right of either party to disagree and assert a Claim in accordance with Article 15. Any adjustment in the Contract Sum shall be determined in accordance with Section 7.3.3.

3.77 Delete Section 10.3.3 and substitute the following:

10.3.3 The Work in the affected area shall be resumed immediately following the occurrence of any one of the following events: (a) the Owner causes remedial work to be performed that results in the absence of hazardous materials or substances; (b) the Owner and the Contractor, by written agreement, decide to resume performance of the Work; or (c) the Work may safely and lawfully proceed, as determined by an appropriate governmental authority or as evidenced by a written report to both the Owner and the Contractor, which is prepared by an environmental engineer reasonably satisfactory to both the Owner and the Contractor.

3.78 In Section 10.3.5, delete the word "The" at the beginning of the sentence and substitute the following:

In addition to its obligations under Section 3.18, the

3.79 Delete the language of Section 10.3.6 and substitute the word "Reserved."

3.80 *Insert the following at the end of Section 10.4:*

The Contractor shall immediately give the Architect notice of the emergency. This initial notice may be oral followed within five days by a written notice setting forth the nature and scope of the emergency. Within fourteen days of the start of the emergency, the Contractor shall give the Architect a written estimate of the cost and probable effect of delay on the progress of the Work.

3.81 Delete 11.1.2 and substitute the following:

11.1.2 The insurance required by Section 11.1.1 shall be written for not less than limits of liability specified below or required by law, whichever coverage is greater. Coverages shall be written on an occurrence basis and shall be maintained without interruption from the date of commencement of the Work until the date of final payment and termination of any coverage required to be maintained after final payment, and, with respect to the Contractor's completed operations coverage, until the expiration of the period for correction of Work or for such other period for maintenance of completed operations coverage as specified in the Contract Documents.

(1) COMMERCIAL GENERAL LIABILITY:

(a) General Aggregate (per project)	\$1,000,000
(b) Products/Completed Operations	\$1,000,000
(c) Personal and Advertising Injury	\$1,000,000
(d) Each Occurrence	\$1,000,000
(e) Fire Damage (Any one fire)	\$50,000
(f) Medical Expense (Any one person)	\$5,000

(2) BUSINESS AUTO LIABILITY (including All Owned, Non-owned, and Hired Vehicles): (a) Combined Single Limit _______\$1,000,000

(3) WORKER'S COMPENSATION:

(a) State Statutory	
(b) Employers Liability	<u>\$100,000</u> Per Acc.
	<u>\$500,000</u> Disease, Policy Limit
	<u>\$100,000</u> Disease, Each Employee

In lieu of separate insurance policies for Commercial General Liability, Business Auto Liability, and Employers Liability, the Contractor may provide an umbrella policy meeting or exceeding all coverage requirements set forth in this Section 11.1.2. The umbrella policy limits shall not be less than \$3,000,000.

11.1.3 Prior to commencement of the Work, and thereafter upon replacement of each required policy of insurance, Contractor shall provide to the Owner a written endorsement to the Contractor's general liability insurance policy that:

(i) names the Owner as an additional insureds for claims caused in whole or in part by the Contractor's negligent acts or omissions during the Contractor's operations;

(ii) provides that no material alteration, cancellation, non-renewal, or expiration of the coverage contained in such policy shall have effect unless all additional insureds have been given at least ten (10) days prior written notice of cancellation for non-payment of premiums and thirty (30) days prior written notice of cancellation for any other reason; and

(iii) provides that the Contractor's liability insurance policy shall be primary, with any liability insurance of the Owner as secondary and noncontributory.

Prior to commencement of the Work, and thereafter upon renewal or replacement of each required policy of insurance, Contractor shall provide to the Owner a signed, original certificate of liability insurance (ACORD 25). Consistent with this Section 11.1, the certificate shall identify the types of insurance, state the limits of liability for each type of coverage, name the Owner a Consultants as Certificate Holder, provide that the general aggregate limit applies per project, and provide that coverage is written on an occurrence basis. Both the certificates and the

^{3.82} Delete Section 11.1.3 and substitute the following:

endorsements must be received directly from either the Contractor's insurance agent or the insurance company. An additional certificate evidencing continuation of liability coverage, including coverage for completed operations, naming the Owner as an additional insured for claims made under the Contractor's completed operations, and otherwise meeting the above requirements, shall be submitted with the final Application for Payment as required by Section 9.10.2 and thereafter upon renewal or replacement of such coverage until the expiration of the time required by Section 11.1.2. Information concerning reduction of coverage on account of revised limits or claims paid under the General Aggregate, or both, shall be furnished by the Contractor with reasonable promptness.

3.83 Delete Section 11.1.4 and substitute the following:

11.1.4 A failure by the Owner either (i) to demand a certificate of insurance or written endorsement required by Section 11.1, or (ii) to reject a certificate or endorsement on the grounds that it fails to comply with Section 11.1 shall not be considered a waiver of Contractor's obligations to obtain the required insurance.

3.84 In Section 11.3.1, delete the first sentence and substitute the following:

Unless otherwise provided in the Contract Documents, the Contractor shall purchase and maintain, in a company or companies lawfully authorized to do business in the jurisdiction in which the Project is located, property insurance written on a builder's risk "all-risk" or equivalent policy form in the amount of the initial Contract Sum, plus value of subsequent Contract Modifications and cost of materials supplied or installed by others, comprising total value for the entire Project at the site on a replacement cost basis.

- **3.85** Delete the language of Section 11.3.1.2 and substitute the word "Reserved."
- **3.86** Delete the language of Section 11.3.1.3 and substitute the word "Reserved."
- **3.87** Delete Section 11.3.2 and substitute the following:

11.3.2 BOILER AND MACHINERY INSURANCE

The Contractor shall purchase and maintain boiler and machinery insurance required by the Contract Documents or by law, which shall specifically cover such insured objects during installation and until final acceptance by the Owner; this insurance shall include interests of the Owner, Contractor, Subcontractors and Sub-subcontractors in the Work, and the Owner and Contractor shall both be named insureds.

3.88 Delete Section 11.3.3 and substitute the following:

11.3.3 LOSS OF USE INSURANCE

The Owner, at the Owner's option, may purchase and maintain such insurance as will insure the Owner against loss of use of the Owner's property due to fire or other hazards, however caused. To the extent any losses are covered and paid for by such insurance, the Owner waives all rights of action against the Contractor for loss of use of the Owner's property, including consequential losses due to fire or other hazards however caused.

3.89 Delete Section 11.3.4 and substitute the following:

11.3.4 If the Owner requests in writing that insurance for risks other than those described herein or other special causes of loss be included in the property insurance policy, the Contractor shall, if possible, include such insurance, and the cost thereof shall be charged to the Owner by appropriate Change Order.

- **3.90** Delete the language of Section 11.3.5 and substitute the word "Reserved."
- **3.91** Delete Section 11.3.6 and substitute the following:

11.3.6 Before an exposure to loss may occur, the Contractor shall file with the Owner a copy of each policy that includes insurance coverages required by this Section 11.3. Each policy shall contain all generally applicable conditions, definitions, exclusions and endorsements related to this Project. Each policy shall contain a provision that the policy will not be canceled or allowed to expire, and that its limits will not be reduced, until at least 30 days' prior written notice has been given to the Owner.

3.92 Delete the first sentence of Section 11.3.7 and substitute the following:

The Owner and Contractor waive all rights against (1) each other and any of their subcontractors, subsubcontractors, agents and employees, each of the other, and (2) the Architect, Architect's consultants, separate contractors described in Article 6, if any, and any of their subcontractors, sub-subcontractors, agents and employees, for damages caused by fire or other causes of loss to the extent the property insurance provided by the Contractor pursuant to this Section 11.3 covers and pays for the damage, except such rights as they have to proceeds of such insurance held by the Contractor as fiduciary.

3.93 Delete the first sentence of Section 11.3.8 and substitute the following:

A loss insured under the Contractor's property insurance shall be adjusted by the Contractor as fiduciary and made payable to the Contractor as fiduciary for the insureds, as their interests may appear, subject to requirements of any applicable mortgagee clause and of Section 11.3.10.

3.94 *Delete Section 11.3.9 and substitute the following:*

11.3.9 If required in writing by a party in interest, the Contractor as fiduciary shall, upon occurrence of an insured loss, give bond for proper performance of the Contractor's duties. The cost of required bonds shall be charged against proceeds received as fiduciary. The Contractor shall deposit in a separate account proceeds so received, which the Contractor shall distribute in accordance with such agreement as the parties in interest may reach. If after such loss no other special agreement is made and unless the Owner terminates the Contract for convenience, replacement of damaged property shall be performed by the Contractor.

3.95 Delete Section 11.3.10 and substitute the following:

11.3.10 The Contractor as fiduciary shall have power to adjust and settle a loss with insurers unless one of the parties in interest shall object in writing within five days after occurrence of loss to the Contractor's exercise of this power; if such objection is made, the dispute shall be resolved in the manner provided in the contract between the parties in dispute as the method of binding dispute resolution. The Contractor as fiduciary shall make settlement with insurers or, in the case of a dispute over distribution of insurance proceeds, in accordance with a final order or determination issued by the appropriate authority having jurisdiction over the dispute.

3.96 Delete Section 11.4.1 and substitute the following:

11.4.1 Before commencing any services hereunder, the Contractor shall provide the Owner with Performance and Payment Bonds, each in an amount not less than the Contract Price set forth in Article 4 of the Agreement. The Surety shall have, at a minimum, a "Best Rating" of "A" as stated in the most current publication of "Best's Key Rating Guide, Property-Casualty". In addition, the Surety shall have a minimum "Best Financial Strength Category" of "Class V", and in no case less than five (5) times the contract amount. The Performance Bond shall be written on Form SE-355, "Performance Bond" and the Payment Bond shall written on Form SE-357, "Labor and Material Payment Bond", and both shall be made payable to the Owner.

3.97 Delete Section 11.4.2 and substitute the following:

11.4.2 The Performance and Labor and Material Payment Bonds shall:

- .1 be issued by a surety company licensed to do business in South Carolina;
- .2 be accompanied by a current power of attorney and certified by the attorney-in-fact who executes the bond on the behalf of the surety company; and
- .3 remain in effect for a period not less than one (1) year following the date of Substantial Completion or the time required to resolve any items of incomplete Work and the payment of any disputed amounts, whichever time period is longer.

3.98 Add the following Sections 11.4.3 and 11.4.4:

11.4.3 Any bonds required by this Contract shall meet the requirements of the South Carolina Code of Laws and Regulations, as amended.

11.4.4 Upon the request of any person or entity appearing to be a potential beneficiary of bonds covering payment of obligations arising under the Contract, the Contractor shall promptly furnish a copy of the bonds or shall authorize a copy to be furnished.

3.99 Delete Section 12.1.1 and substitute the following:

12.1.1 If a portion of the Work is covered contrary to the to requirements specifically expressed in the Contract Documents, including inspections of work-in-progress required by all authorities having jurisdiction over the Project, it must, upon demand of the Architect or authority having jurisdiction, be uncovered for observation and be replaced at the Contractor's expense without change in the Contract Time.

- **3.100** In Section 12.2.2.1, delete the words "and to make a claim for breach of warranty" at the end of the third sentence.
- **3.101** In Section 12.2.2.3, add the following to the end of the sentence:

unless otherwise provided in the Contract Documents.

3.102 *Insert the following at the end of Section 12.2.4:*

If, prior to the date of Substantial Completion, the Contractor, a Subcontractor, or anyone for whom either is responsible, uses or damages any portion of the Work, including, without limitation, mechanical, electrical, plumbing, and other building systems, machinery, equipment, or other mechanical device, the Contractor shall cause such item to be restored to "like new" condition at no expense to the Owner.

3.103 Delete Section 13.1 and substitute the following:

13.1 GOVERNING LAW

The Contract, any dispute, claim, or controversy relating to the Contract, and all the rights and obligations of the parties shall, in all respects, be interpreted, construed, enforced and governed by and under the laws of the State of South Carolina, except its choice of law rules.

3.104 Delete Section 13.2, including its Sub-Sections 13.2.1 and 13.2.2, and substitute the following:

13.2 SUCCESSORS AND ASSIGNS

The Owner and Contractor respectively bind themselves, their partners, successors, assigns and legal representatives to covenants, agreements and obligations contained in the Contract Documents. Neither party to the Contract shall assign the Contract as a whole, or in part, without written consent of the other and then only in accordance with and as permitted by Regulation 19-445.2180 of the South Carolina Code of Regulations, as amended. If either party attempts to make such an assignment without such consent, that party shall nevertheless remain legally responsible for all obligations under the Contract.

3.105 *Delete Section 13.3 and substitute the following:*

13.3 WRITTEN NOTICE

Unless otherwise permitted herein, all notices contemplated by the Contract Documents shall be in writing and shall be deemed given:

- .1 upon actual delivery, if delivery is by hand;
- .2 upon receipt by the transmitting party of confirmation or reply, if delivery is by electronic mail, facsimile, telex or telegram;
- .3 upon receipt, if delivery is by the United States mail.

2011 Edition

Rev. 9/7/2011

OSE FORM 00811 STANDARD SUPPLEMENTARY CONDITIONS

Notice to Contractor shall be to the address provided in Section 8.3.2 of the Agreement. Notice to Owner shall be to the address provided in Section 8.2.2 of the Agreement. Either party may designate a different address for notice by giving notice in accordance with this paragraph.

3.106 In Section 13.4.1, insert the following at the beginning of the sentence:

Unless expressly provided otherwise,

3.107 Add the following Section 13.4.3:

13.4.3 Notwithstanding Section 9.10.4, the rights and obligations which, by their nature, would continue beyond the termination, cancellation, rejection, or expiration of this contract shall survive such termination, cancellation, rejection, or expiration, including, but not limited to, the rights and obligations created by the following clauses:

1.5 Ownership and Use of Drawings, Specifications and Other Instruments of Service;
3.5 Warranty
3.17 Royalties, Patents and Copyrights
3.18 Indemnification
7.6 Cost or Pricing Data
11.1 Contractor's Liability Insurance
11.4 Performance and Payment Bond
15.1.6 Claims for Listed Damages
15.1.7 Waiver of Claims Against the Architect
15.6 Dispute Resolution
15.4 Service of Process

3.108 Delete Section 13.6 and substitute the following:

13.6 INTEREST

Payments due to the Contractor and unpaid under the Contract Documents shall bear interest only if and to the extent allowed by Title 29, Chapter 6, Article 1 of the South Carolina Code of Laws. Amounts due to the Owner shall bear interest at the rate of one percent a month or a pro rata fraction thereof on the unpaid balance as may be due.

- **3.109** Delete the language of Section 13.7 and substitute the word "Reserved."
- **3.110** Add the following Sections 13.8 through 13.16:

13.8 PROCUREMENT OF MATERIALS BY OWNER

The Contractor accepts assignment of all purchase orders and other agreements for procurement of materials and equipment by the Owner that are identified as part of the Contract Documents. The Contractor shall, upon delivery, be responsible for the storage, protection, proper installation, and preservation of such Owner purchased items, if any, as if the Contractor were the original purchaser. The Contract Sum includes, without limitation, all costs and expenses in connection with delivery, storage, insurance, installation, and testing of items covered in any assigned purchase orders or agreements. Unless the Contract Documents specifically provide otherwise, all Contractor warranty of workmanship and correction of the Work obligations under the Contract Documents shall apply to the Contractor's installation of and modifications to any Owner purchased items,.

13.9 INTERPRETATION OF BUILDING CODES

As required by Title 10, Chapter 1, Section 180 of the South Caroline Code of Laws, as amended, OSE shall determine the enforcement and interpretation of all building codes and referenced standards on state buildings. The Contractor shall refer any questions, comments, or directives from local officials to the Owner and OSE for resolution.

13.10 MINORITY BUSINESS ENTERPRISES

Contractor shall notify Owner of each Minority Business Enterprise (MBE) providing labor, materials, equipment, or supplies to the Project under a contract with the Contractor. Contractor's notification shall be via the first monthly status report submitted to the Owner after execution of the contract with the MBE. For each such MBE, the Contractor shall provide the MBE's name, address, and telephone number, the nature of the work to be performed or materials or equipment to be supplied by the MBE, whether the MBE is certified by the South Carolina Office of Small and Minority Business Assistance, and the value of the contract.

13.11 SEVERABILITY

If any provision or any part of a provision of the Contract Documents shall be finally determined to be superseded, invalid, illegal, or otherwise unenforceable pursuant to any applicable Legal Requirements, such determination shall not impair or otherwise affect the validity, legality, or enforceability of the remaining provision or parts of the provision of the Contract Documents, which shall remain in full force and effect as if the unenforceable provision or part were deleted.

13.12 ILLEGAL IMMIGRATION

Contractor certifies and agrees that it will comply with the applicable requirements of Title 8, Chapter 14 of the South Carolina Code of Laws and agrees to provide to the State upon request any documentation required to establish either: (a) that Title 8, Chapter 14 is inapplicable both to Contractor and its subcontractors or sub-subcontractors; or (b) that Contractor and its subcontractors or sub-subcontractors; or (b) that Contractor and its subcontractors or sub-subcontractors; or (b) that Contractor and its subcontractors or sub-subcontractors; or (b) that Contractor and its subcontractors or sub-subcontractors are in compliance with Title 8, Chapter 14. Pursuant to Section 8-14-60, "A person who knowingly makes or files any false, fictitious, or fraudulent document, statement, or report pursuant to this chapter is guilty of a felony, and, upon conviction, must be fined within the discretion of the court or imprisoned for not more than five years, or both." Contractor agrees to include in any contracts with its subcontractors language requiring its subcontractors to (a) comply with the applicable requirements of Title 8, Chapter 14, and (b) include in their contracts with the sub-subcontractors language requiring the sub-subcontractors to comply with the applicable requirements of Title 8, Chapter 14. (An overview is available at www.procurement.sc.gov)

13.13 SETOFF

The Owner shall have all of its common law, equitable, and statutory rights of set-off.

13.14 DRUG-FREE WORKPLACE

The Contractor certifies to the Owner that Contractor will provide a Drug-Free Workplace, as required by Title 44, Chapter 107 of the South Carolina Code of Laws, as amended.

13.15 FALSE CLAIMS

According to the S.C. Code of Laws § 16-13-240, "a person who by false pretense or representation obtains the signature of a person to a written instrument or obtains from another person any chattel, money, valuable security, or other property, real or personal, with intent to cheat and defraud a person of that property is guilty" of a crime.

13.16 NON-INDEMNIFICATION:

Any term or condition is void to the extent it requires the State to indemnify anyone. It is unlawful for a person charged with disbursements of state funds appropriated by the General Assembly to exceed the amounts and purposes stated in the appropriations. (§ 11-9-20) It is unlawful for an authorized public officer to enter into a contract for a purpose in which the sum is in excess of the amount appropriated for that purpose. It is unlawful for an authorized public officer to divert or appropriate the funds arising from any tax levied and collected for any one fiscal year to the payment of an indebtedness contracted or incurred for a previous year. (§ 11-1-40)

3.111 Delete Section 14.1.1 and substitute the following:

14.1.1 The Contractor may terminate the Contract if the Work is stopped for a period of 45 consecutive days through no act or fault of the Contractor or a Subcontractor, Sub-subcontractor or their agents or employees or any other persons or entities performing portions of the Work under direct or indirect contract with the Contractor, for any of the following reasons:

.1 Issuance of an order of a court or other public authority having jurisdiction that requires substantially all Work to be stopped; or

- **.2** An act of government, such as a declaration of national emergency that requires substantially all Work to be stopped.
- .3 Because the Architect has not issued a Certificate for Payment and has not notified the Contractor of the reason for withholding certification as provided in Section 9.4.1, or because the Owner has not made payment on a Certificate for Payment within the time stated in the Contract Documents and the Contractor has stopped work in accordance with Section 9.7
- **3.112** Insert the following at the end of Section 14.1.3:

Any adjustment to the Contract Sum pursuant to this Section shall be made in accordance with the requirements of Article 7.

- 3.113 In Section 14.1.4, replace the word "repeatedly" with the word "persistently."
- **3.114** *Delete Section 14.2.1 and substitute the following:*

14.2.1 The Owner may terminate the Contract if the Contractor

- .1 repeatedly refuses or fails to supply enough properly skilled workers or proper materials, or otherwise fails to prosecute the Work, or any separable part of the Work, with the diligence, resources and skill that will ensure its completion within the time specified in the Contract Documents, including any authorized adjustments;
- .2 fails to make payment to Subcontractors for materials or labor in accordance with the Contract Documents and the respective agreements between the Contractor and the Subcontractors;
- .3 repeatedly disregards applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of a public authority; or
- .4 otherwise is guilty of substantial breach of a provision of the Contract Documents.
- **3.115** In Section 14.2.2, delete the parenthetical statement ", upon certification by the Initial Decision Maker that sufficient cause exists to justify such action," immediately following the word "Owner" in the first line.
- 3.116 In Section 14.2.4, replace the words "Initial Decision Maker" with the word "Architect"
- 3.117 Add the following Section 14.2.5:

14.2.5 If, after termination for cause, it is determined that the Owner lacked justification to terminate under Section 14.2.1, or that the Contractor's default was excusable, the rights and obligations of the parties shall be the same as if the termination had been issued for the convenience of the Owner under Section 14.4.

3.118 Delete the second sentence of Section 14.3.2 and substitute the following:

Any adjustment to the Contract Sum made pursuant to this section shall be made in accordance with the requirements of Article 7.3.3.

3.119 Delete Section 14.4.1 and substitute the following:

14.4.1 The Owner may, at any time, terminate the Contract, in whole or in part for the Owner's convenience and without cause. The Owner shall give written notice of the termination to the Contractor specifying the part of the Contract terminated and when termination becomes effective.

3.120 Delete Section 14.4.2 and substitute the following:

14.4.2 Upon receipt of written notice from the Owner of such termination for the Owner's convenience, the Contractor shall

- .1 cease operations as directed by the Owner in the notice;
- .2 take actions necessary, or that the Owner may direct, for the protection and preservation of the Work;

- 3 except for Work directed to be performed prior to the effective date of termination stated in the notice, terminate all existing subcontracts and purchase orders and enter into no further subcontracts and purchase orders; and
- .4 complete the performance of the Work not terminated, if any.

3.121 Delete Section 14.4.3 and substitute the following:

14.4.3 In case of such termination for the Owner's convenience, the Contractor shall be entitled to receive payment for Work executed, costs incurred by reason of such termination, and any other adjustments otherwise allowed by the Contract. Any adjustment to the Contract Sum made pursuant to this Section 14.4 shall be made in accordance with the requirements of Article 7.3.3.

3.122 Add the following Sections 14.4.4, 14.4.5, and 14.5:

14.4.4 Contractor's failure to include an appropriate termination for convenience clause in any subcontract shall not (i) affect the Owner's right to require the termination of a subcontract, or (ii) increase the obligation of the Owner beyond what it would have been if the subcontract had contained an appropriate clause.

14.4.5 Upon written consent of the Contractor, the Owner may reinstate the terminated portion of this Contract in whole or in part by amending the notice of termination if it has been determined that:

- .1 the termination was due to withdrawal of funding by the General Assembly, Governor, or Budget and Control Board or the need to divert project funds to respond to an emergency as defined by Regulation 19-445.2110(B) of the South Carolina Code of Regulations, as amended;
- .2 funding for the reinstated portion of the work has been restored;
- .3 circumstances clearly indicate a requirement for the terminated work; and
- .4 reinstatement of the terminated work is advantageous to the Owner.

14.5 CANCELLATION AFTER AWARD BUT PRIOR TO PERFORMANCE

Pursuant to Title 11, Chapter 35 and Regulation 19-445.2085 of the South Carolina Code of Laws and Regulations, as amended, this contract may be canceled after award but prior to performance.

3.123 Insert the following sentence after the second sentence of Section 15.1.1:

A voucher, invoice, payment application or other routine request for payment that is not in dispute when submitted is not a Claim under this definition.

3.124 *Delete Section 15.1.2 and substitute the following:*

15.1.2 NOTICE OF CLAIMS

Claims by either the Owner or Contractor must be initiated by written notice to the other party and to the Architect. Such notice shall include sufficient information to advise the Architect and other party of the circumstances giving rise to the claim, the specific contractual adjustment or relief requested and the basis of such request. Claims by either party arising prior to the date final payment is due must be initiated within 21 days after occurrence of the event giving rise to such Claim or within 21 days after the claimant first recognizes the condition giving rise to the Claim, whichever is later except as stated for adverse weather days in Section 15.1.5.2. By failing to give written notice of a Claim within the time required by this Section, a party expressly waives its claim.

3.125 Delete Section 15.1.3 and substitute the following:

15.1.3 CONTINUING CONTRACT PERFORMANCE

Pending final resolution of a Claim, including any administrative review allowed under Section 15.6, except as otherwise agreed in writing or as provided in Section 9.7 and Article 14, the Contractor shall proceed diligently with performance of the Contract and the Owner shall continue to make payments in accordance with the Contract Documents. The Architect will issue Certificates for Payment in accordance with the initial decisions and determinations of the Architect.

3.126 *Insert the following at the end of Section 15.1.5.1:*

Claims for an increase in the Contract Time shall be based on one additional calendar day for each full calendar day that the Contractor is prevented from working.

- **3.127** *Insert the following Sub-Sections at the end of Section 15.1.5.2:*
 - .1 Claims for adverse weather shall be based on actual weather conditions at the job site or other place of performance of the Work, as documented in the Contractor's job site log.
 - .2 For the purpose of this Contract, a total of five (5) calendar days per calendar month (non-cumulative) shall be anticipated as "adverse weather" at the job site, and such time will not be considered justification for an extension of time. If, in any month, adverse weather develops beyond the five (5) days, the Contractor shall be allowed to claim additional days to compensate for the excess weather delays only to the extension of time only and is exclusive of all other rights and remedies available under the Contract Documents or imposed or available by law.
 - .3 The Contractor shall submit monthly with their pay application all claims for adverse weather conditions that occurred during the previous month. The Architect shall review each monthly submittal in accordance with Section 15.5 and inform the Contractor and the Owner promptly of its evaluation. Approved days shall be included in the next Change Order issued by the Architect. Adverse weather conditions not claimed within the time limits of this Subparagraph shall be considered to be waived by the Contractor. Claims will not be allowed for adverse weather days that occur after the scheduled (original or adjusted) date of Substantial Completion.
- **3.128** Delete Section 15.1.6 and substitute the following:

15.1.6 CLAIMS FOR LISTED DAMAGES

Notwithstanding any other provision of the Contract Documents, including Section 1.2.1, but subject to a duty of good faith and fair dealing, the Contractor and Owner waive Claims against each other for listed damages arising out of or relating to this Contract.

15.1.6.1 For the Owner, listed damages are (i) lost revenue and profit, (ii) losses resulting from injury to business or reputation, (iii) additional or escalated overhead and administration expenses, (iv) additional financing costs, (v) costs suffered by a third party unable to commence work, (vi) attorney's fees, (vii) any interest, except to the extent allowed by Section 13.6 (Interest), (viii) lost revenue and profit for lost use of the property, (ix) costs resulting from lost productivity or efficiency.

15.1.6.2 For the Contractor, listed damages are (i) lost revenue and profit, (ii) losses resulting from injury to business or reputation, (iii) additional or escalated overhead and administration expenses, (iv) additional financing costs, (v) attorney's fees, (vi) any interest, except to the extent allowed by Section 13.6 (Interest); (vii) unamortized equipment costs; and, (viii) losses incurred by subcontractors for the types of damages the Contractor has waive as against the Owner. Without limitation, this mutual waiver is applicable to all damages due to either party's termination in accordance with Article 14. Nothing contained in this Section shall be deemed to preclude an award of liquidated damages, when applicable, in accordance with the requirements of the Contract Documents. This mutual waiver is not applicable to amounts due or obligations under Section 3.18 (Indemnification).

3.129 Add the following Section 15.1.7:

15.1.7 WAIVER OF CLAIMS AGAINST THE ARCHITECT

Notwithstanding any other provision of the Contract Documents, including Section 1.2.1, but subject to a duty of good faith and fair dealing, the Contractor waives all claims against the Architect and any other design professionals who provide design and/or project management services to the Owner, either directly or as independent contractors or subcontractors to the Architect, for listed damages arising out of or relating to this Contract. The listed damages are (i) lost revenue and profit, (ii) losses resulting from injury to business or reputation, (iii) additional or escalated overhead and administration expenses, (iv) additional financing costs, (v)

attorney's fees, (vi) any interest; (vii) unamortized equipment costs; and, (viii) losses incurred by subcontractors for the types of damages the Contractor has waive as against the Owner. This mutual waiver is not applicable to amounts due or obligations under Section 3.18 (Indemnification).

- **3.130** Delete the language of Sections 15.2, 15.3, and 15.4, including all Sub-Sections, and substitute the word "Reserved" for the deleted language of each Section and Sub-Section.
- **3.131** Add the following Sections 15.5 and 15.6 with their sub-sections:

15.5 CLAIM AND DISPUTES - DUTY OF COOPERATION, NOTICE, AND ARCHITECTS INITIAL DECISION

15.5.1 Contractor and Owner are fully committed to working with each other throughout the Project to avoid or minimize claims. To further this goal, Contractor and Owner agree to communicate regularly with each other and the Architect at all times notifying one another as soon as reasonably possible of any issue that if not addressed may cause loss, delay, and/or disruption of the Work. If claims do arise, Contractor and Owner each commit to resolving such claims in an amicable, professional, and expeditious manner to avoid unnecessary losses, delays, and disruptions to the Work.

15.5.2 Claims shall first be referred to the Architect for initial decision. An initial decision shall be required as a condition precedent to resolution pursuant to Section 15.6 of any Claim arising prior to the date of final payment, unless 30 days have passed after the Claim has been referred to the Architect with no decision having been rendered, or after all the Architect's requests for additional supporting data have been answered, whichever is later. The Architect will not address claims between the Contractor and persons or entities other than the Owner.

15.5.3 The Architect will review Claims and within ten days of the receipt of a Claim (1) request additional supporting data from the claimant or a response with supporting data from the other party or (2) render an initial decision in accordance with Section 15.5.5.

15.5.4 If the Architect requests a party to provide a response to a Claim or to furnish additional supporting data, such party shall respond, within ten days after receipt of such request, and shall either (1) provide a response on the requested supporting data, (2) advise the Architect when the response or supporting data will be furnished or (3) advise the Architect that all supporting data has already been provided. Upon receipt of the response or supporting data, the Architect will render an initial decision in accordance with Section 15.5.5.

15.5.5 The Architect will render an initial decision in writing; (1) stating the reasons therefor; and (2) notifying the parties of any change in the Contract Sum or Contract Time or both. The Architect will deliver the initial decision to the parties within two weeks of receipt of any response or supporting data requested pursuant to Section 16.4, or within such longer period as may be mutually agreeable to the parties. If the parties accept the initial decision, the Architect shall prepare a Change Order with appropriate supporting documentation for the review and approval of the parties and the Office of State Engineer. If either the Contractor, Owner, or both, disagree with the initial decision, the Contractor and Owner shall proceed with dispute resolution in accordance with the provisions of Section 15.6.

15.5.6 In the event of a Claim against the Contractor, the Owner may, but is not obligated to, notify the surety, if any, of the nature and amount of the Claim. If the Claim relates to a possibility of a Contractor's default, the Owner may, but is not obligated to, notify the surety and request the surety's assistance in resolving the controversy.

15.6 DISPUTE RESOLUTION

15.6.1 If a claim is not resolved pursuant to Section 15.5 to the satisfaction of either party, both parties shall attempt to resolve the dispute at the field level through discussions between Contractor's Representative and Owner's Representative. If a dispute cannot be resolved through Contractor's Representative, and Owner's Representative, then the Contractor's Senior Representative and the Owner's Senior Representative, upon the request of either party, shall meet as soon as conveniently possible, but in no case later than twenty-one days after such a request is made, to attempt to resolve such dispute. Prior to any meetings between the Senior Representatives, the parties will exchange relevant information that will assist the parties in resolving their dispute. The meetings required by this Section are a condition precedent to resolution pursuant to Section 15.6.2.

15.6.2 If after meeting in accordance with the provisions of Section 15.6.1, the Senior Representatives determine that the dispute cannot be resolved on terms satisfactory to both the Contractor and the Owner, then either party may submit the dispute by written request to South Carolina's Chief Procurement Officer for Construction (CPOC). Except as otherwise provided in Article 15, all claims, claims, or controversies relating to the Contract shall be resolved exclusively by the appropriate Chief Procurement Officer in accordance with Title 11, Chapter 35, Article 17 of the South Carolina Code of Laws, or in the absence of jurisdiction, only in the Court of Common Pleas for, or in the absence of jurisdiction a federal court located in, Richland County, State of South Carolina. Contractor agrees that any act by the State regarding the Contract is not a waiver of either the State's sovereign immunity or the State's immunity under the Eleventh Amendment of the United State's Constitution.

15.6.3 If any party seeks resolution to a dispute pursuant to Section 15.6.2, the parties shall participate in nonbinding mediation to resolve the claim. If the claim is governed by Title 11, Chapter 35, Article 17 of the South Carolina Code of Laws as amended and the amount in controversy is \$100,000.00 or less, the CPOC shall appoint a mediator, otherwise, the mediation shall be conducted by an impartial mediator selected by mutual agreement of the parties, or if the parties cannot so agree, a mediator designated by the American Arbitration Association ("AAA") pursuant to its Construction Industry Mediation Rules. The mediation will be governed by and conducted pursuant to a mediation agreement negotiated by the parties or, if the parties cannot so agree, by procedures established by the mediator.

15.6.4 Without relieving any party from the other requirements of Sections 15.5 and 15.6, either party may initiate proceedings in the appropriate forum prior to initiating or completing the procedures required by Sections 15.5 and 15.6 if such action is necessary to preserve a claim by avoiding the application of any applicable statutory period of limitation or repose.

15.6.5 SERVICE OF PROCESS

Contractor consents that any papers, notices, or process necessary or proper for the initiation or continuation of any claims, claims, or controversies relating to the Contract; for any court action in connection therewith; or for the entry of judgment on any award made, may be served on Contractor by certified mail (return receipt requested) addressed to Contractor at the address provided for the Contractor's Senior Representative or by personal service or by any other manner that is permitted by law, in or outside South Carolina. Notice by certified mail is deemed duly given upon deposit in the United States mail.

3.132 Add the following Article 16:

ARTICLE 16 PROJECT-SPECIFIC REQUIREMENTS AND INFORMATION

- **16.1. Inspection Requirements:** (Indicate the inspection services required by the Contract)
- Special Inspections are required and are not part of the Contract Sum. (see section 01400)
- Building Inspections are required and are not part of the Contract Sum. (see section 01400)
- Building Inspections are required and are part of the Contract Sum. The inspections required for this Work
- are : (Indicate which services are required and the provider)



STANDARD SUPPLEMENTARY CONDITIONS

16.1.1 Contractor shall schedule and request inspections in an orderly and efficient manner and shall notify the Owner whenever the Contractor schedules an inspection in accordance with the requirements of Section 16.1. Contractor shall be responsible for the cost of inspections scheduled and conducted without the Owner's knowledge and for any increase in the cost of inspections resulting from the inefficient scheduling of inspections.

16.2 List Cash Allowances, if any. (*Refer to attachments as needed* If *none, enter NONE*) <u>Signage - See Division 01 Sections</u>

16.3. Requirements for Record Drawings, if any. (*Refer to attachments as needed*. If *none, enter NONE*) See Division 01 Sections

16.4. Requirements for Shop Drawings and other submittals, if any, including number, procedure for submission, list of materials to be submitted, etc. (*Refer to attachments as needed. If none, enter NONE*) <u>See Division 01 Sections</u>

16.5. Requirements for signage, on-site office or trailer, utilities, restrooms, etc., in addition to the Contract, if any. (*Refer to attachments as needed. If none, enter NONE*) <u>See Division 01 Sections</u>

16.6. Requirements for Project Cleanup in addition to the Contract, if any. (*Refer to attachments as needed. If none, enter NONE*)

See Division 01 Sections

OSE FORM 00811

16.7. List all attachments that modify these General Conditions. (*If none, enter NONE*) USC Supplemental General Conditions for Construction Projects

USC SUPPLEMENTAL GENERAL CONDITIONS FOR CONSTRUCTION PROJECTS

- 1. Contractor' s employees shall take all reasonable means not to interrupt the flow of student traffic in building corridors, lobbies and stairs. All necessary and reasonable safety precautions shall be taken to prevent injury to building occupants while transporting materials and equipment through the building to the work area. Providing safe, accessible, plywood pedestrian ways around construction may be required if a suitable alternative route is not available.
- 2. Fraternization between Contractor' s employees and USC students, faculty or staff is strictly prohibited-zero tolerance!
- 3. USC will not tolerate rude, abusive or degrading behavior on the job site. Heckling and cat-calling directed toward students, faculty or staff or any other person on USC property is strictly prohibited. Any contractor whose employees violate this requirement will be assessed a fine of up to \$500 per violation.
- 4. Contractor's employees must adhere to the University's policy of maintaining a drugfree and smoke-free/tobacco free workplace.
- 5. Contractor must sign a Contractor Key Receipt/Return form before any keys are issued. Keys must be returned immediately upon the completion of the work. The Contractor will bear the cost of any re-keying necessary due to the loss of or failure to return keys.
- 6. A welding permit must be issued by the University Fire Marshall before any welding can begin inside a building. Project Manager will coordinate.
- 7. Contractor must notify the University immediately upon the discovery of suspect material such as those potentially containing asbestos or other such hazardous materials. These materials **must not** be disturbed until approved by the USC Project Manager.
- 8. At the beginning of the project, the USC Project Manager will establish the Contractor=s lay-down area. This area will also be used for the Contractor=s work vehicles. No personal vehicles will be allowed in this area, or in any areas surrounding the construction site that are not regular or authorized parking lots. Personal vehicles must be parked in the perimeter parking lots. Parking permits can be obtained at the USC Parking Office located in the Pendleton Street parking garage. The lay down area will be clearly identified to the contractor by the PM, with a sketch or drawing provided to Parking. In turn, the contractor will mark off this area with a sign containing the project name, PM name, Contractor name and contact number, and end date. Where this area is subject to foot traffic, protective barriers will be provided as specified by the PM. The area will be maintained in a neat and orderly fashion. Vehicles parked in the lay down area (or designated parking areas) will be clearly marked or display a CPC furnished placard for identification.

Updated: July 15, 2011

- 9. Contractor will be responsible for providing its own temporary toilet facilities, unless prior arrangements are made with the USC Project Manager.
- 10. Use of USC communications facilities (telephones, computers, etc.) by the Contractor is prohibited, unless prior arrangements are made with the USC Project Manager.
- 11. For all projects over \$100,000, including IDC's, an SE-395, Contractor Performance Evaluation, will be completed by the USC Project Manager and reviewed with the GC at the beginning of the project and a copy given to the GC. At the end of the project the form will be completed and a Construction Performance rating will be established.
- 12. Contractor is responsible for removal of all debris from the site, and is required to provide the necessary dumpsters which will be emptied at least 2 times per week. Construction waste must not be placed in University dumpsters. THE CONSTRUCTION SITE MUST BE THOROUGHLY CLEANED WITH ALL TRASH PICKED UP AND PROPERLY DISPOSED OF ON A DAILY BASIS AND THE SITE MUST BE LEFT IN A SAFE AND SANITARY CONDITION EACH DAY. THE UNIVERSITY WILL INSPECT JOB SITES REGULARLY AND WILL FINE ANY CONTRACTOR FOUND TO BE IN VIOLATION OF THIS REQUIREMENT AN AMOUNT OF UP TO \$1,000 PER VIOLATION.

13. <u>Contractor must provide all O&M manuals, as-built drawings, and training of USC</u> personnel on new equipment, controls, etc. prior to Substantial Completion. Final payment will not be made until this is completed.

- 14. The contractor will comply with all regulations set forth by OSHA and SCDHEC. Contractor must also adhere to USC's internal policies and procedures (available by request). As requested, the contractor will submit all Safety Programs and Certificates of Insurance to the University for review.
- 15. Tree protection fencing is required to protect existing trees and other landscape features to be preserved within a construction area. The limits of this fence will be evaluated for each situation with the consultant, USC Arborist and USC Project Manager. The tree protection fence shall be 5' high chain link fence unless otherwise approved by USC Project Manager. No entry or materials storage will be allowed inside the tree protection zone. A 4" layer of mulch shall be placed over the tree protection area to maintain moisture in the root zone.
- 16. Where it is necessary to cross walks, tree root zones (i.e., under canopy) or lawns the following measures shall be taken: For single loads up to 9,000 lbs., a 3/4" minimum plywood base shall be placed over areas impacted. For single loads over 9,000 lbs., two layers of 3/4" plywood is required.
- 17. For projects requiring heavy loads to cross walks tree root zones or lawns. A construction entry road consisting of 10' X 16' oak logging mates on 12" coarse, chipped, hardwood base. Mulch and logging mats shall be supplemented throughout the project to keep matting structurally functional.

Updated: July 15, 2011
- 18. Any damage to existing landscaping (including lawn areas) will be remediated before final payment is made.
- 19. Orange safety fence to be provided by the contractor. (USC Arborist, Kevin Curtis may be contacted at 777-0033 or 315-0319)

Campus Vehicle Expectations

- 1. All motorized vehicles on the University campus are expected to travel and park on roadways and/or in parking stalls.
- 2. All motorized vehicle traffic on USC walkways must first receive the Landscape Manager=s authorization. Violators may be subject to fines and penalties.
- 3. All motorized vehicles that leak or drip liquids are prohibited from traveling or parking on walks or landscaped areas.
- 4. Contractors, vendors, and delivery personnel are required to obtain prior parking authorization before parking in a designated space. Violators may be subject to fines and/or penalties. See Item 10 below.
- 5. Drivers of equipment or motor vehicles that damage university hardscape or landscape will be held personally responsible for damages and restoration expense.
- 6. Vehicle drivers who park on landscape or drives must be able to produce written evidence of need or emergency requiring parking on same.
- 7. All vehicles parked on landscape, hardscape, or in the process of service delivery, must display adequate safety devices, i.e. flashing lights, cones, signage, etc.
- 8. All drivers of equipment and vehicles will be respectful of University landscape, equipment, structures, fixtures and signage.
- 9. All incidents of property damage will be reported to Parking Services or the Work Management Center.
- 10. Parking on campus is restricted to spaces designated by Parking Services at the beginning of the project. Once the project manager and contractor agree on how many spaces are needed, the project manager will obtain a placard for each vehicle. This placard must be hung from the mirror of the vehicle, otherwise a ticket will be issued and these tickets cannot be "fixed". Parking spaces are restricted to work vehicles only; no personal vehicles.

Updated: July 15, 2011

KNOW ALL MEN BY THESE PRESENTS, that (Insert full name or legal title and address of Contractor)

Name: _____ Address: _____

hereinafter referred to as "Contractor", and (Insert full name and address of principal place of business of Surety)

Name: _____ Address:

hereinafter called the "surety", are jointly and severally held and firmly bound unto (Insert full name and address of Agency)

Name: University of South Carolina Address:743 Greene Street

<u>Columbia, SC 29208</u>

hereinafter referred to as "Agency", or its successors or assigns, the sum of _______, being the sum of the Bond to which payment to be well and truly made, the Contractor and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, Contractor has by written agreement dated ______ entered into a contract with Agency to construct

State Project Name: Softball Stadium Construction

State Project Number: H27-6088-MJ

Brief Description of Awarded Work, as found on the SE-330, Bid Form:

The project consists of approx. 1300-seat stadium. The construction includes concrete footings, concrete structure, steel structure, metal building structure, masonry, alum. storefront, alum. composite panels, roofing, associated plumbing, electrical, fire protection, & HVAC work, and associated interior finishes, casework & stadium specialty items. Field lighting, fencing & minor site development work are included (field is exisitng). Small and minority business participation is encouraged.

in accordance with Drawings and Specifications prepared by (Insert full name and address of A/E)

Name: <u>Quackenbush Architects + Planners</u> Address:<u>1217 Hampton Street</u> <u>Columbia, SC 29201</u>

which agreement is by reference made a part hereof, and is hereinafter referred to as the Contract.

IN WITNESS WHEREOF, Surety and Contractor, intending to be legally bound hereby, subject to the terms stated herein, do each cause this Performance Bond to be duly executed on its behalf by its authorized officer, agent or representative.

DATED thisday of, 2BO	ND NUMBER
CONTRACTOR	SURETY
By:(Seal)	By:(Seal)
Print Name:	Print Name:
Print Title:	Print Title: (Attach Power of Attorney)
Witness:	Witness:

(Additional Signatures, if any, appear on attached page)

Performance Bond

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION IS SUCH THAT:

1. The Contractor and the Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors and assigns to the Agency for the full and faithful performance of the contract, which is incorporated herein by reference

2. If the Contractor performs the contract, the Surety and the Contractor have no obligation under this Bond, except to participate in conferences as provided in paragraph 3.1.

3. The Surety's obligation under this Bond shall arise after:

3.1 The Agency has notified the Contractor and the Surety at the address described in paragraph 10 below, that the Agency is considering declaring a Contractor Default and has requested and attempted to arrange a conference with the Contractor and the Surety to be held not later than 15 days after receipt of such notice to discuss methods of performing the Contract. If the Agency, the Contractor and the Surety agree, the Contractor shall be allowed a reasonable time to perform the Contract, but such an agreement shall not waive the Agency's right, if any, subsequently to declare a Contractor Default; or

3.2 The Agency has declared a Contractor Default and formally terminated the Contractor's right to complete the Contract.

4. The Surety shall, within 15 days after receipt of notice of the Agency's declaration of a Contractor Default, and at the Surety's sole expense, take one of the following actions:

4.1 Arrange for the Contractor, with consent of the Agency, to perform and complete the Contract; or

4.2 Undertake to perform and complete the Contract itself, through its agents or through independent contractors; or

4.3 Obtain bids or negotiated proposals from qualified contractors acceptable to the Agency for a contract for performance and completion of the Contract, arrange for a contract to be prepared for execution by the Agency and the contractor selected with the Agency's concurrence, to be secured with performance and payment bonds executed by a qualified surety equivalent to the Bonds issued on the Contract, and pay to the Agency the amount of damages as described in paragraph 7 in excess of the Balance of the Contract Sum incurred by the Agency resulting from the Contractor Default; or

4.4 Waive its right to perform and complete, arrange for completion, or obtain a new contractor, and:

4.4.1 After investigation, determine the amount for which it may be liable to the Agency and, within 60 days of waiving its rights under this paragraph, tender payment thereof to the Agency; or

4.4.2 Deny liability in whole or in part and notify the Agency, citing the reasons therefore.

5. Provided Surety has proceeded under paragraphs 4.1, 4.2, or 4.3, the Agency shall pay the Balance of the Contract Sum to either:

5.1 Surety in accordance with the terms of the Contract; or

5.2 Another contractor selected pursuant to paragraph 4.3 to perform the Contract.

5.3 The balance of the Contract Sum due either the Surety or another contractor shall be reduced by the amount of damages as described in paragraph 7.

6. If the Surety does not proceed as provided in paragraph 4 with reasonable promptness, the Surety shall be deemed to be in default on this Bond 15 days after receipt of written notice from the Agency to the Surety demanding that the Surety perform its obligations under this Bond, and the Agency shall be entitled to enforce any remedy available to the Agency.

6.1 If the Surety proceeds as provided in paragraph 4.4, and the

Agency refuses the payment tendered or the Surety has denied liability, in whole or in part, then without further notice the Agency shall be entitled to enforce any remedy available to the Agency.

6.2 Any dispute, suit, action or proceeding arising out of or relating to this Bond shall be governed by the Dispute Resolution process defined in the Contract Documents and the laws of the State of South Carolina.

7. After the Agency has terminated the Contractor's right to complete the Contract, and if the Surety elects to act under paragraph 4.1, 4.2, or 4.3 above, then the responsibilities of the Surety to the Agency shall be those of the Contractor under the Contract, and the responsibilities of the Agency to the Surety shall those of the Agency under the Contract. To a limit of the amount of this Bond, but subject to commitment by the Agency of the Balance of the Contract Sum to mitigation of costs and damages on the Contract, the Surety is obligated to the Agency without duplication for:

7.1 The responsibilities of the Contractor for correction of defective Work and completion of the Contract; and

7.2 Additional legal, design professional and delay costs resulting from the Contractor's Default, and resulting from the actions or failure to act of the Surety under paragraph 4; and

7.3 Damages awarded pursuant to the Dispute Resolution Provisions of the Contract. Surety may join in any Dispute Resolution proceeding brought under the Contract and shall be bound by the results thereof; and

7.4 Liquidated Damages, or if no Liquidated Damages are specified in the Contract, actual damages caused by delayed performance or non-performance of the Contractor.

8. The Surety shall not be liable to the Agency or others for obligations of the Contractor that are unrelated to the Contract, and the Balance of the Contract Sum shall not be reduced or setoff on account of any such unrelated obligations. No right of action shall accrue on this Bond to any person or entity other than the Agency or its heirs, executors, administrators, or successors.

9. The Surety hereby waives notice of any change, including changes of time, to the contract or to related subcontracts, purchase orders and other obligations.

10. Notice to the Surety, the Agency or the Contractor shall be mailed or delivered to the address shown on the signature page. **11.** Definitions

11.1 Balance of the Contract Sum: The total amount payable by the Agency to the Contractor under the Contract after all proper adjustments have been made, including allowance to the Contractor of any amounts to be received by the Agency in settlement of insurance or other Claims for damages to which the Contractor is entitled, reduced by all valid and proper payments made to or on behalf of the Contractor under the Contract.

11.2 Contractor Default: Failure of the Contractor, which has neither been remedied nor waived, to perform the Contract or otherwise to comply with the terms of the Contract.

KNOW ALL MEN BY THESE PRESENTS, that (Insert full name or legal title and address of Contractor)

Name: _____ Address:_____

hereinafter referred to as "Contractor", and (Insert full name and address of principal place of business of Surety)

Name: _____ Address:_____

hereinafter called the "surety", are jointly and severally held and firmly bound unto (Insert full name and address of Agency)

Name: <u>University of South Carolina</u> Address:<u>743 Greene Street</u> <u>Columbia, SC 2920</u>8

hereinafter referred to as "Agency", or its successors or assigns, the sum of ______, being the sum of the Bond to which payment to be well and truly made, the Contractor and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, Contractor has by written agreement dated ______ entered into a contract with Agency to construct

Project Name: Softball Stadium Construction

Project Number: <u>H27-6088-MJ</u>

Brief Description of Awarded Work, as found on the SE-330, Bid Form:

The project consists of approx. 1300-seat stadium. The construction includes concrete footings, concrete structure, steel structure, metal building structure, masonry, alum. storefront, alum. composite panels, roofing, associated plumbing, electrical, fire protection, & HVAC work, and associated interior finishes, casework & stadium specialty items. Field lighting, fencing & minor site development work are included (field is exisitng). Small and minority business participation is encouraged.

in accordance with Drawings and Specifications prepared by (Insert full name and address of A/E)

Name: <u>Quackenbush Architects + Planners</u> Address:<u>1217 Hampton Street</u> Columbia, SC 29201

which agreement is by reference made a part hereof, and is hereinafter referred to as the Contract.

IN WITNESS WHEREOF, Surety and Contractor, intending to be legally bound hereby, subject to the terms stated herein, do each cause this Labor and Material Payment Bond to be duly executed on its behalf by its authorized officer, agent or representative.

DATED thisday of, 2 BC (shall be no earlier than Date of Contract)	OND NUMBER	
CONTRACTOR	SURETY	
By:(Seal)	Ву:	(Seal)
Print Name:	Print Name:	
Print Title:	Print Title: (Attach Power of Attorney)	
Witness:	Witness:	

(Additional Signatures, if any, appear on attached page)

SE-357 Labor and Material Payment Bond

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION IS SUCH THAT:

1. The Contractor and the Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors and assigns to the Agency to pay for all labor, materials and equipment required for use in the performance of the Contract, which is incorporated herein by reference.

2. With respect to the Agency, this obligation shall be null and void if the Contractor:

2.1 Promptly makes payment, directly or indirectly, for all sums due Claimants; and

2.2 Defends, indemnifies and holds harmless the Agency from all claims, demands, liens or suits by any person or entity who furnished labor, materials or equipment for use in the performance of the Contract.

3. With respect to Claimants, this obligation shall be null and void if the Contractor promptly makes payment, directly or indirectly, for all sums due.

4. With respect to Claimants, and subject to the provisions of Title 29, Chapter 5 and the provisions of §11-35-3030(2)(c) of the SC Code of Laws, as amended, the Surety's obligation under this Bond shall arise as follows:

4.1 Every person who has furnished labor, material or rental equipment to the Contractor or its subcontractors for the work specified in the Contract, and who has not been paid in full therefore before the expiration of a period of ninety (90) days after the date on which the last of the labor was done or performed by him or material or rental equipment was furnished or supplied by him for which such claim is made, shall have the right to sue on the payment bond for the amount, or the balance thereof, unpaid at the time of institution of such suit and to prosecute such action for the sum or sums justly due him.

4.2 A remote claimant shall have a right of action on the payment bond upon giving written notice by certified or registered mail to the Contractor within ninety (90) days from the date on which such person did or performed the last of the labor or furnished or supplied the last of the material or rental equipment upon which such claim is made.

4.3 Every suit instituted upon a payment bond shall be brought in a court of competent jurisdiction for the county or circuit in which the construction contract was to be performed, but no such suit shall be commenced after the expiration of o ne year after the day on which the last of the labor was performed or material or rental equipment was supplied by the person bringing suit.

5. When the Claimant has satisfied the conditions of paragraph 4, the Surety shall promptly and at the Surety's expense take the following actions:

5.1 Send an answer to the Claimant, with a copy to the Agency, within sixty (60) days after receipt of the claim, stating the amounts that are undisputed and the basis for challenging any amounts that are disputed.

5.2 Pay or arrange for payment of any undisputed amounts.

5.3 The Surety's failure to discharge its obligations under this paragraph 5 shall not be deemed to constitute a waiver of defenses the Surety or Contractor may have or acquire as to a claim. However, if the Surety fails to discharge its obligations under this paragraph 5, the Surety shall indemnify the Claimant for the reasonable attorney's fees the Claimant incurs to recover any sums found to be due and owing to the Claimant.
6. Amounts owed by the Agency to the Contractor under the

Contract shall be used for the performance of the Contract and to satisfy claims, if any, under any Performance Bond. By the Contractor furnishing and the Agency accepting this Bond, they agree that all funds earned by the contractor in the performance of the Contract are dedicated to satisfy obligations of the Contractor and the Surety under this Bond, subject to the Agency's prior right to use the funds for the completion of the Work.

7. The Surety shall not be liable to the Agency, Claimants or others for obligations of the Contractor that are unrelated to the Contract. The Agency shall not be liable for payment of any costs or expenses of any claimant under this bond, and shall have under this Bond no obligations to make payments to, give notices on behalf of, or otherwise have obligations to Claimants under this Bond.

8. The Surety hereby waives notice of any change, including changes of time, to the Contract or to related Subcontracts, purchase orders and other obligations.

9. Notice to the Surety, the Agency or the Contractor shall be mailed or delivered to the addresses shown on the signature page. Actual receipt of notice by Surety, the Agency or the contractor, however accomplished, shall be sufficient compliance as of the date received at the address shown on the signature page.

10. By the Contractor furnishing and the Agency accepting this Bond, they agree that this Bond has been furnished to comply with the statutory requirements of the South Carolina Code of Laws, as amended, and further, that any provision in this Bond conflicting with said statutory requirements shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. The intent is that this Bond shall be construed as a statutory Bond and not as a common law bond.

11. Upon request of any person or entity appearing to be a potential beneficiary of this bond, the Contractor shall promptly furnish a copy of this Bond or shall permit a copy to be made.

12. Any dispute, suit, action or proceeding arising out of or relating to this Bond shall be governed by the laws of the State of South Carolina.

13. DEFINITIONS

13.1 Claimant: An individual or entity having a direct contract with the Contractor or with a Subcontractor of the Contractor to furnish labor, materials, or equipment for use in the performance of the Contract. The intent of this Bond shall be to include without limitation in the terms "labor, materials or equipment" that part of water, gas, power, light, heat, oil, gasoline, telephone service or rental equipment used in the Contract, architectural and engineering services required for performance of the Work of the Contractor and the Contractor's Subcontractors, and all other items for which a mechanic's lien might otherwise be asserted.

13.2 Remote Claimant: A person having a direct contractual relationship with a subcontractor of the Contractor or subcontractor, but no contractual relationship expressed or implied with the Contractor.

13.3 Contract: The agreement between the Agency and the Contractor identified on the signature page, including all Contract Documents and changes thereto.

SE-480	
CONSTRUCTION CHANGE ORDER	Change Order No.:

Agency: University of South Carolina Project Number: H27-6088-MJ

Date:

Project Name: Softball Stadium Construction

Contractor:

Contract Dated:

For:

This Contract is changed as follows: (Insert description of change in space provided below)

Adjustments in the Contract Sum:		
1. Original Contract Sum:		
2. Change in Contract Sum by previously approved Change Orders:		
3. Contract Sum prior to this Change Order:		\$0.00
4. Amount of this Change Order:		
5. New Contract Sum, including this Change Order:		\$0.00
Adjustments in Contract Time:		
1. Original Substantial Completion Date:		
2. Sum of previously approved increases and decreases:	Days	
3. Changes in Days for this Change Order:	Days	
4. New Substantial Completion Date:	·	
Contractor Acceptance:		
BY:	Date:	
(Signature of Representative		-
Print Name:		
Architect Recommendation for Acceptance:		
BY:	Date:	
(Signature of Representative		•
Print Name:		
Agency Acceptance and Certification		
BY:	Date:	
(Signature of Representative		-
Print Name:		
Change is within Agency Construction Procureme	nt Certification amount of	-
Change is not within Agency Construction Procure	ement Certification amount	
Office of the State Engineer Authorization for change not within A	gency Construction Procur	ement Certification:
Signature of OSE Project Manager:		

University of South Carolina Softball Stadium Construction BID SET

CONTRACTOR'S ONE YEAR GUARANTEE

STATE OF _____

COUNTY OF _____

We as General Contractor on the above-named project do hereby guarantee that all work executed under the requirements of the Contract Documents shall be free from defects due to faulty materials and/or workmanship for a period of one (1) year from date of acceptance of the work by the Owner and/or Architect/Engineer, and hereby agree to remedy defects due to faulty materials and/or workmanship, and pay for any damage resulting therefrom, at no cost to the Owner, provided however, that the following are excluded from this guarantee:

Defects or failures resulting from abuse by Owner.

Damage caused by fire, tornado, hail, hurricane, acts of God, wars, riots, or civil commotion.

(Name of Contracting Firm)

*By _____

Title _____

*Must be executed by an officer of the Contracting Firm.

SWORN TO before me this

_____ day of _____ 20__(SEAL)

_____(STATE)

My commission expires _____

DOCUMENT 000115 - LIST OF DRAWING SHEETS

1.1 LIST OF DRAWINGS

- A. List of Drawings: Drawings consist of the following Contract Drawings and other drawings of type indicated:
- T1.1 COVER SHEET, INDEX OF DRAWINGS
- T1.2 GENERAL NOTES, SYMBOL, LEGENDS
- T1.3 CODE ANALYSIS
- T2.1 LIFE SAFTEY PLAN CONCOURSE LEVEL OVERALL
- T2.2 LIFE SAFTEY PLAN LOWER LEVEL ENLARGED
- T2.3 LIFE SAFETY PLAN CONCOURSE LEVEL ENLARGED
- T2.4 LIFE SAFETY PLAN UPPER LEVEL OVERALL
- C1 GENERAL NOTES, LEGEND, SYMBOLS & ABBRIVATIONS
- C2 EXISITING & DEMOLITION PLAN
- C3 SITE LAYOUT PLAN
- C4 GRADING & STORM DRAINAGE PLAN
- C5 WATER DISTRIBUTION & SANITARY SWER PLAN
- C6 STORM WATER POLLUTION PREVENTION PLAN
- C7 PROFILES & DETAILS
- C8 SITE DETAILS
- C9 SITE DETAILS
- C10 SITE DETAILS

AS1.1	SITE PLAN
A1.1	LOWER LEVEL OVERALL PLAN
A1.1A	LOWER LEVEL ENLARGED PLANS
A1.2	CONCOURSE LEVEL OVERALL PLAN
A1.2A	ENLARGED CONCOURSE LEVEL PLAN
A1.2B	ENLARGED CONCOURSE PLAN - ALTERNATE NO. 1
A1.3	UPPER LEVEL OVERALL PLAN
A1.3A	ENLARGED UPPER LEVEL & ROOF PLAN
A1.4	HIGH ROOF PLAN, TYPICAL ROOF DETAILS
A1.5	ENLARGED PLAN AT PLAZA, BRIDGE, LOWER LEVEL ENTRY PLAN, ALT 2
A1.6	ENLARGED PLANS & TOILET ACCESSORY LEGEND, CONCESSION SCHEDULE
A1.7	ENLARGED PLAN LOWER LEVEL HOME SIDE
A1.8	ENLARGED UPPER LEVEL PLAN AT PRESS BOX
A1.9	DUGOUT PLANS AND ELEVATIONS
A2.1	REFLECTED CEILING PLANS LOWER LEVEL
A2.2	CONCOURSE LEVEL REFLECTED CEILING PLANS
A2.3	UPPER LEVEL REFLECTED CEILING PLAN
A3.0	PARTITION DETAILS, MISC DETAILS
A3.1	PARTITION TYPES
A3.2	PLAN DETAILS

A3.3	PLAN DETAILS
A3.4	PLAN DETAILS
A4.0	EXTERIOR FINISH MATERIALS, PERSPECTIVE VIEWS
A4.1	BUILDING ELEVATIONS
A4.2	BUILDING ELEVATIONS
A4.3	BUILDING ELEVATIONS BATTING CAGE
A4.4	BUILDING ELEVATIONS PLAZA & TICKET BLDG
A4.5	BUILDING ELEVATIONS - FIELD NETTING, PADDING
A5.1	BUILDING SECTIONS
A5.2	BUILDING SECTIONS - BATTING CAGE
A5.3	BUILDING SECTIONS
A5.4	RAMP AND STAIR SECTIONS, HOME SIDE
A5.5	RAMP AND STAIR SECTIONS, VISITOR SIDE
A5.6	RAIL ELEVATIONS
A5.7	SEATING BOWL SECTIONS
A5.8	SEATING BOWL SECTIONS
A5.9	DETAILS
A5.10	DETAILS
A5 11	FIELD WALL AND NETTING DETAILS
A5 12	INDOOR BATTING CAGE PLAN AND DETAILS
A6.0	TYPICAL EXTERIOR WALL, FLOOR, AND ROOF TYPES, CAST STONE TYPES
A6 1	WALL SECTIONS HOME SIDE & DETAILS
A6 ?	WALL SECTIONS
A6 3	WALL SECTIONS
A6.4	WALL SECTIONS & DETAILS
A6 5	WALL SECTIONS - PRESS BOX AREA
A6.6	WALL SECTIONS - PRESS BOX AREA DETAILS
A67	WALL SECTIONS - PRESS DOR MREA, DETAILS
A6.8	WALL SECTIONS TICKET BUILDING AND ENTRANCE
A6.9	WALL SECTIONS & DETAILS
A7 1	DOOR SCHEDULE AND TYPES LOUVER TYPES
Δ7 2	WINDOW TYPES I OLIVER TYPES
Δ73	DOOR DETAILS
A7.4	LOUVER OVERHEAD DOOR & SECTIONAL DOOR DETAILS
A7.5	WINDOW DETAILS
A7.6	DOOR SILLS, WINDOW DETAILS
A8.0	FINISH SCHEDULE. FINISH MATERIALS, DETAILS
A8.1	LOWER LEVEL HOME SIDE ENLARGED FINISH PLAN
A8.2	CONCOURSE LEVEL FINISH PLAN. SIGNAGE. & SEAT NUMBERING
A8.3	INTERIOR ELEVATIONS
A8.4	INTERIOR ELEVATIONS
A8.5	INTERIOR ELEVATIONS
A8.6	CASEWORK SECTIONS AND DETAILS
A8.7	TEAM LOCKER ROOM DETAILS
A9.1	ENLARGED STAIR PLANS & SECTIONS STAIR ST01. STAIR DETAILS
A9.2	ENLARGED STAIR PLANS & SECTIONS STAIR STO2 & STO3 & ELEVATOR DETAILS
A9.3	ENLARGED STAIR PLANS AND SECTIONS STAIR STO4 AND STAIR DETAILS
A9.4	STAIR AND ELEVATOR DETAILS
A10.1	ALTERNATE NO 3 - ENLARGED BATTING CAGE PLANS

A10.2	ALTERNATE NO 3 - BATTING CAGE ELEVATIONS & SECTIONS
AV1.1	SOUND SYSTEM LAYOUT PLAN
S0.1	GENERAL NOTES
S1.1	FOUNDATION PLAN LOWER LEVEL VISITOR SIDE
S1.2	FOUNDATION PLAN LOWER LEVEL HOME SIDE
S1.3	BATTING CAGE FOUNDATION PLAN (BASE BID & AL)
S1.4	ALTERNATE NO 2 PLAZA ENTRANCE
S1.5	ALTERNATE NO 2 SECTIONS
S2.1	CONCOURSE LEVEL FRAMING PLAN VISITOR SIDE
S2.2	CONCOURSE LEVEL FRAMING PLAN HOME SIDE
S 3.1	UPPER LEVEL FRAMING PLAN
S4.1	ROOF FRAMING PLAN
S5.1	FOUNDATION SECTIONS
\$5.2	FOUNDATION SECTIONS
\$5.3	FOUNDATION SECTIONS
S5.4	TYPICAL FOUNDATION DETAILS
S6.1	UPPER FLOOR SECTIONS
S6.2	UPPER FLOOR SECTIONS
S6.3	UPPER FLOOR SECTIONS
S6.4	UPPER FLOOR SECTIONS
S7.1	ROOF FRAMING SECTIONS
S7.2	ROOF FRAMING SECTIONS
S8.1	TYPICAL FRAMING SECTIONS
FP101	LOWER LEVEL FIRE PROTECTION
FP102	CONCOURSE LEVEL FIRE PROTECTION
FP103	UPPER LEVEL FIRE PROTECTION
P000	PLUMBING LEGEND AND ABBREVIATION
P100	FOUNDATION PLAN SANITARY AND STORM
P101	LOWER LEVEL SANITARY AND STORM
P102	CONCOURSE LEVEL SANITARY AND STORM
P103	UPPER LEVEL SANITARY AND STORM
P201	LOWER LEVEL DOMESTIC WATER
P202	CONCOURSE LEVEL DOMESTIC WATER
P203	UPPER LEVEL SANITARY AND STORM
P400	PLUMBING RISER DIAGRAMS
P401	PLUMBING RISER DIAGRAMS
P402	PLUMBING RISER DIAGRAMS
P403	PLUMBING RISER DIAGRAMS
P404	PLUMBING RISER DIAGRAMS
P405	PLUMBING RISER DIAGRAMS
P500	PLUMBING DETAILS
P501	PLUMBING DETAILS
P502	PLUMBING DETAILS
P600	PLUMBING SCHEDULES

M000 MECHANICAL LEGEND AND ABBREVIATIONS

M100	LOWER LEVEL-DIFFUSER PLAN
M101	CONCOURSE LEVEL DIFFUSER PLAN
M102	UPPER LEVEL DIFFUSER PLAN
M103	LOWER LEVEL MECHANCIAL PIPING
M104	CONCOURSE LEVEL HVAC
M105	UPPER LEVEL HVAC
M201	LOWER LEVEL MECHANICAL PIPING
M202	CONCOURSE MECHANICAL PIPING
M203	UPPER LEVEL MECHANICAL PIPING
M400	MECHANICAL SCHEMATICS
M401	MECHANICAL SCHEMATICS
M402	MECHANICAL SCHEMATICS
M403	MECHANICAL INPUT / OUTPUT SUMMARY
M500	MECHANICAL DETAILS
M501	MECHANICAL DETAILS
M600	MECHANICAL SCHEDULES
M601	MECHANICAL SCHEDULES
E000	ELECTRICAL LEGEND AND ABBREVIATIONS
E001	ELECTRICAL SITE PLAN
E002	SPORTS LIGHTING PLAN
E101	LOWER LEVEL ELECTRICAL POWER AND SPECIAL SYSTEM
E102	CONCOURSE LEVEL ELECTRICAL POWER AND SPECIAL SYSTEMS
E103	UPPER LEVEL ELECTRICAL POWER AND SPECIAL SYSTEMS
E201	LOWER LEVEL ELECTRICAL LIGHTING PLANS
E202	CONCOURSE LEVEL ELECTRICAL LIGHTING PLANS
E203	UPPER LEVEL ELECTRICAL LIGHTING
E401	ELECTRICAL DETAILS
E501	ELECTRICAL SINGLE LINE DIAGRAM
E502	ELECTRICAL SINGLE LINE DIAGRAM
E503	ELECTRICAL COMMUNICATION SINGLE LINE DIAGRAM
E601	ELECTRICAL SCHEDULES
E602	ELECTRICAL PANEL BOARD SCHEDULES
E603	ELECTRICAL PANEL BOARD SCHEDULES
E604	ELECTRICAL PANEL BOARD SCHEDULES

END OF DOCUMENT 000115

DOCUMENT 003132 - GEOTECHNICAL DATA

1.1 GEOTECHNICAL DATA

- A. This Document with its referenced attachments is part of the Procurement and Contracting Requirements for Project. They provide Owner's information for Bidders' convenience and are intended to supplement rather than serve in lieu of Bidders' own investigations. They are made available for Bidders' convenience and information, but are not a warranty of existing conditions. This Document and its attachments are not part of the Contract Documents.
- B. A geotechnical investigation report for Project, prepared by GS2 dated October 31, 2011 is available for viewing as appended to this Document.
- C. Related Requirements:
 - 1. Document 002113 "Instructions to Bidders" for the Bidder's responsibilities for examination of Project site and existing conditions.

END OF DOCUMENT 003132

Proposed Softball Stadium at Beckham Field

South Marion Street The University of South Carolina Columbia, South Carolina

GS2 Project Number 11-3661-G October 31, 2011

Report of Geotechnical Exploration

Prepared for:

The University of South Carolina Campus Planning and Construction 743 Greene Street Columbia, South Carolina 29208



Corporate Headquarters 1200 Veterans Road, Suite A Columbia, South Carolina 29209 (803) 776-2105 (803) 776-2106

Columbia Office 241 Business Park Boulevard Columbia, South Carolina 29203 (803) 750-1510 (803) 750-0773

Charleston Office 4301 Dorchester Road, Suite 12A North Charleston, South Carolina 29405 (843) 763-4093 (843) 763-4094

> Bluffton Testing Office P.O. Box 2143 Bluffton, South Carolina 29910 (843) 297-2035 (843) 763-4094

Greenville Office 350 Feaster Road, Suite A Greenville, South Carolina 29615 (864) 312-9994 (864) 312-9995

Florence Office 2353D Walker Swinton Road Timmonsville, South Carolina 29161 (843) 292-9660 (843) 292-9661

Myrtle Beach Testing Office 1514 U.S. Highway 501 Gumm Plaza Myrtle Beach, South Carolina 29577 (843) 444-2766 (843) 444-2799

Environmental Department 1345 Garner Lane, Suite 308 Columbia, South Carolina 29210 (803) 772-2031 (803) 772-2034

www.gs2engineering.com

PROJECT INFORMATION

Proposed Development

October 31, 2011

The University of South Carolina Campus Planning and Construction 743 Greene Street Columbia, South Carolina 29208

Attention: Ms. Ann Derrick

Reference:

Report of Geotechnical Exploration Proposed Softball Stadium at Beckham Field South Marion Street The University of South Carolina Columbia, South Carolina GS2 Project No.: 11-3661-G

Dear Ms. Derrick,

This report presents our geotechnical exploration of the site of the proposed Softball Stadium at Beckham Field for the University of South Carolina, in downtown Columbia, South Carolina. Information obtained from our geotechnical exploration has been used to evaluate the existing site conditions for the use of developing design parameters for the proposed structures. This work was performed in general accordance with industry standards and our proposal number P3402-11, dated September 6, 2011.

Recommendations detailed in this report are specific to the soil conditions in the immediate vicinity of the boring and sounding locations for this particular project. This report does not include any environmental assessment of soils, surface water or groundwater, the determination of wetlands, the determination of noise impact, the assessment of air quality, the identification of cultural resources, and the identification of endangered species. These services are beyond the scope of services of a geotechnical exploration.

We understand from the information provided via email on September 2 and 6, 2011, that the proposed development will include the demolition of the existing stadium seating and auxiliary structures surrounding the in-place, and recently renovated Beckham Field, where the University of South Carolina women's softball team plays home games, followed by the construction of a new Softball Stadium structure, which is planned to be 25,000 square feet in area, and consist of three stories consisting of a lower level, a concourse level and an upper level.

We have assumed that the Stadium structure is planned to be constructed utilizing a combination reinforced CMU block, cast-in-place concrete and steel framed wall system, and is to be supported utilizing a cast-in-place, concrete, shallow foundation system and concrete slab-on-grades. Maximum wall and column loads for this structure are understood to be on the order of 3 kips per linear foot and 10 to 180 kips, respectively.

Additionally, we understand that the development will also include the extension of the Promenade Walkway, which is understood to be a raised walkway that will extend from its current termination at the recently constructed Tennis Facility, along the Northeastern portion of the site, as well as have a raised walkway into the concourse level of the new Stadium structure.

We have assumed that the Promenade Walkway structure is planned to be constructed utilizing a cast-in-place concrete wall system, and is to be supported utilizing a cast-in-place, concrete, shallow foundation system and concrete slab-on-grades. Maximum wall loads for this structure are assumed to be on the order of up to 5 kips per linear foot.

Finally, we understand that Athletic Lighting, surrounding the softball field and stadium, will be constructed as part of the development.

We have assumed, through our knowledge of similar structures, that the proposed Athletic Lighting will be comprised of steel structures that will house lighting and that the axial, lateral, and overturning moment loads of the proposed structures are to be supported utilizing a caisson deep foundation system.

Additionally, site specific topographic information was provided; however, finished floor elevations for the development were not available at the time of our exploration. Therefore, based on our understanding of the existing site grades and from our experience with similar developments, we have assumed that cuts and fills on the order of 2 to 3 feet will be required to level the development areas.

Furthermore, we have assumed that the design and construction of the proposed structures will be governed by the International Building Code, Edition 2006 or 2009 (IBC2006/2009).

SITE SETTING

Site Location

The site of the existing Beckham Field is located along the southwestern side of South Marion Street, southwest of its intersection with Crestwood Drive, on the campus of The University of South Carolina, in downtown Columbia, South Carolina. More specifically, the proposed development is to surround



the existing Beckham Field. The location of the site relative to the nearby streets is shown in the *Site Location Map*, Figure 1 in Appendix A.

<u>Site Description</u> The subject site was noted to be generally square in shape, and, at the time of our visit, it was noted to be developed with the existing Beckham Field and auxiliary structures. In general, the existing facility appeared to be in good working order.

The site was further noted to be bordered by an existing parking lot and the Roost Dorm to the north, an existing parking lot and the existing Track and Field facility to the east, the existing Track and Field facility and an existing soccer practice field to the south, and the recently completed Tennis Facility to the west. Access to the site was gained via paved drives emanating from South Marion Street.

Site Topography Topographically, the site is located on the southwestern side slope of a broad ridge in the Upper Coastal Plain Physiographic Province that is noted to be sloping from northeast to southwest, with surface runoff in the vicinity of the site appearing to drain primarily into the surrounding, in-place infrastructure, leading to Rocky Branch and eventually into the Congaree River. Ground surface elevations across the site appear to range from 205 to 199 feet above mean sea level. General topographic information was obtained from the USGS Southwest Columbia topographic quadrangle, as shown in the USGS Topographic Map, Figure 2 in Appendix A.

SUMMARY OF FIELD EXPLORATION

The subsurface conditions within the area of the **proposed Softball Stadium** were explored with 7 mechanically-augered soil borings, with Standard Penetration Tests (SPT) taken at regular intervals, while the recovered samples were visually and texturally classified by ASTM D2488 *Standard Practice for Description and Identification of Soils (Visual-Manual Procedure).* These borings were extended to the termination/refusal depths of 20 to 45 feet, below the existing ground surface.

Additionally, the subsurface conditions within the area of the **proposed Promenade Walkway structure** were explored with 2 mechanicallyaugered soil borings, with Standard Penetration Tests (SPT) taken at regular intervals, while the recovered samples were visually and texturally classified by ASTM D2488 Standard Practice for Description and Identification of Soils (Visual-Manual Procedure). These borings were extended to the termination depths of 20 feet, below the existing ground surface.

Finally, the subsurface conditions within the areas of the *proposed Athletic Lighting structures* were explored with 6 mechanically-augered soil borings, with Standard Penetration Tests (SPT) taken at regular intervals,



while the recovered samples were visually and texturally classified by ASTM D2488 Standard Practice for Description and Identification of Soils (Visual-Manual Procedure). These borings were extended to the termination depths of 30 feet below the existing ground surface.

The approximate soil boring locations are shown on the attached *Boring Location Plan*, Figure 3 in Appendix A. The borings were located in the field by measuring from estimated property and building corners.

SITE SOIL CONDITIONS

Site Geology

The site is located in an old river terrace formed in the Upper Coastal Plain Physiographic Province of South Carolina, in downtown Columbia. The soils of this terrace are composed of a mixture of re-deposited material washed from upstream sources of ancient rivers, and are typically mixed with rocks that vary in size and depth which have been rounded through years of exposure to flowing water. The deposits in these areas are highly variable and may cover areas of the river bed and associated flood plains, which when deposited were established in very loose and wet conditions. Ultimately these terraces are underlain by firmer materials of the Piedmont Physiographic Province.

More specifically, the geology and geomorphology of the city of Columbia are dictated by several key factors of which the Fall Line and the local River Systems are the most dominant. Upstream from the Fall Line rivers and streams typically have very small floodplains, while downstream these floodplains widen greatly. T. Frank Johnson's 1972 mapping of the Columbia quadrangles depicts the near surface soil composition for areas along the east banks of the Broad River, to about Assembly Street, and west of the Broad River to consist of material that weathered from Phyllites and Granite, with the coastal plain sediments in this area typically 35 to 50 feet thick. Additionally, geological mapping of the Columbia quadrangles depicts the near surface soil composition for areas of Columbia east of Assembly Street to consist of coastal plain and river terrace sediments on the order of 80 to 90 feet thick. In both cases the coastal plain sediments are underlain by several feet of weathered rock and Potassium Feldsparrich Granite. The granite underlying the surface deposits is known to be metamorphic in nature, and relatively weathered.

Soil Conditions The subsurface conditions encountered at the boring locations are detailed on the attached *Soil Test Boring Logs*. These logs represent our interpretation of the subsurface conditions at the boring locations based on our visual and textural examination of the recovered soil samples. The horizontal lines in the Soil Description column of the boring logs represent an approximate interface between various soil strata. It is important to understand that these horizontal lines represent an estimated depth of soil variance where as the actual soil change may be gradual.



Surface Materials: The borings encountered roughly 0 to 12 inches of topsoil at the ground surface across the site.

Proposed Softball Stadium structure: Beneath the surface materials, where encountered, the borings within the proposed Softball Stadium structure (Borings B-4, B-5, B-7, B-8, B-10, B-12 and B-13) generally encountered native Coastal Plain deposits, consisting of intermediate layers of clean, clayey and silty sands (SP, SC and SM), with intermittent layers of sandy silts and silts (ML) encountered in Borings B-4, B-7, B-8 and B-10 to termination/refusal depths of 20 to 45 feet below the existing ground surface.

The near-surface (0 to 3 to 5 feet) native sandy (SP and SC) soils exhibited SPT N-values noted to range from 6 to 43 blows per foot (bpf), indicating loose to dense relative densities, while the deeper native sandy (SP, SC and SM) soils exhibited SPT N-values noted to range from 5 to 100+ bpf, indicating loose to very dense relative densities. The intermittent layers of native silty (ML) soils exhibited SPT N-values noted to range from 11 to 100+ bpf, indicating firm to very hard relative consistencies.

Proposed Promenade Walkway structure: Beneath the surface materials, where encountered, the borings within the proposed Promenade Walkway structure (Borings B-1 and B-2) generally encountered native Coastal Plain deposits, consisting of clayey sands (SC) underlain by silty sands (SM) to termination depths of 20 feet below the existing ground surface.

The near-surface (0 to 3 feet) native sandy (SC) soils exhibited SPT N-values noted to range from 2 to 12 bpf, indicating very loose to firm relative densities, while the deeper native sandy (SC and SM) soils exhibited SPT N-values noted to range from 22 to 100+ bpf, indicating very firm to very dense relative densities.

Proposed Athletic Lighting Structures: Beneath the surface materials, where encountered, the borings within the proposed Athletic Lighting structures (Borings B-3, B-6, B-9, B-11, B-14 and B-15) generally encountered native Coastal Plain deposits, consisting of intermediate layers of clean, clayey and silty sands (SP, SC and SM), with intermittent layers of silts (ML) and clays (CL) encountered in Borings B-3, B-9, B-11 and B-14 to termination depths of 30 feet below the existing ground surface.

The native sandy (SP, SC and SM) soils exhibited SPT N-values noted to range from 4 to 100+ bpf, indicating very loose to very dense relative densities, while the intermittent layers of native silty (ML) and clayey (CL) soils exhibited SPT N-values noted to range from 11 to 100+ bpf, indicating firm to very hard relative consistencies.



<u>Groundwater</u>	Free groundwater was e of drilling at depths rang existing ground surface backfilled upon completion not recorded. Groundwa experience seasonal flup precipitation, construction	encountered in Borings B-3 through B-7 at the time ging from of approximately 11 to 27 feet below the bar. Due to safety concerns, the boreholes were on and therefore 24-hour groundwater depths were ater levels are dependent on many factors and can uctuations and various other fluctuations due to activities, and many other factors.
SEISMIC CONSIDERATIONS		
<u>Regional Seismic Conditions</u>	This site is situated appre Carolina, which is the m Seaboard. The Charles event that has occurre throughout the Charlesto 15 miles northwest of C Middleton Place Plantatio	oximately 110 miles northwest of Charleston, South ost prominent area of seismicity along the Atlantic ston earthquake of 1886 was the largest seismic ed in this region and damage was extensive on area. The epicenter was located approximately Charleston between the town of Summerville and on.
	Recent discoveries of re Carolina have expanded indicates that at least fi large enough to produce Charleston area within continues to experience	lict liquefaction in the Low Country region of South knowledge about seismicity in the area. Evidence ve episodes of strong prehistoric ground shaking widespread liquefaction have occurred within the the last 7500 years. The Charleston region earthquakes of smaller magnitudes yearly.
IBC 2006/2009 Seismic		
<u>Site Class</u>	Our analysis of the soil obtained from our SP geological conditions, A design parameters estab Code 2006 or 2009 (IB known regional condition established in the IBC 20 defined to have a Site Cl	seismic conditions was based on the information T borings performed, known site and vicinity known regional seismic conditions, and seismic lished in data published in the International Building C 2006/2009), section 1613. Therefore, from the s, the SPT N-values measured, and the parameters 006/2009, we have determined that the site is best ass C .
Earthquake Ground Motion	Earthquake ground mot obtained from the Interna The values for this site obtained utilizing the ma ground motions represen	ion parameters at the bedrock for this site were ational Building Code (IBC2006/2009) section 1613. are presented in Table 1. Ground motions were apped accelerations, with the design responses for ated in the following sections.
	Table 1:	Probabilistic Ground Motion Values
	Spectral Response Acceleration	Ground Motion Values for Recurrence Period (g) 2% in 50 Years (2006/2009)

1.0 sec Sa 1. Sa is the Spectral Response Acceleration at the noted period. Note:

0.555

0.149



0.2 sec Sa¹

Based on the information presented in the preceding table, and the IBC2006/2009 section 1613.5.3, the corresponding site coefficients for the site are calculated to be:

- F_a = 1.178
 F_y = 1.651
- **Design Spectral Response** Based on the information presented in the preceding table, and the corresponding site coefficients for the site, we have calculated the Design Spectral Response Acceleration Parameters, according to IBC2006/2009 section 1613.5.4, for this site to be:
 - S_{DS} = 0.44
 - S_{D1} = 0.16

CONCLUSIONS AND RECOMMENDATIONS

The borings performed during this exploration indicate that the existing sandy soils (SP, SC and SM) are *suitable*, while the existing, low-plasticity silty and clayey soils (ML and CL) are *marginally suitable*, for support of the proposed structures as well as for use as structural fill due to their inherent characteristics.

Additionally, the borings performed during this exploration indicate that the existing near-surface site soils appear adequate to support the proposed Softball Stadium structure, with some minor ground modifications, and Promenade Walkway structure on a conventional shallow foundation system, while the proposed Athletic Lighting structures can be supported utilizing a caisson deep foundation system.

It is important to note that fine-grained soils (silts and clays) such as those found at this site may be sensitive to variations in moisture content with a relatively narrow range of workable moisture contents. Therefore, close control of moisture content will be necessary during grading and fill placement operations. In addition, the soils at this site may become difficult to work during periods of wet weather. Grading operations under wet conditions may result in deterioration of otherwise suitable soil conditions, or of previously placed and properly compacted fill. These inherent soil properties make these soils less desirable for support and for use as structural fill. However, if the soils identified above as *marginally suitable* are placed properly, suitable support of the structures is achievable.

These conclusions, and the associated recommendations, are provided in the assumption that the soil conditions at the site do not vary greatly from those encountered in our borings and that our recommendations presented in the following sections of this report are followed.



<u>Suitability of Solis</u>	As previously stated, the hear-surface soils at the site have been identified to have an <i>SP</i> , <i>SC</i> , <i>SM</i> , <i>ML</i> and <i>CL</i> USCS soil classification. Most text includes soils with Unified Soil Classifications of SW, SP, SM, SC, SM-SC, ML and CL as suitable for support of structure or for use as structural fill, while soils with classifications of MH, CH, OL and OH are considered unsuitable. Therefore, it is important to note the site contains soils that are considered in the industry to be <u>suitable</u> (SP, SC and SM) to <u>marginally suitable</u> (MI and CL). The following sections provide more insight into each soil classification, with emphasis placed on their workability and preferred structural loading.
	Soils that have SC (with high Plasticity Indexes), ML and CL designations are less preferable fill soils that exhibit fair to good structural support characteristics under buildings, less ease in workability, with little flexibility in achieving compaction at various moisture contents.
	Fine-grained soils (SC (with high PIs, ML and CL), are typically sensitive to variations in moisture content with a relatively narrow range of workable moisture contents. Therefore, close control of moisture content will probably be necessary during grading and fill placement operations, where these soils are involved. In addition, these soils may become difficult to work during periods of wet weather. Grading operations under wet conditions may result in the deterioration of otherwise suitable soil conditions, or of previously placed and properly compacted fill.
Site Preparation	General Clearing, Stripping & Grubbing: Any vegetation, root mat, organic laden topsoil, surface materials and debris should be stripped and grubbed from structurally loaded or fill areas and wasted off site or in areas

organic laden topsoil, surface materials and debris should be stripped and grubbed from structurally loaded or fill areas and wasted off site or in areas to be landscaped, prior to placement of structure or fill. The removal of these materials should extend at least 5 feet beyond the perimeter of the proposed structurally loaded areas. It is important to note that roughly 0 to 12 inches of surface materials in the form of topsoil were encountered at the ground surface across the site. Additionally, it is important to note that landscape gravel and asphalt paved drives/walkways were observed throughout the site, and that these materials will require removal prior to placement of structure or fill.

Additionally, as the future project site falls within a previously developed property, it is **probable** that surface and buried debris and utilities will be encountered during excavation activities. Therefore, any surface and/or buried debris, or underground utilities encountered where it has not otherwise been identified in this report, will need to be removed from beneath and within a 5 foot perimeter of structure or fill area, and wasted off site or in areas to be landscaped prior to placement of structural fills.



Softball Stadium Subgrade Recommendations: As mentioned above, due to the loose soil conditions encountered within the vicinity of Borings B-4, B-8, B-12 and B-13 within the footprint of the proposed Softball Stadium structure, it will be necessary to use near-surface ground modifications in order to support the proposed structure. In general, the modification of the near-surface soils should incorporate the reworking or densification of the loose sandy soils from a depth of 3 to 4 feet below the existing ground surface within the vicinity of these borings.

Once the general stripping, clearing and grubbing are complete, methods of ground modification of this area may include 1.) in-place densification or 2.) undercut and replacement.

Once the general stripping, clearing and grubbing are complete, and upon achieving finished grade, or prior to fill placement, the proposed fill and exposed cut areas of the remainder of the building pad subgrade area should be carefully inspected and proofrolled in order to detect locally yielding soils.

<u>General In-Place Densification Recommendations:</u> In-place soil densification can be accomplished using a large smooth-drum vibratory roller by making several passes over the area to be densified in a crossing pattern, after the site has been stripped. Densification in-place of loose "dead sands" yields varying results in the field, and is highly dependent upon obtaining a sufficiently large roller, the in-situ moisture content, and the ability to achieve confinement on at least one side, (i.e. along one strip), prior to proceeding to the next. Obtaining confinement in sand is typically an iterative process and requires that multiple passes along well established rolling lanes be performed, the initial passes made with the vibratory setting used and the finishing passes made with a static roller. Upon achieving an optimal densification in one direction it is recommended that the rolling efforts be repeated in the perpendicular direction, until no noticeable improvements in densification are observed.

In-place soil densification is recommended for soils in which below optimum moisture contents are present, and where groundwater is greater than 3 feet below the depth of densification required. Densification of the on-site soils should continue until an SPT N-value of 10, or an equivalent Dynamic Cone Penetrometer (DCP) value of 13, is achieved, with a target density of 98 percent of the laboratory Standard Proctor maximum dry density (ASTM D698). The densification techniques and activities should be verified as the work progresses. In the event that adequate confinement for densification is not achieved, we recommend that over-excavation and replacement be conducted.



<u>General Undercut and Replacement Recommendations:</u> If the undercut and replacement technique is preferred, we recommend that the area to be stabilized be undercut to a depth of roughly 3 to 4 feet below existing ground surface elevations, and that the resulting excavation base be inspected to determine if further undercut is required to provide a stable base for fill placement. If the base is stable, the excavation should be backfilled with properly compacted structural fill, in general accordance with the recommendations presented in the *Structural Fill* section of this report. We further recommend that the replacement fill utilized at the site have a Unified Soil Classifications of **SP** or **SM** or **SC** (with low plasticity indexes), due to its ability to retain structural stability when exposed to possible wet conditions. During placement, fill should be placed in general accordance with the recommendations presented in the *Structural Fill* section of this report.

Promenade Walkway Subgrade Recommendations: Once the general stripping, clearing and grubbing are complete, and upon achieving finished grade, or prior to fill placement, the proposed fill and exposed cut areas of the subgrade area should be carefully inspected and proofrolled in order to detect locally yielding soils.

Special Soil Conditions - Crest and Sideslopes of Embankment: Where grade slabs will be supported by a soil subgrade within this portion of the Promenade Walkway structure, it is recommended that a total of 5 feet of the near-surface soils along the crest and sideslopes of the embankment be modified utilizing undercut and replacement techniques. Undercutting operations in this portion of the site should be continued until reaching suitable depth, or to a maximum depth of 5 feet below ground surface, at which time we recommend that the excavation bottom be densified in-place in order to tighten any loose underlying soils or soils disturbed by the excavation process. We require densification in-place to help provide a stable base to place structural fill, which will aid in the ability and time required to achieve compaction of the replaced fill. We recommend that areas of reworked near-surface soils and any compacted fill placed along the embankment be handled in general accordance with the Structural Fill and Slope Construction Recommendations section of this report.

General Foundation Subgrades: The proper placement of fill soil will likely provide a suitable footing subgrade beneath the foundations for the proposed structures at this site. However, this does not alleviate the contractor from verifying that adequately dense bearing soils are present within the foundation subgrades, as stipulated in the recommendations provided in the *Foundation and Construction Recommendations* section of this report.



Alternate Ground Modification of Foundation Subgrades: If unstable bearing soils are encountered during footing excavation, an alternate ground modification technique that may be used to remedy the bearing soils includes the over-excavation of the bearing soils directly beneath the footprint of the foundations, and the backfilling the resulting excavation with properly compacted structural fill or washed No. 57 stone, to near original bearing elevations.

General Pre-Pour Inspections: After achieving a stabilized subgrade, and prior to the construction of the finished slabs, assuming some time will pass where the grade slab subgrade is exposed, the prepared subgrade will need to be re-inspected and proofrolled in order to detect locally yielding soils.

General Proofroll Recommendations: Proofrolling should be performed with a twenty-ton rubber-tired tandem axle vehicle or similarly loaded vehicle or construction equipment, and should be observed by a qualified geotechnical engineer. For mass graded areas and building pad areas, the designated vehicle should make at least four passes over each section of the exposed soils with the last two passes perpendicular to the first two. A final proofroll is recommended to be performed within 24 hours of construction. If inclement weather occurs or if the proofroll fails to yield favorable results within this 24-hour window, then reworking of the subgrade soils may be required to achieve a suitable subgrade.

Any localized areas of yielding, soft/loose and/or saturated soils identified during proofrolling will need to be densified in-place, undercut and the removed soil replaced with properly compacted structural fill, or be modified by the use of mechanical or chemical means. Any modification activities should be monitored and all fill should be placed in general accordance with the recommendations presented in the *Structural Fill* section of this report.

Excavation Considerations and Precautions

The excavations required at the site **may** be extensive. We therefore recommend that when conducting excavation activities at the site, special care be taken to not undermine, or disturb, in-place bearing subgrades associated with portions of adjacent roadways or structures that are supported by the near-surface soils.

Furthermore, the extensive excavations will likely require that the excavation sidewalls be properly sloped or shored. The contractor selected for this project should account for these safety precautions, and should insure that all excavations and other work activities that result from our recommendations be conducted in accordance with OSHA regulations. Additionally, it is important to note that the recommendations presented in this report and our presence during work activities should not be construed as the acceptance of the responsibility of insuring a safe work environment



Stormwater and

or the safety of other personnel. This responsibility is the contractors, solely.

Groundwater Management As stated previously, shallow groundwater was encountered in Borings B-3 through B-7 at the time of drilling at depths ranging from of approximately 11 to 27 feet below the ground surface. Therefore, it appears the groundwater is at a sufficient depth as to not inhibit grading and construction activities at the site. Additionally, from our knowledge of the area, the present soil types, and the natural topography, perched groundwater conditions are possible. Perched groundwater is defined as surface stormwater that infiltrates the near surface loose or sandy soil conditions and becomes perched, or trapped, on the deeper, more dense or less permeable layers of soils at the site. If perched groundwater is encountered, the contractor will need to be prepared to dewater any excavations or exposed subgrade soils by ditching or pumping. From our experience with similar projects and site conditions, the soil types encountered at this site will likely require several days (sands) to a week (silts and clays) to drain.

> Any exposed subgrade soils and recently placed fill soils should be well drained to minimize the accumulation of stormwater runoff. If the exposed subgrade soils are not as anticipated, or become excessively wet, the geotechnical engineer should be consulted. Additionally, the working site grades should be graded to allow for positive run-off of the underconstruction areas to help prevent destabilization of existing subgrades or recently placed fill soils. Finally, the finished site grades should be designed by a registered civil engineer, and should promote positive drainage away from finished structures, to prevent water-softening of structural soils, or possible undermining of structures.

Structural Fill

On-site Sands: As stated previously, the on-site sandy soils (SP, SC, and SM) encountered at this site appear **suitable** for reuse as structural fill due to their inherent characteristics.

On-site Silts: As stated previously, the on-site, low-plasticity silty soils (ML) are <u>marginally suitable</u> for reuse as structural fill due to their inherent characteristics.

On-site Clays: As stated previously, the on-site, low-plasticity clayey soils (CL) are <u>marginally suitable</u> for reuse as structural fill due to their inherent characteristics.

As mentioned previously, the fine-grained nature of the on-site soils (silts and clays) indicates that they are typically sensitive to variations in moisture content, with a relatively narrow range of workable moisture contents. Therefore, close control of moisture content will be necessary during



grading and fill placement operations. In addition, the soils at this site may become difficult to work during periods of wet weather. Grading operations under wet conditions may result in the deterioration of otherwise suitable soil conditions, or of previously placed and properly compacted fill.

Furthermore, these inherent soil properties (silts and clays) make these soils less desirable for use as structural fill; however, if placed properly, suitable support of structures is achievable, provided subgrade drainage is established and maintained throughout the service life of the structure. Alternate, more suitable, borrow soils should be sought in the event that the on-site soils are deemed, during grading activities by the geotechnical engineer, to be <u>unsuitable</u> for use as structural fill for the support of structures.

General Fill Recommendations: Prior to the placement of fill soils, representative soil samples should be obtained and tested to determine their classification and compaction characteristics.

Optimum fill material should be free of debris and rocks larger than 2 inch diameter, and any fibrous organic material or organic soils. We recommend that fibrous organic material found in the fill materials be no more than 5 percent by weight. Additionally, we recommend optimum fill materials to have a Plasticity Index (PI) less than 15 and a maximum dry density, determined by laboratory Proctor testing, of at least 85 pounds per cubic foot (pcf). Compaction characteristics of the fill soils should be determined using the laboratory Standard Proctor density test, ASTM D698, "Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 5.5-lb. Rammer and 12-in. Drop".

Fill material should be placed in no more than 8-inch thick lifts, loose measurement, and within +/- 2 percent of the optimum moisture content determined by ASTM D698. Fills placed beneath the area of the structures and 10 feet beyond the structures' perimeters should be compacted to a minimum **98** percent of the laboratory Standard Proctor maximum dry density (ASTM D698).

General Quality Control Recommendations: For mass grading beneath structures, compaction testing should be performed at a minimum frequency of one test per lift per 2000 square feet of fill placed. For utility trench backfill, compaction testing should be performed at a minimum frequency of one test per lift per 200 feet of fill placed within utility trenches, where these trenches are extended beneath structure. Upon completion of the mass grading and the installation of buried utilities and/or conduits, it will be necessary to re-test the compaction of the structural fill placed within all backfilled utility trenches, especially where they have been buried within a previously tested and approved grade slab area. Failure to re-inspect and



re-test these trenches beneath grade slab areas may result in varying soil support of the loaded subgrade soils.

Special Fill Placement Recommendations – Slope Fill: Where fill will be placed along existing slope embankments, we recommend that the areas to receive fill be benched into terraces and slightly over-built, in order to minimize the presence of a loose zone of poorly compacted soils near the slope face. Large terraces are recommended for the compaction activities along the slope in order to allow large earth moving and compacting equipment access to the work area, ultimately aiding in the ability and speeding the time required achieve compaction. Further to recommendations are provided in the Slope Construction Recommendations section of this report.

Special Fill Placement Recommendations – At or Near Groundwater Elevations: Where fill will be placed at or near groundwater elevations, if encountered, the static setting of the roller should be used. The use of the static setting will minimize the capillary action created from an increased pore-water pressure of the underlying saturated soils, which is most commonly created with the use of a vibratory setting of the roller. This will ultimately minimize the saturation of the fill soils and the degradation of previously placed fills.

Slope Construction Recommendations

Permanent compacted fill and exposed cut slopes, if required, should be inclined no steeper than 2H:1V, for slopes greater than a height of 4 feet. Furthermore, we recommend that fill slopes constructed along existing slopes or embankments steeper than 4H:1V have a keyway constructed along the slope base to help counteract sliding failure. The keyway width should be at least ½ of the planned slope height, and the keyway should be embedded a minimum of 2 feet into a competent soil layer.

Furthermore, we recommend that any compacted fill slopes be benched and slightly over-built, (in order to minimize the presence of a loose zone of poorly compacted soils near the slope face), and then cut back to firm, well compacted soils prior to the placement of structure or vegetative cover. Cut slopes may require some reworking of the near surface soils in order to achieve a more sound slope surface. Upon construction of a competent slope face, it is critical that the slope face be protected from erosion, through the installation of a geotextile fabric or the application of a vegetative cover.

We caution against the installation of foundation, drop inlets or storm sewer lines within an improper embedment zone of the slope face, where possible over stressing and leakage may create maintenance problems or possible isolated slope failure. In general these structures need to be installed a minimum distance of 1¹/₂ times the height of the embankment, as measured



from the crest and/or toe of the slope. Furthermore, proper embedment of foundations or buried utilities beneath slope faces should be established prior to construction, with a minimum embedment for foundation recommended to be 5 feet below the down gradient portion of the slope, while a minimum embedment for buried utilities is recommended to be 3 feet below the down gradient portion of the slope.

Soil Retainage Structures We understand that retaining wall structures **may** be necessary at the site to support lateral soils forces, and we understand that other soil retainage systems **may** be required during excavation and foundation construction activities conducted on-site.

Therefore, we have estimated the earth pressure coefficients for each support condition in a drained situation, for the <u>on-site sandy soils</u> encountered at the site. The estimated values are dependent on the soil type, and the unit weight of the soil, as determined from laboratory testing, for the type of material actually used, and should be verified upon fill selection.

Support Condition	Pressure Coefficient
	existing on-site sands
Active (Wall deflects laterally away from retained soil).	Ka = 0.36
At-rest (Wall is restrained from movement).	Ko = 0.53
Passive (Wall deflects laterally toward retained soil).	Kp = 2.77

|--|

1.) A design unit weight of 110 pounds per cubic foot, cohesion of 0 pounds per square foot, and a phi angle of 28 degrees are assumed for the existing sandy soils.

2.) It is important to note that the presented coefficients are estimated for the insitu conditions encountered at the time of drilling. Therefore, if off-site fill is placed behind the walls of the structure, then samples of the borrow material should be presented to the laboratory for analysis, and the coefficients of the borrow material should be utilized for design instead of the coefficients presented above.

The design of the retainage structures should include an allowance for positive gravity drainage of the retained soils either using permanent toe drains or weep holes.

Additionally, compaction of fills behind retainage structures should be conducted with light, hand-held compactors. Heavy equipment, such as rollers or grading equipment should not be allowed to operate within 10 feet of the retaining wall during construction in order to avoid developing additional excessive lateral earth pressures.

We caution against the installation of structures, drop inlets or storm sewer lines within a proper offset zone of the retaining wall, where possible over stressing and leakage may create maintenance problems or possible wall



failure. Proper offsets for construction behind and at the base of retaining walls should be established prior to construction. Minimum offset for the edge of structure or infrastructure should be at least 1 to $1\frac{1}{2}$ times the height of the wall, with distances measured perpendicular and away from the top of the wall, starting at the crest and toe of the wall.

Shallow Foundation and Construction Recommendations

Provided that the site is properly prepared and that the ground modifications are complete and have been verified as stipulated in the *Site Preparation* of this report, and that fill has been placed in accordance with the *Structural Fill* section of this report, the footings for the *Softball Stadium structure* and the *Promenade Walkway structure* may be proportioned for an allowable bearing pressure of **2,500** pounds per square foot (psf). The following paragraphs provide additional recommendations, assuming that the ground modifications prescribed in this report are followed.

For these planned structures at the site, we recommend that the continuous foundations have a minimum width of $1\frac{1}{2}$ feet, and that the spread foundations have a minimum width of **3** feet, to avoid localized punching failure. Additionally, we recommend that the foundations for the structures bear at a minimum depth of 12 inches below the final ground surface, in order to ensure that the bearing surfaces are below the maximum frost depth.

General Foundation Recommendations: The actual depth of embedment of the foundations should be dictated by the ability to achieve the foundation and soil forces required to adequately resist up-lift and overturning for the subject structure. Soil forces reacting with embedded shallow foundations may be used to aid in the resistance of both uplift and overturn for this structure. The weight of the soil "wedge" above the footing may be used to aid in the resistance of uplift forces. We recommend that a unit weight of 110 pcf be used to compute the resisting soil weight. This unit weight has been estimated assuming select fill will be used as backfill and that the fill will be compacted to at least 98 percent of the Standard Proctor maximum dry density. The volume of the soil wedge may be calculated by assuming that the resisting soil section extends 45 degrees vertically from the outside top edge of the foundation to the ground surface. Additionally, passive earth pressure of the soils adjacent to the foundations, as well as soil friction at the foundation base and sides, may be used to develop shear to aid in the resistance of uplift and overturn. An ultimate friction coefficient between the foundation concrete and adjacent soil can be assumed to be on the order of 0.40.

The footings should be properly benched and the bearing soils free of loose debris or ponded water. If excavated bearing soils are exposed to the environment for extended periods of time or varying weather conditions,



they may weaken. Foundation concrete should not be placed on bearing soils that have been weakened from the effects of the environment. Therefore, we recommend that the footings be concreted shortly after excavation. If the footing excavation should remain open overnight, or if rain becomes imminent, we recommend that the bearing soils be covered with a 2 to 4 inch mud-mat of 2000 psi concrete.

General Quality Control Recommendations: We strongly recommend that the footing excavations are observed and Dynamic Cone Penetrometer (DCP) values obtained by a qualified geotechnical engineer or engineering technician in order to confirm that the bearing soils are acceptable for the recommended bearing pressure. DCP testing should be conducted at a minimum frequency of 50 linear feet for continuous footings and at every pier footing, to minimum depths of twice the excavated foundation width. Unsuitable bearing soils, if encountered, will likely be required to be overexcavated and the resulting excavation to be backfilled with properly compacted fill, washed No. 57 stone or concrete. We recommend that the washed stone, if used, be wrapped with a non-woven filter fabric, where it will be submerged or partially submerged in groundwater.

Anticipated Settlement: Provided the site preparation and construction recommendations presented in this report are followed, the total estimated settlement for these structures will likely be on the order of less than 1 inch. Therefore, the differential settlement could be expected to be ½ of the total settlement for the cohessionless and cohesive soils encountered at the site for similar bearing conditions. The structural engineer of record should account for the anticipated total and differential settlements, and design and reinforce the foundations in such a manner as to accommodate any excessive differential settlements. It is important to note that these estimates do not account for any seismic induced settlements.

Deep Foundation and Construction Recommendations

As previously mentioned the proposed *athletic lighting structures* at the site are assumed to be supported by a drilled shaft (caisson) deep foundation system. The drilled shaft foundations should be designed to accommodate the structures' axial, up-lift and overturning loads and moments. From our understanding of the project and industry standards, the structures are to be designed by others at a later date. Therefore, we recommend that a copy of this report be provided to the firm at the time of awarding the design, for their use in the design process. The design parameter Table 3, included in Appendix B, gives strength parameters for use in design of the drilled shaft foundations. The bearing capacity values include safety factors, while the soil strength parameters are considered "ultimate" values and should be used with appropriate safety factors.



General Recommendations: Drilled shafts **may** require temporary protective steel casings to clean the shaft bottoms. Also, the bottom of each shaft should be evaluated by a geotechnical engineer from our firm in order to assess the bearing capacity of the drilled shafts. Because the shafts will require access, we recommend a minimum shaft diameter of 36 inches. In addition, we recommend that the drilled shafts be installed within three inches of center (eccentricity), and have a plumbness within two percent of the length of the shaft. We recommend that the shafts be drilled with a drill rig capable of a down force (crowd) of at least 37,000 pounds and a torque of at least 50,000 foot-pounds, such as a Hughes LDH, or equivalent.

Following evaluation by the geotechnical engineer, the shafts should be immediately concreted. The protective casing, if required, should be extracted as the concrete is placed. However, the casing should not be moved until a sufficient head of concrete is in place to prevent the squeezing or closing up of the shaft diameter. The concrete must be placed down the center of the shaft without contacting the side of the hole or any reinforcing steel. Though this does not necessarily require a centering chute, the contractor must be required to provide a positive means of directing the concrete down the center of the shaft to reduce side flow and segregation. Concrete slumps ranging from 5 to 7 inches are recommended for shaft construction. Concrete with slumps in this range should fill irregularities along the sides and bottom of the shaft.

The geotechnical engineer should be retained on a full-time basis to observe drilled shaft construction and should evaluate the bearing capacity and document the shaft diameter, depth, cleanliness, eccentricity and plumbness. Significant deviations from the specified or anticipated conditions should be reported to the owner's representative and the structural engineer.

Grade Slabs We understand that the slab of the structures at this site will be a soil supported cast-in-place concrete, grade-slab. We therefore recommend that slabs be jointed, reinforced and/or doweled in appropriate locations in order to allow differential and rotational movement between parts of the slab without uncontrolled cracking or sharp vertical displacements.

We further recommend that a re-compacted modulus of subgrade reaction of **140** pounds per cubic inch be used for the <u>on-site sandy soils</u> for design of slab reinforcement at this site. In addition, an underslab vapor barrier should be included where finished areas will receive floor coverings. Slab design and construction using vapor barriers should be performed using methods detailed in the ACI <u>Manual of Concrete Practice</u>.

Construction activities and exposure to the environment can cause deterioration of the prepared subgrades. Therefore, we recommend that the subgrades be observed and compaction tests performed by a qualified



geotechnical engineer or engineering technician in order to confirm suitability of the soil subgrades.

BASIS FOR RECOMMENDATIONS

The recommendations presented in this report are based on our understanding of the project information, our interpretation of the data obtained during our exploration and provided to us, as well as our experience with similar soil and project conditions. The Standard Penetration Tests (SPT) values obtained at the boring locations have been used to estimate existing soil conditions at this specific site. Regardless of the thoroughness of this exploration, it is possible that the soil conditions intermediate of the borings vary from the soil conditions encountered at the boring locations. Therefore, it will be necessary for a geotechnical engineer or qualified engineering technician to be present during grading operations in order to evaluate and document that the anticipated design conditions actually exist.

CLOSING

Once again we appreciate the opportunity to provide our services for your geotechnical consulting needs. If there are any questions concerning our recommendations or if additional information becomes available please contact us at 803.750.1510.

Sincerely, GS2 ENGINEERING & ENVIRONMENTAL CONSULTANTS, INC.

Robert C. Bruorton, P.E. Chief Geotechnical Engineer, AVP

George A. Sembos, P.E. Senior Engineer, President



APPENDIX A

Figure 1. Site Location Map Figure 2. USGS Topographic Map Figure 3. Boring Location Plan






APPENDIX B

Table 3: Drilled Shaft Design Recommendations

Soil Test Boring Log Key

Soil Test Boring Logs

TABLE 3 DRILLED SHAFT DESIGN RECOMMENDATIONS Proposed Softball Stadium at Beckham Field Columbia, South Carolina GS2 Project Number: 11-3661-G							
			Recommended	Rec	ommended Tota	al Stress Parame	eters
Boring Number	Depth (feet)	Bearing Material Description	Bearing Pressure (psf)	ø Angle (Degrees)	c Cohesion (psf)	Dry Unit Weight (pcf)	In Situ Unit Weight (pcf)
В-3	0-3	Clayey SAND	2500	28	500	120	140
	3-5	Clean SAND	3000	30	0	110	125
	5-10	Fine to Medium Silty SAND	2500	28	300	115	135
	10-25	Medium to Coarse Silty SAND	4000	30	300	115	135
	25-30	SILT	4000	0	4000	100	115
B-6	0-10	Clayey SAND	2500 - 3000	28	500	120	140
	10-15	Fine to Medium Silty SAND	3500	28	300	115	135
	15-30	Medium to Coarse Silty SAND	4000	30	300	115	135
В-9	0-8	Clayey SAND	1500 - 2500	28	500	120	140
	8-10	CLAY	2500	0	4000	110	115
	10-15	SILT	2500	0	4000	100	115
	15-30	Medium to Coarse Silty SAND	3500 - 4000	30	300	115	135
B-11	0-3	Clayey SAND	2500	28	500	120	140
	3-8	Fine to Medium Silty SAND	2500	28	300	115	135
	8-10	CLAY	3000	0	4000	110	115
	10-15	SILT	3500	0	4000	100	115
	15-30	Medium to Coarse Silty SAND	3000 - 3500	30	300	115	135
B-14	0-3	Clean SAND	2500	30	0	110	125
	3-5	CLAY	3000	0	4000	110	115
	5-8	Clayey SAND	2500	28	500	120	140
	8-10	Fine to Medium Silty SAND	4000	28	300	115	135
	10-20	Clayey SAND	3500	28	500	120	140
	20-28	Medium to Coarse Silty SAND	4000	30	300	115	135
	28-30	Clean SAND	4000	30	0	110	125
B-15	0-3	Clean SAND	2500	30	0	110	125
	3-5	Fine to Medium Silty SAND	3000	28	300	115	135
	5-15	Clayey SAND	4500	28	500	120	140
	15-20	Fine to Medium Silty SAND	4000	28	300	115	135
	20-30	Medium to Coarse Silty SAND	3500	30	300	115	135

Notes:

Recommendations assume a minimum shaft diameter of 36 inches.
The recommended bearing pressures do not consider settlement of the structures. Site and structure specific settlement analysis, based on laboratory testing, is recommended if tolerable settlements are specified in design.



COLOR SCHEME (Primary Soil Type):

PATTERN SCHEME: (Secondary Soil Type)



SURFACE MATERIALS

Generally consist of Asphalt, Graded Aggregate Base Course, Concrete or Topsoils. Topsoils typicall combine a mixture of soils and organic materials. Topsoils are typically recognized through texture and odor.



SANDY

Denotes a soil that has a percentage of sand. The portion of the soil that is sandy in nature is considered coarse-grained. When used in conjunction with the yellow color scheme, this pattern means the soil has more than 50% retained on the No. 200 sieve (i.e 0.075 mm in diameter).



SANDS

Sands are considered to be a granular soil type with no cohesive properties. Grain sizes are categorized as fine (falls between 0.075 and 0.420 mm. in diameter), medium (falls between 0.420 and 2 mm. in diameter) or coarse (falls between 2 and 4.75 mm. in diameter).



<u>SILTS</u>

Silt grain sizes typically fall between 0.002 and 0.075 mm. in diameter. The Atterberg's limits for silts typically plot below the A-Line on a Plasticity Chart. Silts are typically distinguished as having a Low Plasticity (P.I. is between 0 and 22) or as having a High Plasticity (P.I. is between 22 and 59). Silts exhibit some cohesive properties.



CLAYS

Clay grain sizes typically are smaller 0.002 mm. in diameter. The Atterberg's limits for clays typically plot on or above the A-Line on a Plasticity Chart. Clays are typically distinguished as having a Low Plasticity (P.I. is between 0 and 22) or as having a High Plasticity (P.I. is between 22 and 59). Clays exhibit strong cohesive properties.



COOPER MARL

The Cooper Marl Formation is typically olive green in color and classifies as a silty sand or sandy silt. It is composed of overconsolidated marine deposits and is highly reactive to hydrochloric acid. The Cooper Marl sometimes contains cemented layers of phosphate. This formation is native to the Low Country Area of South Caroilina.



NO RECOVERY

Denotes that there was no recovery in the split-spoon sampler barrel upon its retrieval from the borehole. No recovery may be due to very hard soil layers that are unable to be penetrated by the barrel or super-saturated soils that are unable to be retained in the barrel.



<u>SILTY</u>

Denotes a soil that has a percentage of silt. The portion of the soil that is silty in nature is considered finegrained. When used in conjunction with the gray color scheme, this pattern means the soil has more than 50% passing the No. 200 sieve (i.e 0.075 mm in diameter).



CLAYEY

Denotes a soil that has a percentage of clay. The portion of the soil that is clayey in nature is considered fine-grained. When used in conjunction with the red color scheme, this pattern means the soil has more than 50% passing the No. 200 sieve (i.e 0.075 mm in diameter).

Ľ

PARTIALLY WEATHERED ROCK

Denotes a soil that is considered Partially Weathered Rock (PWR). PWR is defined as residuum that exhibits SPT N-values in excess of 100 bpf



DEBRIS LADEN

Denotes a soil that is laden with debris. Debris may consist of anything man-made, including, but not limited to, house hold trash, construction debris (concrete, brick, metal, etc.) or may consist of natural debris, such as organics. Depending on the severity and type of the debris, these materials may require excavation and replacement.



OLD FILL

Denotes a soil that is assumed or known to be previously placed, possibly untested, old fill. As there is no known record of its placement, these soils are undocumented, and may require excavation and replacement.

Note:

The above detailed color schemes are indicative of the predominant pimary soil type observed in the indicated soil strata at the Boring locations for the subject site. Secondary soil types are detailed by the pattern scheme. Both the color and pattern scheme are detailed in the Remarks column of the SOIL TEST BORING LOG. All soil descriptions are based on visual and textural properties observed in the recovered soils. No laboratory tests were performed on the soils described in this report, unless noted within the remarks column of the logs.

Project Name: Proposed Softball Stadium at Beckham Field

Project Number: 11-3661-G

Date of Test: October 21, 2011



Boring Number: B-1

Depth		Sample	Blow	
(feet)	Soil Description COASTAL PLAIN: Firm Mottled Orange, Red and Brown Clavey Fine to Medium SAND	Interval	Counts*	Remarks
1	(SC)			
2		0 to 1-1/2'	12	
2				
3				
4	Dhese Mottled Orange, Red, Brown and Gray Clayey Fine to Medium SAND. (SC)			
		0.4/01/- 51	40	
5	Very Dense Light Gray Silty Fine to Medium SAND with rocks. (SM)	3-1/2 10 5	42	
6				
7				
		6' to 7-1/2'	50/4"	
8	Dense Mottled White and Pink Silty Fine to Medium SAND. (SM)	_		
9				
10		8-1/2' to 10'	34	
	Dense to Very Dense Light Tan Silty Medium to Coarse SAND. (SM)		-	
11				
12				
13				
10				
14				
15		13-1/2' to 15'	50/3"	WET
16				
10				
17				
18				
10				
19				
20	Paring Terminated at 20 East	18-1/2' to 20'	39	WET
21				
22				
22				
23				
24				
25		23-1/2' to 25'		
25		23-1/2 10 23		
	Deptn of Boring (it): <u>20 Feet</u>	Location of Boring:	see Boring Loca	ation Plan
Depth o	f Groundwater T.O.B. (feet): Not Encountered	Method of Drilling:	Hollow Stem Au	uger
Depth of	f Groundwater 24 hrs. (feet): Not Available	Performed By:	GS2 Drilling	

Project Name: Proposed Softball Stadium at Beckham Field

Project Number: 11-3661-G

Date of Test: October 21, 2011



Boring Number: <u>B-2</u>

Depth (feet)	Soil Description	Sample	Blow Counts*	Pemarks		
(leet)	SURFACE MATERIALS: 12 inches of TOPSOIL.	interval	Counts	itemaits		
1						
	COASTAL PLAIN: Very Loose Light Gray Clayey Fine to Medium SAND. (SC)	0 to 1-1/2'	2			
2						
3						
	Dense Mottled Red, Tan and Gray Clayey Fine to Meidum SAND. (SC)					
4						
5		3-1/2' to 5'	38			
	Very Firm Mottled Orange, Tan and White Clayey Fine to Medium SAND. (SC)					
6						
7						
		6' to 7-1/2'	22			
8	Varia Dance Mettled Ded Dink and White City Fine to Medium CAND (CM)					
9	very dense mottled Red, Pink and white Sity Fine to medium SAND. (SM)					
-						
10	Vary Dance Diskish grange City Figs to Masily 2000 with scales (CM)	8-1/2' to 10'	52	MOIST		
11	very dense Pinkish-orange Sitty Fine to Medium SAND with rocks. (SM)					
12						
13						
-	Very Firm Light Tan Silty Medium to Coarse SAND with rocks. (SM)					
14						
15		13-1/2' to 15'	67	MOIST		
10		10 1/2 10 10	0.			
16						
17						
18						
19						
15						
20		18-1/2' to 20'	24	WET		
21	Boring Terminated at 20 Feet.					
22						
23						
24						
25		23-1/2' to 25'				
	Dopth of Poring (#): 20 Foot	Looption of Damin	ooo Dominis I -	-		
	Depth of Boring (it): <u>20 Feet</u>	Location of Boring:	See Boring Loca	ation Plan		
Depth o	f Groundwater T.O.B. (feet): Not Encountered	Method of Drilling:	Hollow Stem Au	<u>iger</u>		
Depth of	Groundwater 24 hrs. (feet): Not Available	Performed By:	GS2 Drilling			
*	* The Blow Counts given above are recorded for a 140 pound hammer (falling 30 inches/blow) to drive a 2 inch O.D., 1.375 inch I.D. split-barrel sampler 12 inches,					

after an initial 6 inch seating increment.

Project Name: Proposed Softball Stadium at Beckham Field

Project Number: 11-3661-G

Date of Test: October 20, 2011



Boring Number: B-3

Denth		Sample	Blow	
(feet)	Soil Description	Interval	Counts*	Remarks
	SURFACE MATERIALS: 6 inches of TOPSOIL.			
1	COASTAL PLAIN: Firm Tan Clayey Fine to Medium SAND. (SC)	0 to 1 1/0	4.4	
2		U to 1-1/2"	11	
-				
3		4		
4	Dense Gray Fine to Medium SAND with rocks. (SP)			
-7				
5		3-1/2' to 5'	33	
e	Loose to Firm White Silty Fine to Medium SAND. (SM)			
0				
7				
0		6' to 7-1/2'	15	MOIST
ð				
9				
		0.4/01	_	
10	Very Firm Tap and White Silty Medium to Coarse SAND (SM)	8-1/2' to 10'	7	MOIST
11	vory ministran and venice only recording to Codise SAIND. (SIN)			
12				
13				
10				
14				
15		13-1/2' to 15'	25	MOIST
10	Dense to Very Dense White Silty Medium to Coarse SAND. (SM)	10 1/2 10 13	20	
16				
17				
17				
18				
4.0				
19				
20		18-1/2' to 20'	40	WET
21				
22				GW at TOB
23				
24				
25		23-1/2' to 25'	67	WET
	Depth of Boring (ft): <u>30 Feet</u>	ocation of Boring:	see Boring Loca	ation Plan
Depth o	f Groundwater T.O.B. (feet): 22 Feet	lethod of Drilling.	Hollow Stem A	laer
	· · · · · · · · · · · · · · · · · · ·			<u></u>
Depth of	Groundwater 24 hrs. (feet): Not Available	Performed By:	GS2 Drilling	
			hand and a fait	

Project Name: Proposed Softball Stadium at Beckham Field

Project Number: 11-3661-G

Date of Test: October 20, 2011



Boring Number: B-3 (cont)

Depth (feet)	Soil Description	Sample Interval	Blow Counts*	Remarks
26	continued Very Hard Mottled White and Tan SILT (ML)			
27				
21				
28				
29				
30	Boring Terminated at 30 Feet	28-1/2' to 30'	50/5"	
31				
32				
33				
34				
35		33-1/2' to 35'		
36				
37				
38				
39				
40		38-1/2' to 40'		
41				
42				
43				
44				
45		43-1/2' to 45'		
46				
47				
48				
49				
50		48-1/2' to 50'		
	Depth of Boring (ft): <u>30 Feet</u>	Location of Boring:	see Boring Loc	ation Plan
Depth o	f Groundwater T.O.B. (feet): <u>22 Feet</u>	Method of Drilling:	Hollow Stem A	uger
Depth of	f Groundwater 24 hrs. (feet): <u>Not Available</u>	Performed By:	<u>GS2 Drilling</u>	
*	The Blow Counts given above are recorded for a 140 pound hammer (falling 30 inches/blow) to drive a 2 inch after an initial 6 inch seating increment.	o O.D., 1.375 inch I.D. spli	t-barrel sampler 12 i	inches,

Project Name: Proposed Softball Stadium at Beckham Field

Project Number: 11-3661-G

Date of Test: October 21, 2011



Boring Number: <u>B-4</u>

Depth (feet)	Soil Description	Sample	Blow Counts*	Remarks	
(1001)	SURFACE MATERIALS: 12 inches of TOPSOIL.	Interval	Counts	Remains	
1	COASTAL PLAIN: Losoe Light Gray Fine to Medium SAND. (SP)	0 to 1-1/2'	8		
2					
3	Dense Mottled Orange, Tan, Red and Gray Clayey Fine to Medium SAND. (SC)				
4					
5		3-1/2' to 5'	43		
6	Dense White Clayey Fine to Medium SAND. (SC)				
7					
8		6' to 7-1/2'	36		
0	Very Firm Mottled Pink and Tan Silty Fine to Medium SAND. (SM)				
9					
10	Very Dense Yellowish-tan Silty Medium to Coarse SAND. (SM)	8-1/2' to 10'	21		
11					
12					
13					
14					
15		13-1/2' to 15'	53	MOIST	
16	Hard White Fine Sandy SILT. (ML)				
17					
10				CW at TOP	
10				Gwallob	
19					
20	Boring Terminated at 20 Feet.	18-1/2' to 20'	44	MOIST	
21					
22					
23					
24					
25		23-1/2' to 25'			
	Depth of Boring (ft): <u>20 Feet</u>	Location of Boring:	see Boring Loca	ation Plan	
Depth o	f Groundwater T.O.B. (feet): <u>18 Feet</u>	Method of Drilling:	Hollow Stem Au	lger	
Depth of	Groundwater 24 hrs. (feet): Not Available	Performed By:	<u>GS2 Drilling</u>		
*	* The Blow Counts given shove are recorded for a 140 nound hammer (falling 30 inches/blow) to drive a 2 inch O.D. 1 375 inch I.D. snitt-barral sampler 12 inches				

Project Name: Proposed Softball Stadium at Beckham Field

Project Number: 11-3661-G

Date of Test: October 21, 2011



Boring Number: <u>B-5</u>

Depth (foot)	Sail Description	Sample	Blow	Pomorko
(leel)	SURFACE MATERIALS: 12 inches of TOPSOIL.	Interval	Counts	Remarks
1	COASTAL PLAIN: Firm Grav Clavey Fine to Medium SAND (SC)	0 to 1-1/2'	13	
2		0.001.02		
3				
4	Very Dense Mottled Brown and Gray Clayey Fine to Medium SAND. (SC)			
- ·			<u></u>	
5	Firm Mottled Dark Gray, Tan and Brown Silty Fine to Medium SAND. (SM)	3-1/2 10 5	62	
6				
7		6' to 7 1/2'	15	MOIST
8		6 10 7-1/2	15	MOIST
9	Loose White Fine SAND. (SP)			
10		8-1/2' to 10'	5	MOIST
10	Dense to Very Dense Light Tan Silty Medium to Coarse SAND with rocks. (SM)	0-1/2 10 10	5	MOIST
11				GW at TOB
12				
13				
14				
15		12 1/2' to 15'	12	TRIOM
15		13-1/2 10 15	43	MOIST
16				
17				
18				
19				
20		18-1/2' to 20'	58	MOIST
	Boring Terminated at 20 Feet.			
21				
22				
23				
24				
25		23-1/2' to 25'		
	Depth of Boring (ft): <u>20 Feet</u>	Location of Boring:	see Boring Loc	ation Plan
Depth o	f Groundwater T.O.B. (feet): <u>11 feet 5 inches</u>	Method of Drilling:	Hollow Stem Au	<u>uger</u>
Depth of	Groundwater 24 hrs. (feet): Not Available	Performed By:	<u>GS2 Drilling</u>	
*	The Blow Counts given above are recorded for a 140 pound hammer (falling 30 inches/blow) to drive a 2 inc	h O.D., 1.375 inch I.D. split	-barrel sampler 12 i	nches,

40 pound hammer (falling 30 inches/blow) to after an initial 6 inch seating increment.

Project Name: Proposed Softball Stadium at Beckham Field

Project Number: 11-3661-G

Date of Test: October 20, 2011



Boring Number: <u>B-6</u>

Depth		Sample	Blow	
(feet)	Soil Description	Interval	Counts*	Remarks
1	SURFACE MATERIALS: 6 ICNNes of TOPSOIL.			
	CONSTRETERIN. Very Finn Reddish blown Glayey Fine to Medium SAND. (SC)	0 to 1-1/2'	22	
2				
0				
3	Firm Mottled Orange, Tan and Light Grav Clavey Fine to Medium SAND. (SC)			
4				
5	Lagas Linkt Crew Clauser Fina to Madium CAND (CC)	3-1/2' to 5'	16	MOIST
6	LOUSE LIGHT Gray Clayey Fine to Medium SAND. (SC)			
7				
8		6" to 7-1/2"	9	MOIST
9				
10		8-1/2' to 10'	9	MOIST
10	Dense Mottled Yellowish-tan Silty Fine SAND. (SM)	0 1/2 10 10	0	
11				
12				
12				
13				
14				
14				
15		13-1/2' to 15'	45	
16	Very Firm to Dense White Silty Medium to Coarse SAND. (SM)			
10				
17				
40				
18				
19				
		40.4/01/- 001	00	1477
20		18-1/2 to 20	28	WEI
21				GW at TOB
22				
22				
23				
24				
24				
25		23-1/2' to 25'	46	WET
	Depth of Boring (ft): <u>30 Feet</u>	Location of Boring:	see Boring Loc	ation Plan
Depth o	f Groundwater T.O.B. (feet): <u>21 Feet</u>	Method of Drilling:	Hollow Stem Au	uger
Depth of	Groundwater 24 hrs. (feet). Not Available	Performed By:	GS2 Drilling	
Dopuro		i chonned by.	COL Drinning	
*	The Blow Counts given above are recorded for a 140 pound hammer (falling 30 inches/blow) to drive a 2 inch	n O.D., 1.375 inch I.D. split	-barrel sampler 12 i	nches,

after an initial 6 inch seating increment.

Project Name: Proposed Softball Stadium at Beckham Field

Project Number: 11-3661-G





Boring Number: <u>B-6 (cont)</u>

Depth (feet)	Soil Description	Sample Interval	Blow Counts*	Remarks
26	continued			
20	Very Finn to Dense while Silly Medium to Coarse SAND. (Sill)			
27				
28				
29	-			
30	Boring Terminated at 30 Feet	28-1/2' to 30'	38	WET
31				
32				
33				
34				
35		33-1/2' to 35'		
36				
37				
38				
20				
40		38-1/2' to 40'		
41				
42	-			
43				
44				
45	-	43-1/2' to 45'		
46				
47				
48				
49				
50		48-1/2' to 50'		
	Depth of Boring (ft): <u>30 Feet</u>	Location of Boring:	see Boring Loc	ation Plan
Depth c	of Groundwater T.O.B. (feet): <u>21 Feet</u>	Method of Drilling:	Hollow Stem Au	<u>lder</u>
Depth o	f Groundwater 24 hrs. (feet): Not Available	Performed By:	GS2 Drilling	
*	The Blow Counts given above are recorded for a 140 pound hammer (falling 30 inches/blow) to drive a 2 inch C after an initial 6 inch seating increment.	0.D., 1.375 inch I.D. split	-barrel sampler 12 i	nches,

Project Name: Proposed Softball Stadium at Beckham Field

Project Number: 11-3661-G

Date of Test: October 21, 2011



Boring Number: B-7

Depth (feet)	Soil Description	Sample Interval	Blow Counts*	Remarks
	COASTAL PLAIN: Dense Dark Gray Fine to Medium SAND. (SP)			
1		0 to 1-1/2	13	
2		01011/2	-10	
2				
3	Firm Tan Fine to Medium SAND. (SP)			
4				
5		3-1/2' to 5'	12	WET
	Dense Gray Fine to Medium SAND with rocks. (SP)			
6				
7				
8		6' to 7-1/2'	45	WET
0	Very Dense Tan Fine to Medium SAND. (SP)			
9				
10		8-1/2' to 10'	54	WET
	Dense Orangish-tan Fine to Medium SAND. (SP)			
11				
12				
13				
14				
15		13-1/2' to 15'	32	WET
16	Very Stiff Tannish-white Fine Sandy SILT. (ML)			
10				
17				
18				
10				
19				
20	Versi Denne White Citte Medium to Coome CAND (CM)	18-1/2' to 20'	25	WET
21	Very Dense while Silly Medium to Coarse SAND. (Sill)			
22				
22				
23				
24				
25		00 1/01 to 051	E0/2"	WET
20	1	23-1/2 10 25	50/3	VV E 1
	Depth of Boring (ft): <u>45 Feet</u>	Location of Boring:	see Boring Loc	ation Plan
Depth c	f Groundwater T.O.B. (feet): <u>27 Feet</u>	Method of Drilling:	Hollow Stem Au	lger
Depth o	f Groundwater 24 hrs. (feet): Not Available	Performed By:	<u>GS2 Drilling</u>	

Project Name: Proposed Softball Stadium at Beckham Field

Project Number: 11-3661-G

Date of Test: October 21, 2011



Boring Number: B-7 (cont)

Depth (feet)	Soil Description	Sample Interval	Blow Counts*	Remarks
26	continued			
20				
21				GW at TOB
28				
29				
30	Vary Dance Mattled Tan and White Siley Madium to Coarse SAND (SM)	28-1/2' to 30'	66	
31				
32				
33				
34				
25		22 1/2' to 25'	50/5"	
- 35	Hard to Very Hard Tan SILT. (ML)	33-1/2 10 35	50/5	
36				
37				
38				
39				
40		38-1/2' to 40'	35	
41				
42				
43				
43				
44				
45	Auger Refusal at 45 Feet	43-1/2' to 45'	50/5"	
46				
47				
48				
49				
50		48-1/2' to 50'		
	Depth of Boring (ft): <u>45 Feet</u>	ocation of Boring:	see Boring Loc	ation Plan
Depth o	f Groundwater T.O.B. (feet): <u>27 Feet</u>	Method of Drilling:	Hollow Stem A	uger
Depth of	f Groundwater 24 hrs. (feet): Not Available	Performed By:	<u>GS2 Drilling</u>	
	The Blow Counts given above are recorded for a 140 pound hammer (falling 30 inches/blow) to drive a 2 inch 0.	D 1 375 inch I D soli	barrel sampler 12 i	inches

Project Name: Proposed Softball Stadium at Beckham Field

Project Number: 11-3661-G

Date of Test: October 26, 2011



Boring Number: <u>B-8</u>

Depth (feet)	Soil Description	Sample	Blow Counts*	Remarks		
(1001)	COASTAL PLAIN: Firm Mottled Reddish-brown and Gray Clayey Fine to Medium SAND).	oounta	Temano		
1	(SC)					
2		0 to 1-1/2'	13			
_						
3	Dense Mettled Ded, Draws and Teo Clavay, Fire to Medium CAND with realise (CC)					
4	Dense motiled Red, Brown and Tan Clayey Fine to medium SAND with rocks. (SC)					
-						
5	Firm Mottled Red and Grav Clavev Fine to Medium SAND with rocks. (SC)	3-1/2' to 5'	34			
6	· · · · · · · · · · · · · · · · · · ·					
7						
1		6' to 7-1/2'	16			
8						
9	Firm White Fine Sandy SILT. (ML)					
10	Firm Mottled Orange Tap and White Silty Medium to Coarse SAND (SM)	8-1/2' to 10'	11	MOIST		
11						
10						
12						
13						
14						
15	Dance Tannish white Silty Medium to Coarce SAND (SM)	13-1/2' to 15'	19	MOIST		
16						
17						
18						
10						
13						
20	Device Territoria dat 20 Feat	18-1/2' to 20'	36	MOIST		
21	Boring Terminated at 20 Feet					
22						
23						
24						
27						
25		23-1/2' to 25'				
	Depth of Boring (ft): 20 Feet Location of Boring: see Boring Location Plan					
Depth o	Depth of Groundwater T.O.B. (feet): Not Encountered Method of Drilling: Hollow Stem Auger					
Depth of	f Groundwater 24 hrs. (feet). Not Available	Performed Pur	GS2 Drilling			
Depth 0	i Groundwater 24 115. (1551). <u>INULAVAIIADIE</u>	renomed By:	552 Drilling			

Project Name: Proposed Softball Stadium at Beckham Field

Project Number: 11-3661-G

Date of Test: October 26, 2011



Boring Number: <u>B-9</u>

Depth (feet)	Soil Description	Sample	Blow Counts*	Remarks		
(1001)	SURFACE MATERIALS: 6 inches of TOPSOIL.	incrva	Oounta	Remains		
1	COASTAL PLAIN: Firm Orangsih-tan Clayey Fine to Medium SAND. (SC)					
		0 to 1-1/2'	19			
2						
3						
0	Loose Mottled Orange and Brown Clayey Fine to Medium SAND. (SC)					
4						
5		3-1/2' to 5'	8			
6	Very Loose Gray Clayey Fine to Medium SAND. (SC)					
0						
7						
		6' to 7-1/2'	4	WET		
8						
٥	Stiff Gray and Tan CLAY. (CL)					
5						
10		8-1/2' to 10'	11	WET		
	Very Stiff Tannish-white SILT. (ML)					
11						
12						
13						
14						
15		13-1/2' to 15'	19			
	Very Firm Tannish-white Silty Medium to Coarse SAND with rocks. (SM)					
16						
17						
18						
19						
20		18-1/2' to 20'	25			
20	Dense to Very Dense White Silty Medium to Coarse SAND with rocks. (SM)	10 1/2 10 20	25			
21						
22						
23						
20						
24						
05		00 4/01 - 05	40			
25		23-1/2 to 25	40			
	Depth of Boring (ft): <u>30 Feet</u> Location of Boring: see Boring Location Plan					
Depth o	f Groundwater T.O.B. (feet): Not Encountered	Method of Drilling.	Hollow Stem A	Jaer		
	······································					
Depth of	f Groundwater 24 hrs. (feet): Not Available	Performed By:	<u>GS2 Drilling</u>			

Project Name: Proposed Softball Stadium at Beckham Field

Project Number: 11-3661-G

Date of Test: October 26, 2011



Boring Number: B-9 (cont)

Depth (feet)	Soil Description	Sample Interval	Blow Counts*	Remarks	
26	continued				
20					
27					
28					
29					
30		28-1/2' to 30'	50/5"	WET	
31	Boring Terminated at 30 Feet				
32					
33					
34					
25		22 1/2' to 25'			
35		33-1/2 10 35			
36					
37					
38					
39					
40		38-1/2' to 40'			
41					
42					
43					
44					
45		42 1/2' to 45'			
45		43-1/2 10 45			
46					
47					
48					
49					
50		48-1/2' to 50'			
	Depth of Boring (ft): <u>30 Feet</u>	Location of Boring:	see Boring Loca	ation Plan	
Depth o	Depth of Groundwater T.O.B. (feet): Not Encountered Method of Drilling: Hollow Stem Auger				
Depth of	f Groundwater 24 hrs. (feet): <u>Not Available</u>	Performed By:	GS2 Drilling		
*	The Blow Counts given above are recorded for a 140 pound hammer (falling 30 inches/blow) to drive a 2 inch after an initial 6 inch seating increment.	O.D., 1.375 inch I.D. split	barrel sampler 12 i	nches,	

Project Name: Proposed Softball Stadium at Beckham Field

Project Number: 11-3661-G

Date of Test: October 26, 2011



Boring Number: <u>B-10</u>

Depth (feet)	Soil Description	Sample Interval	Blow Counts*	Remarks	
(COASTAL PLAIN: Firm Red Clayey Fine to Medium SAND. (SC)	interval	oodino	Tomano	
1		0 10 1 1 10	10		
2		0 to 1-1/2	13		
3	Firm Tannish-gray Fine to Medium SAND (SP)				
4	Finn Fannish-gray Fine to Medium SAND. (SF)				
-			10		
5	Very Firm Mottled Tan, White and Orange Silty Fine to Medium SAND (SM)	3-1/2' to 5'	13		
6					
7					
1		6' to 7-1/2'	27		
8					
٥	Very Firm Mottled Tan and Light Gray Clayey Fine to Medium SAND. (SC)				
3					
10		8-1/2' to 10'	22		
11	Hard Mottled 1 an and White SIL1. (ML)				
12					
13					
14					
15		13-1/2' to 15'	46		
40	Very Dense White Silty Medium to Coarse SAND. (SM)				
16					
17					
18					
10					
19					
20		18-1/2' to 20'	50/5"	MOIST	
	Boring Terminated at 20 Feet				
21					
22					
23					
24					
25		23-1/2' to 25'			
	Dooth of Poring (ft): 20 East		coo Poring Las	ation Plan	
	Depth of Boring (ft): <u>20 Feet</u> Location of Boring: <u>see Boring Location Plan</u>				
Depth o	Depth of Groundwater T.O.B. (feet): <u>Not Encountered</u> Method of Drilling: <u>Hollow Stem Auger</u>				
Depth of	f Groundwater 24 hrs. (feet): Not Available	Performed By:	GS2 Drilling		

Project Name: Proposed Softball Stadium at Beckham Field

Project Number: 11-3661-G

Date of Test: October 26, 2011



Boring Number: B-11

Denth		0	DI	
(feet)	Soil Description	Sample Interval	BIOW Counts*	Remarks
	COASTAL PLAIN: Loose Reddish-brown Clayey Fine to Medium SAND with rocks. (SC	C)		-
1				
2		0 to 1-1/2'	7	
2				
3				
	Loose Mottled Red, Orange and Brown Silty Fine to Medium SAND. (SM)			
4				
5		3-1/2' to 5'	6	
Ű	Loose Mottled Tan and Orange Silty Fine to Medium SAND. (SM)	0 1/2 10 0	Ŭ	
6				
_				
7		6' to 7 1/2'	0	MOIST
8		0 10 7-1/2	0	WOIST
	Stiff Gray CLAY. (CL)			
9				
10		9 1/2' to 10'	10	
10	Hard White SILT (ML)	8-1/2 10 10	12	
11				
12				
13				
15				
14				
15	Eirm White Silty Medium to Coorce SAND (SM)	13-1/2' to 15'	38	
16	Finn white Sity Medium to Coarse SAND. (SW)			
17				
40				
18				
19				
20	Vory Firm to Dance Tennish white Silty Madium to Convers SAND, (CM)	18-1/2' to 20'	14	MOIST
21	very Firm to Dense Fannish-white Sity Medium to Coarse SAND. (SM)			
	1			
22				
00				
23				
24				
25		23-1/2' to 25'	27	
Depth of Boring (ft): <u>30 Feet</u> Location of Boring: see Boring Location Plan				
Depth o	n Groundwater 1.U.B. (Teet): Not Encountered	wethoa of Drilling:	HONOW Stem A	uger
Depth of	f Groundwater 24 hrs. (feet): Not Available	Performed By:	GS2 Drilling	

Project Name: Proposed Softball Stadium at Beckham Field

Project Number: 11-3661-G





Boring Number: B-11 (cont)

Depth (feet)	Soil Description	Sample Interval	Blow Counts*	Remarks
26	continued Very Firm to Dense Tannish-white Silty Medium to Coarse SAND. (SM)			
27				
20				
28				
29				
30	Boring Terminated at 30 Feet	28-1/2' to 30'	37	
31				
32				
33				
34				
35		33-1/2' to 35'		
36				
37				
38				
39				
40	-	38-1/2' to 40'		
41				
42				
43				
44				
45		43-1/2' to 45'		
46				
47				
48				
49				
50		48-1/2' to 50'		
	Depth of Boring (ft): <u>30 Feet</u>	Location of Boring:	see Boring Loc	ation Plan
Depth o	of Groundwater T.O.B. (feet): Not Encountered	Method of Drilling:	Hollow Stem Au	uger_
Depth of	f Groundwater 24 hrs. (feet): <u>Not Available</u>	Performed By:	<u>GS2 Drilling</u>	
*	The Blow Counts given above are recorded for a 140 pound hammer (falling 30 inches/blow) to drive a 2 inch after an initial 6 inch seating increment.	O.D., 1.375 inch I.D. split	-barrel sampler 12 i	nches,

Project Name: Proposed Softball Stadium at Beckham Field

Project Number: 11-3661-G

Date of Test: October 20, 2011



Boring Number: B-12

Depth	Sail Description	Sample	Blow	Domorko
(ieel)	SURFACE MATERIALS: 6 inches of TOPSOII	mervar	Courits	nemarks
1	COASTAL PLAIN: Loose Grav Fine to Mediuim SAND. (SP)			
		0 to 1-1/2'	6	
2				
2				
3	Loose Mottled Orange and Tan Clavey Fine to Medium SAND (SC)			
4	Loose Motiled Orange and Fan Glayey Fine to Medium SAND. (30)			
5		3-1/2' to 5'	7	WET
0	Very Firm Mottled Orange, Tan and Gray Clayey Fine to Medium SAND. (SC)			
6				
7				
		6' to 7-1/2'	25	
8				
	Dense Tan Clayey Fine to Medium SAND. (SC)			
9				
10		8-1/2' to 10'	34	
	Dense Light Gray Clayey Fine to Medium SAND. (SC)			
11				
10				
12				
13				
14				
15		12 1/2' to 15'	40	MOIST
15	Very Drese White Sitty Medium to Coarse SAND (SM)	13-1/2 to 15	43	MOIST
16				
17				
10				
18				
19				
20		18-1/2' to 20'	75	MOIST
21	Boring Terminated at 20 Feet			
21				
22				
23				
24				
25		23-1/2' to 25'		
	Depth of Boring (ft): 20 Feet	Location of Boring:	see Boring Loc	ation Plan
		Downey.	200 Boning 200	
Depth o	f Groundwater T.O.B. (feet): Not Encountered	Method of Drilling:	Hollow Stem Au	lger
Depth of	f Groundwater 24 hrs. (feet): Not Available	Performed By:	GS2 Drilling	
		-	-	

Project Name: Proposed Softball Stadium at Beckham Field

Project Number: 11-3661-G

Date of Test: October 20, 2011



Boring Number: B-13

Depth (feet)	Soil Description	Sample	Blow Counts*	Pemarks		
(ieel)	SURFACE MATERIALS: 6 inches of TOPSOIL	iiileivai	Courits	incilidites		
1	COASTAL PLAIN: Loose Orangibs-red Clavey Fine to Medium SAND (SC)					
	CONCINETENTS. 20030 Orangina rea Orayey Fine to Medium ONNE. (CO)	0 to 1-1/2'	6			
2		0.00	Ū			
3						
	Firm to Very Firm Mottled Orange and Tan Clayey Fine to Medium SAND. (SC)					
4						
5		2 1/2' to 5'	11			
5		3-1/2 10 5	11			
6						
7						
		6' to 7-1/2'	18			
8						
0						
9						
10		8-1/2' to 10'	25			
	Dense Mottled Orange, Tan and Light Gray Clayey Fine to Medium SAND. (SC)					
11						
12						
13						
15						
14						
15		13-1/2' to 15'	50			
	Very Firm White Silty Medium to Coarse SAND. (SM)					
16						
17						
17						
18						
19						
20	Device Terreiroted at 20 Feet	18-1/2' to 20'	29			
21	Boring Terminated at 20 Feet.					
21						
22						
23						
24						
25		23-1/2' to 25'				
	Depth of Boring (ft): 20 Feet Location of Boring: see Boring Location Plan					
Depth o	Depth of Groundwater T.O.B. (feet): Not Encountered Method of Drillina: Hollow Stem Auger					
	· · ·					
Depth of	t Groundwater 24 hrs. (feet): Not Available	Performed By:	GS2 Drilling			

Project Name: Proposed Softball Stadium at Beckham Field

Project Number: 11-3661-G

Date of Test: October 26, 2011



Boring Number: <u>B-14</u>

Depth		Sample	Blow		
(feet)	Soil Description	Interval	Counts*	Remarks	
	SURFACE MATERIALS: 6 inches of TOPSOIL.				
1	COASTAL PLAIN: Firm Tan Fine to Medium SAND. (SP)				
2		0 to 1-1/2'	12		
2					
3					
	Very Stiff Mottled Tan and Red CLAY. (CL)				
4					
5		3-1/2' to 5'	24		
	Firm Orangish-tan Clayey Fine to Medium SAND. (SC)				
6					
7		6' to 7-1/2'	18	MOIST	
8		0 10 7-1/2	10	MOIST	
	Dense Mottled Tan and Orangish-red Silty Fine to Medium SAND. (SM)				
9					
10		8-1/2' to 10'	50		
10	Dense Mottled Tan, Red and White Clayey Fine to Medium SAND. (SC)	0 1/2 10 10	50		
11					
12					
13					
14					
15		12 1/2' to 15'	20		
15		13-1/2 10 15	30		
16					
17					
18					
19					
20		18 1/2' to 20'	27		
20	Dense Mottled Tan and White Silty Medium to Coarse SAND (SM)	10-1/2 10 20	57		
21					
22					
23					
24					
25		22 1/2' to 25'	40	MOIST	
20		20 1/2 10 20	עד		
	Depth of Boring (ft): <u>30 Feet</u>	Location of Boring:	see Boring Loc	ation Plan	
Depth o	f Groundwater T.O.B. (feet): Not Encountered	Method of Drilling:	Hollow Stem Au	uger	
Donth of	Croundwater 24 brs. (feet): Not Available	Performed By	GS2 Drilling		
	Groundwater 24 115. (1661). <u>NULAVAIIADIE</u>	Fenomed By:			
*	* The Blow Counts given above are recorded for a 140 pound hammer (falling 30 inches/blow) to drive a 2 inch O.D., 1.375 inch I.D. split-barrel sampler 12 inches,				

after an initial 6 inch seating increment.

Project Name: Proposed Softball Stadium at Beckham Field

Project Number: 11-3661-G





Boring Number: B-14 (cont)

Depth (feet)	Sail Description	Sample	Blow Counte*	Pomorko
(leet)	continued	Interval	Counts	Remarks
26	Dense Mottled Tan and White Silty Medium to Coarse SAND. (SM)			
27				
28				
	Dense Tan Fine to Medium SAND. (SP)			
29				
30	Boring Terminated at 30 Feet.	28-1/2' to 30'	35	MOIST
31				
32				
33				
34				
35		33-1/2' to 35'		
36				
37				
38				
39				
40		38-1/2' to 40'		
41				
42				
43				
44				
45		43-1/2' to 45'		
46				
47				
48				
10				
49				
50		48-1/2' to 50'		
	Depth of Boring (ft): <u>30 Feet</u>	Location of Boring:	see Boring Loc	ation Plan
Depth o	f Groundwater T.O.B. (feet): Not Encountered	Method of Drilling:	Hollow Stem Au	uger
Depth of	f Groundwater 24 hrs. (feet): <u>Not Available</u>	Performed By:	<u>GS2 Drilling</u>	
*	The Blow Counts given above are recorded for a 140 pound hammer (falling 30 inches/blow) to drive a 2 inch after an initial 6 inch seating increment.	O.D., 1.375 inch I.D. split	-barrel sampler 12 i	nches,

Project Name: Proposed Softball Stadium at Beckham Field

Project Number: 11-3661-G

Date of Test: October 26, 2011



Boring Number: B-15

Dooth		Sampla	Play			
(feet)	Soil Description	Interval	Counts*	Remarks		
	SURFACE MATERIALS: 6 inches of TOPSOIL.					
1	COASTAL PLAIN: Loose Grayish-brown Fine to Medium SAND. (SP)					
		0 to 1-1/2'	8			
2						
3						
-	Firm Mottled Orange and Tan Silty Fine to Medium SAND. (SM)					
4						
_						
5	Vary Dance Orange Clavey Fine to Madium SAND (SC)	3-1/2' to 5'	19			
6	Very Dense Orange Clayey Fine to Medium SAND. (SC)					
7						
		6' to 7-1/2'	73			
8						
0	Dense Mottled Orange, Red and White Clayey Fine to Medium SAND. (SC)					
9						
10		8-1/2' to 10'	46			
11						
40						
12						
13						
14						
15	Dense Tex Office First (s. Martinez, OAND, 70M)	13-1/2' to 15'	46			
16	Dense Tan Slity Fine to Medium SAND. (SM)					
10						
17						
18						
10						
19						
20		18-1/2' to 20'	32			
	Very Firm White Silty Medium to Coarse SAND. (SM)					
21						
22						
22						
23						
24						
25		00 4/01 +- 05	20	MOINT		
25		23-1/2 to 25	30	MUIST		
	Depth of Boring (ft): <u>30 Feet</u> Location of Boring: see Boring Location Plan					
Denth o	Donth of Groundwater T.O.P. (feat): Not Economicated Mathed of Drilling: Hollow Ctom Auger					
Deptil 0	Depth of Groundwater 1.U.B. (reet): Not Encountered Method of Drilling: Hollow Stem Auger					
Depth of	f Groundwater 24 hrs. (feet): <u>Not Available</u>	Performed By:	GS2 Drilling			

Project Name: Proposed Softball Stadium at Beckham Field

Project Number: 11-3661-G

Date of Test: October 26, 2011



Boring Number: B-15 (cont)

Depth (feet)	Soil Description	Sample Interval	Blow Counts*	Remarks
26	continued			
20				
27				
28				
29	-			
30	Boring Terminated at 30 Feet	28-1/2' to 30'	27	MOIST
31				
32	-			
33				
34				
35		33-1/2' to 35'		
36				
37				
38				
30				
40		20.4/2145.401		
40		36-1/2 10 40		
41				
42				
43				
44	-			
45		43-1/2' to 45'		
46				
47				
48				
49				
50		48-1/2' to 50'		
	Depth of Boring (ft): <u>30 Feet</u>	Location of Boring:	see Boring Loc	ation Plan
Depth c	of Groundwater T.O.B. (feet): Not Encountered	Method of Drilling:	Hollow Stem Au	uger
Depth o	f Groundwater 24 hrs. (feet): <u>Not Available</u>	Performed By:	<u>GS2 Drilling</u>	
*	The Blow Counts given above are recorded for a 140 pound hammer (falling 30 inches/blow) to drive a 2 inch after an initial 6 inch seating increment.	O.D., 1.375 inch I.D. split	barrel sampler 12 i	nches,

SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Project information.
 - 2. Bid Document Distribution
 - 3. Work covered by Contract Documents.
 - 4. Phased construction.
 - 5. Work by Owner.
 - 6. Work under separate contracts.
 - 7. Owner-furnished products.
 - 8. Access to site.
 - 9. Coordination with occupants.
 - 10. Work restrictions.
 - 11. Specification and drawing conventions.
 - 12. Owner Approval of Subcontractors Personnel
 - 13. Material Storage, Delivery and Handling
 - 14. Existing Conditions
 - 15. Quality of Work
 - 16. Contractor Supervision
 - 17. Job Sign
 - 18. Inspections, Testing and Special Inspections
 - 19. Permits & Licenses
- B. Related Requirements:
 - 1. Section 015000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.3 PROJECT INFORMATION

- A. Project Identification: University of South Carolina, Softball Stadium Construction, State Project No. H27-6088-MJ
 - 1. Project Location: 200 S. Marion Street, Columbia, SC 29205

- B. Owner: University of South Carolina
 - 1. Owner's Representative: Ann Derrick
- C. Architect: Quackenbush Architects + Planners

1.4 BID DOCUMENT DISTRIBUTION

- A. The documents (in "pdf" format) will be posted on USC Web site: <u>http://purchasing.sc.edu</u> under Facilities / Construction Solicitations & Awards. All addenda will also be posted on this website. Digital copies of documents on websites other than this are not legitimate and not authorized. Bidders using alternate websites to access drawings accept full responsibility for any differences. Hardcopies of the documents will not be distributed. All Bidders are advised that review of partial sets of documents is not recommended and bidders will be responsible for any discrepancies which might have been avoided had a full set of documents been reviewed.
- B. Five complete printed sets of documents will be provided to the successful bidder.

1.5 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work of Project is defined by the Contract Documents and consists of the following:
 - 1. The project consists of approximately 1300-seat stadium. The construction includes concrete footings, concrete structure, steel structure, metal building structure, masonry, aluminum storefront, aluminum composite panels, roofing, associated plumbing, electrical, fire protection, & HVAC work, and associated interior finishes, casework & stadium specialty items. Field lighting, fencing & minor site development work are included (field is exisitng).
- B. Type of Contract:
 - 1. Project will be constructed under a single prime contract.

1.6 PHASED CONSTRUCTION

- A. The Work shall be conducted in two phases, with each phase substantially complete as indicated:
 - 1. **Phase 1 Main Stadium & Associated Facilities.** Work of this phase shall commence within 1 week after the Notice to Proceed and be substantially complete and ready for **occupancy by February 8, 2013.** The work includes the entire stadium structure and dugouts, seating, elevator, egress stairs, toilet rooms, bridge, elevated press box, field lighting, all associated fire protection, mechanical, electrical, lighting, plumbing and site work. All work in the contract documents is included in this phase with the exception of the work outlined below.
 - 2. <u>Phase 2 Batting Cage Structure (and all components inside) & Home Side Interior</u> <u>Finishes.</u> The Home side bullpen shall be complete and accessible in Phase 1. The

remaining Work shall be substantially complete and ready for occupancy at time of Substantial Completion for the Work.

1.7 WORK BY OWNER

- A. General: Cooperate fully with Owner so work may be carried out smoothly, without interfering with or delaying work under this Contract or work by Owner. Coordinate the Work of this Contract with work performed by Owner or Contractor's hired by Owner.
 - 1. Telecommunications: for installation of communication wiring and jacks. This contract shall include the boxes, conduit and cover plates as indicated in E series.
 - 2. Security: for installation of interior and exterior cameras and associated wiring. This contract shall include the boxes, conduit and cover plates as indicated in E series.
 - 3. Flooring: for installation of carpet and rubber flooring and associated rubber base and transition strips. This Contract shall include preparing for flooring (cleaning and removing all debris) and coordinating installation of hardware thresholds.
 - 4. Batting Cage Flooring: for installation of synthetic batting cage flooring and associated components. This Contract shall include preparing the concrete slab (cleaning and removing all debris), installing the floor boxes as indicated in E series and coordinating installation of hardware thresholds.

1.8 WORK UNDER SEPARATE CONTRACTS

- A. General: Cooperate fully with separate contractors so work on those contracts may be carried out smoothly, without interfering with or delaying work under this Contract or other contracts. Coordinate the Work of this Contract with work performed under separate contracts.
- B. Concurrent Work: Owner will award and will assign to Contractor separate contract(s) for the following construction operations at Project site. Those operations will be conducted simultaneously with work under this Contract.
 - 1. Adjacent hardscape and landscaping.
 - 2. Promenade Extension, associated bridge, landscaping and hardscaping.
 - 3. Site utilities.

1.9 OWNER-FURNISHED PRODUCTS

A. Owner will furnish products indicated. The Work includes receiving, unloading, handling, storing, protecting, and installing Owner-furnished products.

1.10 ACCESS TO SITE

A. General: Contractor shall have full use of Project site for construction operations during construction period. Contractor's use of Project site is limited only by Owner's right to perform work or to retain other contractors on portions of Project.

- B. General: Contractor shall have limited use of areas adjacent to the site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.
- C. Use of Site: Limit use of Project site to work in areas indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
 - 1. Limits: Confine construction operations to within the construction fencing indicated.
 - 2. Any damage to the existing softball field shall be repaired to match the existing conditions.
 - 3. Work outside of the outfield fencing shall be limited in duration and access coordinated with Owner. Additional fencing around work outside of construction fencing will be required for safety and security. Fencing may be removed after work in the area is complete.
 - 4. Driveways, Walkways and Entrances: Keep driveways, loading areas, and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.
 - a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
 - b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
- D. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weathertight condition throughout construction period. Repair damage caused by construction operations.
- E. Adjacent Track, Soccer fields, and Tennis facility will be in use during construction. Minimize all work outside the construction and field fencing that would disrupt use of the facilities. Coordinate timing with Owner prior to beginning work outside of the construction fencing.
- F. The contractor is not permitted to use the access road that extends to the parking garage on Heyward Street (on the west side of the main site). Access to the site shall be through the adjacent Roost Dorm Parking lot. Parking lot shall be maintained clean and free from all obstructions. Damage to the existing parking lot by the Contractor shall be repaired to match existing.
- G. Parking: The Roost Dorm parking lot may be used for construction parking and access to the site. Only the lower portion of the parking lot (bay closest to the site) is permitted to be used for parking during the summer only. Two weeks prior August 1, 2012, the parking lot shall be cleaned and all construction damage repaired. After August 1, 2012, parking is not permitted in the lot. Contractor will be permitted to park limited vehicles on the construction site (only contractors and sub-contractors with substantial tools and materials on their trucks). All other parking shall be provided by the Contractor. The Owner will make available the adjacent Round House Parking Lot after August 1, 2012. The Contractor is not permitted to park on Marion Street the full duration of the project.

1.11 COORDINATION WITH OCCUPANTS

- A. Full Owner Occupancy: Owner will occupy site and existing adjacent building(s) and fields during entire construction period. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's day-to-day operations. Maintain existing exits unless otherwise indicated.
 - 1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and approval of authorities having jurisdiction.
 - 2. Notify Owner not less than 72 hours in advance of activities that will affect Owner's operations.
- B. Owner Limited Occupancy of Completed Areas of Construction: Owner reserves the right to occupy and to place and install equipment in completed portions of the Work, prior to Substantial Completion of the Work, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and limited occupancy shall not constitute acceptance of the total Work.
 - 1. Architect will prepare a Certificate of Substantial Completion for each specific portion of the Work to be occupied prior to Owner acceptance of the completed Work.
 - 2. Obtain a Certificate of Occupancy from authorities having jurisdiction before limited Owner occupancy.
 - 3. Before limited Owner occupancy, mechanical and electrical systems shall be fully operational, and required tests and inspections shall be successfully completed. On occupancy, Owner will operate and maintain mechanical and electrical systems serving occupied portions of Work.
 - 4. On occupancy, Owner will assume responsibility for maintenance and custodial service for occupied portions of Work.

1.12 WORK RESTRICTIONS

- A. Work Restrictions, General: Comply with restrictions on construction operations.
 - 1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.
- B. On-Site Work Hours: Limit work in the existing building to normal business working hours of 7 a.m. to 7 p.m., Monday through Friday, unless otherwise indicated.
 - 1. Weekend Hours: No restrictions other than those listed below.
 - 2. Hours for Core Drilling and other noisy activities: 8am-6pm.
- C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after providing temporary utility services according to requirements indicated:

- 1. Notify Architect and Owner not less than two days in advance of proposed utility interruptions.
- 2. Obtain Owner's written permission before proceeding with utility interruptions.
- D. Noise, Vibration, and Odors: Coordinate operations that may result in high levels of noise and vibration, odors, or other disruption to Owner occupancy with Owner.
 - 1. Notify Architect and Owner not less than two days in advance of proposed disruptive operations.
 - 2. Obtain Owner's written permission before proceeding with disruptive operations.
- E. Nonsmoking Building: Smoking is not permitted within the building or within 25 feet (8 m) of entrances, operable windows, or outdoor-air intakes.
- F. Controlled Substances: Use of tobacco products and other controlled substances within the existing building and on Project site is not permitted.
- G. Days for reduced work or limited access:
 - 1. During move-in weekend to the existing Roost Dorm there will be limited access to the site through the parking lot.

1.13 SPECIFICATION AND DRAWING CONVENTIONS

- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
 - 1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
 - 2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.
- C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:
 - 1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
 - 2. Abbreviations: Materials and products are identified by abbreviations published as part of the U.S. National CAD Standard and scheduled on Drawings.

1.14 OWNER APPROVAL OF SUBCONTRACTORS AND PERSONNEL

A. The Contractor shall not employ any subcontractor, superintendent or workmen whose employment on the project is objectionable to the Owner or Architect/Engineer.

1.15 MATERIAL DELIVERY, STORAGE AND HANDLING

- A. The Contractor supplying and delivering equipment or materials must provide personnel and equipment to unload these materials at the time they arrive on site, or make provisions for receiving and unloading the shipment for Contractor inventory purposes.
- B. All materials shall be shipped and stored and handled in a manner that will afford protection and insure their being in first-class condition at the time they are incorporated in the work. After installation, they shall be properly protected against damage insure their being in first-class condition when the construction as a whole is completed and accepted by the Owner.

1.16 EXISTING CONDITIONS

A. The Contractor, subcontractors and material suppliers shall be responsible for inspecting all job conditions affecting the installation of an item and taking all field measurements required prior to fabrication of an item to insure that the item concerned will integrate properly with all adjacent materials and fit all other conditions as they exist or will exist in the finished construction. Work in connection with installation of an item shall be coordinated with all other affected work and trades. Sleeves, anchors, and other items that must be embodied in or that otherwise affect other portions of the work will be located and set while such portions of the work are in progress.

1.17 QUALITY OF WORK

- A. All items shall be installed in a workmanlike manner in accordance with the best recognized practice in the field concerned. Manufactured items shall be installed in strict accordance with manufacturer's printed directions, specifications and/or recommendations for installation of highest quality. All working parts shall be properly adjusted after installation and left in perfect working order. Unless otherwise indicated, items exposed to weather or subject to flooding or wetting shall be installed so as to shed and not hold water. Items shall in all cases be installed plumb and true and/or in proper relation to surrounding materials.
- B. All materials entering into the construction of the building covered by this Contract including but not limited to those mentioned below, shall be securely anchored and/or tied together in accordance with the best recognized practice in the field concerned whether shown, specified or not. Ties and anchors shall be best quality for the purpose. All veneers, finishes, and applied items shall be securely anchored and tied to the backing material. The purpose of this paragraph is that each and every piece of otherwise secured in place in a permanent manner that will permit expansion, contraction and other minor movements and normal use of the structure without structural features of the building becoming impaired and without any of its parts becoming loose.

- C. Unless otherwise specifically mentioned, all anchors, bolts, screws, fittings, fillers, hardware, accessories, trim and other parts required for or in connection with an item of material to make a complete, serviceable, finished and first quality installation shall be furnished and installed as part of the item whether or not called for by the Specifications.
- D. Should the Contractor's work require sealant to compete the 'finished product' appearance of any item he is installing, at the direction of the Architect, that Contractor shall furnish and install that sealant whether or not called for on plans or in specifications.
- E. Unless otherwise specifically specified, all items and parts thereof that are made of steel, iron or other ferrous metal that are not galvanized, plated, or otherwise specified to be factory finished, shall be cleaned and painted with one shop coat of the best quality rust inhibitive metallic primer. After installation, all exposed metal connections and abrasions shall be touched up with the same materials as the shop coat and left in good condition for final finishing.

1.18 CONTRACTOR SUPERVISION

- A. The Contractor shall have on-site for the duration of his work a competent representative, capable of the following:
 - 1. Supervision of tradesmen.
 - 2. Reading and interpreting the Contract Documents.
 - 3. Orderly coordination of this work with the Architect in the daily execution of the work.
 - 4. Laying out his work.
 - 5. Representing the Contractor with the Owner and Architect in the daily execution of the work.
 - 6. Controlling and establishing good quality in the completed work.
 - 7. Communicating with all the workers in the Contractor's Employment.
- B. The Contractor's representative shall be the sole supervisor of the Contractor's Labor Force. He shall attend the regularly scheduled progress meetings on-site, keep himself and his company informed of scheduled requirements, safety hazards, and general job conditions. He shall plan and pursue the work under his supervision and expeditious manner.

1.19 JOB SIGN

- A. See attached job sign sketch at the end of this section. Location of Job Sign shall be approved by Architect and Owner.
- B. Architect will provide digital copy of sign to sign provider.
- C. Sign shall be 8 feet by 4 feet constructed of painted exterior grade plywood supports and sign substrate of aluminum faced signboard or other approved substrate.
- D. Ink shall be solvent based ink system, UV compatible ink.
- E. Printing shall either be directly to approved substrate or to vinyl that will be adhered to signboard.
F. Sign shall remain in good condition during construction period. If sign shows extreme fading, rotting, or deterioration, contractor shall replace sign.

1.20 INSPECTIONS, TESTING AND SPECIAL INSPECTIONS

- A. The Owner will hire inspectors, testing companies and special inspections. See 014150 for additional information and Contractor's responsibilities.
- B. Office of State Engineer Inspections:
 - 1. Above Ceiling Inspection: Before construction is concealed by ceilings, the Architect shall notify OSE that all fire protection and fire stopping is complete and ready for inspection. After the Architect have reviewed items and confirmed they are complete, OSE will be called for a joint inspection with Architect, and Owner.
 - 2. Substantial Completion Inspections: See 017700 "Closeout Procedures" for requirements.

1.21 PERMITS & LICENSES

- A. The Office of State Engineer will issue the Building Permit.
- B. The Contractor shall secure all temporary permits required for the project.
- C. All contractors and sub-contractors shall be required to obtain City of Columbia business licenses (at no cost to the Owner). The contractor should contact the Business License Office directly (803.545.3345) to find out the Business License fees (they are based upon the dollar amount of work performed by the contractor in the city per calendar year vary from contractor to contractor.)
- D. NPDES Permit for Construction Activity
 - 1. The Contractor is responsible for filing a "Notice of Intent" with the South Carolina Department of Health and Environmental Control (SCDHEC) for a National Pollutant Discharge Elimination System (NPDES) Permit under 40 CFR Part 122.
 - 2. Permit application must be filed forty eight hours (48) prior to commencing construction activity.
 - 3. The Contractor shall utilize Best Management Practices (BMP) to control sediment runoff from construction areas.
 - 4. The Contractor shall sign the Contractor's Certification form included in Contracting Requirements of the specifications as a co-permittee for the NPDES permit for the project.
 - 5. General Contractor and all sub-contractors shall sign the co-permittee.

University of South Carolina Softball Stadium Construction BID SET

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

University of South Carolina Softball Stadium Construction BID SET Architect's Project No. 11.122.00 State Project No. H27-6088-MJ 03/16/12

Sign size: 4' x 8'

Colors: Background: White Top Panel with project name: Tan with Black Letters Image: Colored Q+ Panel below image: Red with white letters Bottom stripe: Tan All other text and/or letters at bottom and right: Black, except for the label "General Contractor" Label "General Contractor": Red

Contact Quackenbush Architects + Planners for digital copy of sign prior to fabricating.



SECTION 012100 - ALLOWANCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements governing allowances.
 - 1. Certain items are specified in the Contract Documents by allowances. Allowances have been established in lieu of additional requirements and to defer selection of actual materials and equipment to a later date when direction will be provided to Contractor. If necessary, additional requirements will be issued by Change Order.
- B. Types of allowances include the following:
 - 1. Lump-sum allowances.

1.3 SELECTION AND PURCHASE

- A. At the earliest practical date after award of the Contract, advise Architect of the date when final selection and purchase of each product or system described by an allowance must be completed to avoid delaying the Work.
- B. At Architect's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.
- C. Purchase products and systems selected by Architect from the designated supplier.

1.4 ACTION SUBMITTALS

A. Submit proposals for purchase of products or systems included in allowances, in the form specified for Change Orders.

1.5 INFORMATIONAL SUBMITTALS

A. Submit invoices or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance.

- B. Submit time sheets and other documentation to show labor time and cost for installation of allowance items that include installation as part of the allowance.
- C. Coordinate and process submittals for allowance items in same manner as for other portions of the Work.

1.6 COORDINATION

A. Coordinate allowance items with other portions of the Work. Furnish templates as required to coordinate installation.

1.7 LUMP-SUM ALLOWANCES

- A. Unless otherwise indicated, Contractor's costs for receiving and handling at Project site, labor, installation, overhead and profit, and similar costs related to products and materials ordered by Owner and selected by Architect under allowance shall be included as part of the Contract Sum and not part of the allowance.
- B. Unused Materials: Return unused materials purchased under an allowance to manufacturer or supplier for credit to Owner, after installation has been completed and accepted.
 - 1. If requested by Architect, retain and prepare unused material for storage by Owner. Deliver unused material to Owner's storage space as directed.

1.8 ADJUSTMENT OF ALLOWANCES

- A. Allowance Adjustment: To adjust allowance amounts, prepare a Change Order proposal based on the difference between purchase amount and the allowance, multiplied by final measurement of work-in-place where applicable. If applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, and similar margins.
 - 1. Include installation costs in purchase amount only where indicated as part of the allowance.
 - 2. If requested, prepare explanation and documentation to substantiate distribution of overhead costs and other margins claimed.
 - 3. Owner reserves the right to establish the quantity of work-in-place by independent quantity survey, measure, or count.
- B. Submit claims for increased costs because of a change in scope or nature of the allowance described in the Contract Documents, whether for the purchase order amount or Contractor's handling, labor, installation, overhead, and profit.
 - 1. Do not include Contractor's or subcontractor's indirect expense in the Change Order cost amount unless it is clearly shown that the nature or extent of work has changed from what could have been foreseen from information in the Contract Documents.
 - 2. No change to Contractor's indirect expense is permitted for selection of higher- or lowerpriced materials or systems of the same scope and nature as originally indicated.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine products covered by an allowance promptly on delivery for damage or defects. Return damaged or defective products to manufacturer for replacement.

3.2 PREPARATION

A. Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related work.

3.3 SCHEDULE OF ALLOWANCES

- A. Allowance No. 1: Lump-Sum Allowance: Include the sum of \$8,000 for panel signage.
 - 1. This allowance includes material cost, shipping and installation only. Contractor's overhead and profit, receiving and handling are not included.

SECTION 012300 - ALTERNATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for alternates.

1.3 DEFINITIONS

- A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount if Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.
 - 1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
 - 2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.

1.4 PROCEDURES

- A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.
 - 1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.
- B. Notification: Immediately following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated revisions to alternates.
- C. Execute accepted alternates under the same conditions as other work of the Contract.

University of South Carolina Softball Stadium Construction BID SET

D. Schedule: A schedule of alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

- A. Alternate No. 1 Seating
 - 1. Base Bid: Bench seating with backs for four (4) sections of seating as indicated on Sheet A1.2A and A5.8 and as specified in Section 12 63 00 Stadium Seats". All remaining sections of seating shall be individual seats as shown on A1.2, A5 series and as specified in Section 12 63 00 "Stadium Seats."
 - 2. Alternate: Individual seats for four (4) sections of seating as indicated on Sheet A1.2B and A5 series and as specified in Section 12 63 00 "Stadium Seats".
- B. Alternate No. 2 Ticket Building & Plaza
 - 1. Base Bid: Provide Bridge and associated end column, beam and foundation as shown. Provide temporary guard rail at end of bridge.
 - 2. Alternate: Provide and install the elevated plaza and associated Ticket Building in their entirety as indicated on the drawings. See electrical, structural and HVAC drawings for additional scope included as part of Alternate.
- C. Alternate No. 3 Expanded Batting Cage
 - 1. Base Bid: Provide Batting Cage size as indicated on A1.1A and A4.3. Include metal building and foundations as shown on structural drawings. Include all components as indicated in sections and details and on HVAC and electrical drawings.
 - 2. Alternate: Provide enlarged Batting Cage size as indicated on sheets A10.1 and A10.2. (Enlarged 8 feet). Provide two motorized coiling doors and associated steel lintels as detailed. All other components and materials such as batting cage netting and turf flooring shall remain the same as Base Bid. Structural framing and foundation shall remain the same general size with additional 8 feet. Electrical, HVAC quantity of fixtures and equipment shall remain the same.

SECTION 012500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for substitutions.
- B. Related Requirements:
 - 1. Section 012100 "Allowances" for products selected under an allowance.
 - 2. Section 012300 "Alternates" for products selected under an alternate.
 - 3. Section 016000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

1.3 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
 - 1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
 - 2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.

1.4 ACTION SUBMITTALS

- A. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 - a. Statement indicating why specified product or fabrication or installation cannot be provided, if applicable.
 - b. Coordination information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution.

- c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
- d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
- e. Samples, where applicable or requested.
- f. Certificates and qualification data, where applicable or requested.
- g. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
- h. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
- i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
- j. Detailed comparison of Contractor's construction schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
- k. Cost information, including a proposal of change, if any, in the Contract Sum.
- 1. Contractor's certification that proposed substitution complies with requirements in the Contract Documents except as indicated in substitution request, is compatible with related materials, and is appropriate for applications indicated.
- m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
- 2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
 - a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
 - b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.5 QUALITY ASSURANCE

A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

1.6 PROCEDURES

A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

- A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.
 - 1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
 - a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - b. Requested substitution provides sustainable design characteristics that specified product provided.
 - c. Substitution request is fully documented and properly submitted.
 - d. Requested substitution will not adversely affect Contractor's construction schedule.
 - e. Requested substitution has received necessary approvals of authorities having jurisdiction.
 - f. Requested substitution is compatible with other portions of the Work.
 - g. Requested substitution has been coordinated with other portions of the Work.
 - h. Requested substitution provides specified warranty.
 - i. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.
- B. Substitutions for Convenience: Not allowed unless otherwise indicated.
- C. Substitutions for Convenience: Architect will consider requests for substitution if received within 60 days after the Notice to Proceed. Requests received after that time may be considered or rejected at discretion of Architect.
 - 1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
 - a. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include

compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.

- b. Requested substitution does not require extensive revisions to the Contract Documents.
- c. Requested substitution is consistent with the Contract Documents and will produce indicated results.
- d. Requested substitution provides sustainable design characteristics that specified product provided.
- e. Substitution request is fully documented and properly submitted.
- f. Requested substitution will not adversely affect Contractor's construction schedule.
- g. Requested substitution has received necessary approvals of authorities having jurisdiction.
- h. Requested substitution is compatible with other portions of the Work.
- i. Requested substitution has been coordinated with other portions of the Work.
- j. Requested substitution provides specified warranty.
- k. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

PART 3 - EXECUTION (Not Used)

SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for handling and processing Contract modifications.
- B. Related Requirements:
 - 1. Section 012500 "Substitution Procedures" for administrative procedures for handling requests for substitutions made after the Contract award.

1.3 MINOR CHANGES IN THE WORK

A. Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on <u>SE-480 Construction</u> <u>Change Order.</u>

1.4 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
 - 1. Work Change Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
 - 2. Within time specified in Proposal Request or 20 days, when not otherwise specified, after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
 - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - c. Include costs of labor and supervision directly attributable to the change.
 - d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and

finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.

- e. Quotation Form: Use forms acceptable to Architect.
- B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect.
 - 1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
 - 2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - 3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - 4. Include costs of labor and supervision directly attributable to the change.
 - 5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
 - 6. Comply with requirements in Section 012500 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
 - 7. Proposal Request Form: Use form acceptable to Architect.

1.5 ADMINISTRATIVE CHANGE ORDERS

- A. Allowance Adjustment: See Section 012100 "Allowances" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect actual costs of allowances.
- B. Unit-Price Adjustment: See Section 012200 "Unit Prices" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect measured scope of unit-price work.

1.6 CHANGE ORDER PROCEDURES

A. On Owner's approval of a Work Changes Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor on <u>SE-480 Construction Change Order.</u>

1.7 CONSTRUCTION CHANGE DIRECTIVE

A. Construction Change Directive: Architect may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.

- 1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.
- B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.
 - 1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

SECTION 012900 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.
- B. Related Requirements:
 - 1. Section 012100 "Allowances" for procedural requirements governing the handling and processing of allowances.
 - 2. Section 012200 "Unit Prices" for administrative requirements governing the use of unit prices.
 - 3. Section 012600 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
 - 4. Section 013200 "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.

1.3 DEFINITIONS

A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

1.4 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.
 - 1. Coordinate line items in the schedule of values with other required administrative forms and schedules, including the following:
 - a. Application for Payment forms with continuation sheets.
 - b. Submittal schedule.
 - c. Items required to be indicated as separate activities in Contractor's construction schedule.

- 2. Submit the schedule of values to Architect at earliest possible date, but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
- B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.
 - 1. Identification: Include the following Project identification on the schedule of values:
 - a. Project name and location.
 - b. Name of Architect.
 - c. Architect's project number.
 - d. Contractor's name and address.
 - e. Date of submittal.
 - 2. Arrange schedule of values consistent with format of AIA Document G703.
 - 3. Arrange the schedule of values in tabular form with separate columns to indicate the following for each item listed:
 - a. Related Specification Section or Division.
 - b. Description of the Work.
 - c. Name of subcontractor.
 - d. Name of manufacturer or fabricator.
 - e. Name of supplier.
 - f. Change Orders (numbers) that affect value.
 - g. Dollar value of the following, as a percentage of the Contract Sum to nearest onehundredth percent, adjusted to total 100 percent.
 - 1) Labor.
 - 2) Materials.
 - 3) Equipment.
 - 4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with Project Manual table of contents. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.
 - 5. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
 - 6. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
 - a. Differentiate between items stored on-site and items stored off-site. If required, include evidence of insurance.
 - 7. Provide separate line items in the schedule of values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
 - 8. Allowances: Provide a separate line item in the schedule of values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.

- 9. Each item in the schedule of values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.
 - a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the schedule of values or distributed as general overhead expense, at Contractor's option.
- 10. Schedule Updating: Update and resubmit the schedule of values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.5 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.
 - 1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.
- B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.
- C. Payment Application Times: Submit Application for Payment to Architect by the twenty-fifth day of the month. The period covered by each Application for Payment is one month, ending on the last day of the month.
 - 1. Submit draft copy of Application for Payment seven days prior to due date for review by Architect.
- D. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.
- E. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.
 - 1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
 - 2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
 - 3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
 - 4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.

- F. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.
 - 1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment, for stored materials.
 - 2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
 - 3. Provide summary documentation for stored materials indicating the following:
 - a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
 - b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
 - c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.
- G. Transmittal: Submit three signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.
 - 1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
- H. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's liens from subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application.
 - 1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
 - 2. When an application shows completion of an item, submit conditional final or full waivers.
 - 3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
 - 4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
 - 5. Waiver Forms: Submit executed waivers of lien on forms, acceptable to Owner.
- I. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
 - 1. List of subcontractors.
 - 2. Schedule of values.
 - 3. Contractor's construction schedule (preliminary if not final).
 - 4. Products list (preliminary if not final).
 - 5. Schedule of unit prices.
 - 6. Submittal schedule (preliminary if not final).
 - 7. List of Contractor's staff assignments.

- 8. List of Contractor's principal consultants.
- 9. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
- 10. Initial progress report.
- 11. Report of preconstruction conference.
- 12. Certificates of insurance and insurance policies.
- J. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
 - 1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
 - 2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- K. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
 - 1. Evidence of completion of Project closeout requirements.
 - 2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
 - 3. Updated final statement, accounting for final changes to the Contract Sum.
 - 4. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
 - 5. AIA Document G706A, "Contractor's Affidavit of Release of Liens."
 - 6. AIA Document G707, "Consent of Surety to Final Payment."
 - 7. Evidence that claims have been settled.
 - 8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
 - 9. Final liquidated damages settlement statement.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
 - 1. General coordination procedures.
 - 2. Coordination drawings.
 - 3. Requests for Information (RFIs).
 - 4. Project meetings.
- B. Each contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific contractor.
- C. Related Requirements:
 - 1. Section 013200 "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
 - 2. Section 017300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
 - 3. Section 017700 "Closeout Procedures" for coordinating closeout of the Contract.

1.3 DEFINITIONS

A. RFI: Request from Owner, Architect, or Contractor seeking information required by or clarifications of the Contract Documents.

1.4 INFORMATIONAL SUBMITTALS

- A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
 - 1. Name, address, and telephone number of entity performing subcontract or supplying products.
 - 2. Number and title of related Specification Section(s) covered by subcontract.
 - 3. Drawing number and detail references, as appropriate, covered by subcontract.

- B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home, office, and cellular telephone numbers and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.
 - 1. Post copies of list in project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.

1.5 GENERAL COORDINATION PROCEDURES

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections, that depend on each other for proper installation, connection, and operation.
 - 1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
 - 2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
 - 3. Make adequate provisions to accommodate items scheduled for later installation.
- B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
 - 1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.
- C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities <u>and activities of other contractors</u> to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
 - 1. Preparation of Contractor's construction schedule.
 - 2. Preparation of the schedule of values.
 - 3. Installation and removal of temporary facilities and controls.
 - 4. Delivery and processing of submittals.
 - 5. Progress meetings.
 - 6. Preinstallation conferences.
 - 7. Project closeout activities.
 - 8. Startup and adjustment of systems.
- D. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.

1.6 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
 - 1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
 - a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
 - b. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
 - c. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
 - d. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
 - e. Indicate required installation sequences.
 - f. Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
- B. Coordination Drawing Organization: Organize coordination drawings as follows:
 - 1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
 - 2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within ceiling plenum to accommodate layout of light fixtures indicated on Drawings. Indicate areas of conflict between light fixtures and other components.
 - 3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
 - 4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
 - 5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
 - 6. Mechanical and Plumbing Work: Show the following:
 - a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.

- b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
- c. Fire-rated enclosures around ductwork.
- 7. Electrical Work: Show the following:
 - a. Runs of vertical and horizontal conduit 1-1/4 inches (32 mm) in diameter and larger.
 - b. Light fixture, exit light, emergency battery pack, smoke detector, and other firealarm locations.
 - c. Panel board, switch board, switchgear, transformer, busway, generator, and motor control center locations.
 - d. Location of pull boxes and junction boxes, dimensioned from column center lines.
- 8. Fire-Protection System: Show the following:
 - a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.
- 9. Review: Architect will review coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make changes as directed and resubmit.
- 10. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements in Section 013300 "Submittal Procedures."
- C. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:
 - 1. File Preparation Format: DWG, Version 2011, operating in Microsoft Windows operating system.
 - 2. File Submittal Format: Submit or post coordination drawing files using format same as file preparation format and Portable Data File (PDF) format.
 - 3. Architect will furnish Contractor one set of digital data files of Drawings for use in preparing coordination digital data files.
 - a. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Drawings.
 - b. Digital Data Software Program: Drawings are available in DWG, Version 2011
 - c. Contractor shall execute a data licensing agreement in the form of Agreement included in this Project Manual.

1.7 REQUESTS FOR INFORMATION (RFIs)

- A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
 - 1. Architect will return RFIs submitted to Architect by other entities controlled by Contractor with no response.

- 2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
 - 1. Project name.
 - 2. Project number.
 - 3. Date.
 - 4. Name of Contractor.
 - 5. Name of Architect.
 - 6. RFI number, numbered sequentially.
 - 7. RFI subject.
 - 8. Specification Section number and title and related paragraphs, as appropriate.
 - 9. Drawing number and detail references, as appropriate.
 - 10. Field dimensions and conditions, as appropriate.
 - 11. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 - 12. Contractor's signature.
 - 13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
 - a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.
- C. RFI Forms: Software-generated form with substantially the same content as indicated above, acceptable to Architect.
 - 1. Attachments shall be electronic files in Adobe Acrobat PDF format.
- D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow seven working days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.
 - 1. The following Contractor-generated RFIs will be returned without action:
 - a. Requests for approval of submittals.
 - b. Requests for approval of substitutions.
 - c. Requests for approval of Contractor's means and methods.
 - d. Requests for coordination information already indicated in the Contract Documents.
 - e. Requests for adjustments in the Contract Time or the Contract Sum.
 - f. Requests for interpretation of Architect's actions on submittals.
 - g. Incomplete RFIs or inaccurately prepared RFIs.
 - 2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt of additional information.

- 3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 012600 "Contract Modification Procedures."
 - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 10 days of receipt of the RFI response.
- E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Software log with not less than the following:
 - 1. Project name.
 - 2. Name and address of Contractor.
 - 3. Name and address of Architect.
 - 4. RFI number including RFIs that were returned without action or withdrawn.
 - 5. RFI description.
 - 6. Date the RFI was submitted.
 - 7. Date Architect's response was received.
- F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within seven days if Contractor disagrees with response.
 - 1. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.

1.8 PROJECT MEETINGS

- A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.
 - 1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
 - 2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
 - 3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.
- B. Preconstruction Conference: Architect will schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement.
 - 1. Conduct the conference to review responsibilities and personnel assignments.
 - 2. Attendees: Authorized representatives of Owner Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.

- 3. Agenda: Discuss items of significance that could affect progress, including the following:
 - a. Tentative construction schedule.
 - b. Phasing.
 - c. Critical work sequencing and long-lead items.
 - d. Designation of key personnel and their duties.
 - e. Lines of communications.
 - f. Procedures for processing field decisions and Change Orders.
 - g. Procedures for RFIs.
 - h. Procedures for testing and inspecting.
 - i. Procedures for processing Applications for Payment.
 - j. Distribution of the Contract Documents.
 - k. Submittal procedures.
 - 1. Preparation of record documents.
 - m. Use of the premises.
 - n. Work restrictions.
 - o. Working hours.
 - p. Owner's occupancy requirements.
 - q. Responsibility for temporary facilities and controls.
 - r. Procedures for moisture and mold control.
 - s. Procedures for disruptions and shutdowns.
 - t. Construction waste management and recycling.
 - u. Parking availability.
 - v. Office, work, and storage areas.
 - w. Equipment deliveries and priorities.
 - x. First aid.
 - y. Security.
 - z. Progress cleaning.
- 4. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
- C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.
 - 1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates.
 - 2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
 - a. Contract Documents.
 - b. Options.
 - c. Related RFIs.
 - d. Related Change Orders.
 - e. Purchases.
 - f. Deliveries.
 - g. Submittals.

- h. Review of mockups.
- i. Possible conflicts.
- j. Compatibility requirements.
- k. Time schedules.
- l. Weather limitations.
- m. Manufacturer's written instructions.
- n. Warranty requirements.
- o. Compatibility of materials.
- p. Acceptability of substrates.
- q. Temporary facilities and controls.
- r. Space and access limitations.
- s. Regulations of authorities having jurisdiction.
- t. Testing and inspecting requirements.
- u. Installation procedures.
- v. Coordination with other work.
- w. Required performance results.
- x. Protection of adjacent work.
- y. Protection of construction and personnel.
- 3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
- 4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
- 5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
- D. Project Closeout Conference: Schedule and conduct a project closeout conference, at a time convenient to Owner and Architect, but no later than 90 days prior to the scheduled date of Substantial Completion.
 - 1. Conduct the conference to review requirements and responsibilities related to Project closeout.
 - 2. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 - 3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:
 - a. Preparation of record documents.
 - b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
 - c. Submittal of written warranties.
 - d. Requirements for preparing operations and maintenance data.
 - e. Requirements for delivery of material samples, attic stock, and spare parts.
 - f. Requirements for demonstration and training.
 - g. Preparation of Contractor's punch list.
 - h. Procedures for processing Applications for Payment at Substantial Completion and for final payment.

- i. Submittal procedures.
- j. Coordination of separate contracts.
- k. Owner's partial occupancy requirements.
- 1. Installation of Owner's furniture, fixtures, and equipment.
- m. Responsibility for removing temporary facilities and controls.
- 4. Minutes: Entity conducting meeting will record and distribute meeting minutes.
- E. Progress Meetings: Conduct progress meetings at weekly intervals.
 - 1. Coordinate dates of meetings with preparation of payment requests.
 - 2. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 - 3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - 1) Review schedule for next period.
 - b. Review present and future needs of each entity present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Status of submittals.
 - 4) Deliveries.
 - 5) Off-site fabrication.
 - 6) Access.
 - 7) Site utilization.
 - 8) Temporary facilities and controls.
 - 9) Progress cleaning.
 - 10) Quality and work standards.
 - 11) Status of correction of deficient items.
 - 12) Field observations.
 - 13) Status of RFIs.
 - 14) Status of proposal requests.
 - 15) Pending changes.
 - 16) Status of Change Orders.
 - 17) Pending claims and disputes.
 - 18) Documentation of information for payment requests.

- 4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.
 - a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.
- F. Coordination Meetings: Project Coordinator will conduct Project coordination meetings at biweekly or monthly intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.
 - 1. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meetings shall be familiar with Project and authorized to conclude matters relating to the Work.
 - 2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to combined Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - b. Schedule Updating: Revise combined Contractor's construction schedule after each coordination meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
 - c. Review present and future needs of each contractor present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Access.
 - 4) Site utilization.
 - 3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
 - 1. Startup construction schedule.
 - 2. Contractor's construction schedule.
 - 3. Construction schedule updating reports.
 - 4. Daily, Weekly construction reports.
 - 5. Material location reports.
 - 6. Site condition reports.
 - 7. Special reports.

B. Related Requirements:

- 1. Section 013300 "Submittal Procedures" for submitting schedules and reports.
- 2. Section 014000 "Quality Requirements" for submitting a schedule of tests and inspections.

1.3 DEFINITIONS

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.
 - 1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
 - 2. Predecessor Activity: An activity that precedes another activity in the network.
 - 3. Successor Activity: An activity that follows another activity in the network.
- B. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.
- C. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.

- D. Event: The starting or ending point of an activity.
- E. Float: The measure of leeway in starting and completing an activity.
 - 1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
 - 2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
 - 3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.
- F. Resource Loading: The allocation of manpower and equipment necessary for the completion of an activity as scheduled.

1.4 INFORMATIONAL SUBMITTALS

- A. Format for Submittals: Submit required submittals in the following format:
 - 1. PDF electronic file.
 - 2. Two paper copies.
- B. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
- C. CPM Reports: Concurrent with CPM schedule, subhga\ffdmit each of the following reports. Format for each activity in reports shall contain activity number, activity description, cost and resource loading, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.
 - 1. Activity Report: List of all activities sorted by activity number and then early start date, or actual start date if known.
 - 2. Logic Report: List of preceding and succeeding activities for all activities, sorted in ascending order by activity number and then early start date, or actual start date if known.
 - 3. Total Float Report: List of all activities sorted in ascending order of total float.
- D. Construction Schedule Updating Reports: Submit with Applications for Payment.
- E. Daily Construction Reports: Have available on site if requested.
- F. Weekly Construction Reports: Submit at weekly intervals with project meeting minutes.
- G. Material Location Reports: Submit at monthly intervals.
- H. Site Condition Reports: Submit at time of discovery of differing conditions.
- I. Special Reports: Submit at time of unusual event.
1.5 QUALITY ASSURANCE

- A. Scheduling Consultant Qualifications: An experienced specialist in CPM scheduling and reporting, with capability of producing CPM reports and diagrams within 24 hours of Architect's request.
- B. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to the preliminary construction schedule and Contractor's construction schedule, including, but not limited to, the following:
 - 1. Review software limitations and content and format for reports.
 - 2. Verify availability of qualified personnel needed to develop and update schedule.
 - 3. Discuss constraints, including phasing, interim milestones and partial Owner occupancy.
 - 4. Review delivery dates for Owner-furnished products.
 - 5. Review schedule for work of Owner's separate contracts.
 - 6. Review submittal requirements and procedures.
 - 7. Review time required for review of submittals and resubmittals.
 - 8. Review requirements for tests and inspections by independent testing and inspecting agencies.
 - 9. Review time required for Project closeout and Owner startup procedures.
 - 10. Review and finalize list of construction activities to be included in schedule.
 - 11. Review procedures for updating schedule.

1.6 COORDINATION

- A. Coordinate Contractor's construction schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests, and other required schedules and reports.
 - 1. Secure time commitments for performing critical elements of the Work from entities involved.
 - 2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 - PRODUCTS

2.1 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. Time Frame: Extend schedule from date established for the Notice to Proceed to date of Substantial Completion and final completion.
 - 1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
- B. Activities: Treat each story or separate area as a separate numbered activity for each main element of the Work. Comply with the following:

- 1. Activity Duration: Define activities so no activity is longer than 14 days, unless specifically allowed by Architect.
- 2. Procurement Activities: Include procurement process activities for the following long lead items and major items, requiring a cycle of more than 30 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
- 3. Submittal Review Time: Include review and resubmittal times indicated in Section 013300 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's construction schedule with submittal schedule.
- 4. Startup and Testing Time: Include no fewer than 15 days for startup and testing.
- 5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
- 6. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and final completion.
- C. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
 - 1. Phasing: Arrange list of activities on schedule by phase.
 - 2. Work under More Than One Contract: Include a separate activity for each contract.
 - 3. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
 - 4. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Section 011000 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
 - 5. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Section 011000 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
 - 6. Work Restrictions: Show the effect of the following items on the schedule:
 - a. Coordination with existing construction.
 - b. Limitations of continued occupancies.
 - c. Uninterruptible services.
 - d. Partial occupancy before Substantial Completion.
 - e. Use of premises restrictions.
 - f. Provisions for future construction.
 - g. Seasonal variations.
 - h. Environmental control.
 - 7. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
 - a. Subcontract awards.
 - b. Submittals.
 - c. Purchases.
 - d. Mockups.
 - e. Fabrication.
 - f. Sample testing.

- g. Deliveries.
- h. Installation.
- i. Tests and inspections.
- j. Adjusting.
- k. Curing.
- 1. Startup and placement into final use and operation.
- 8. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:
 - a. Structural completion.
 - b. Temporary enclosure and space conditioning.
 - c. Permanent space enclosure.
 - d. Completion of mechanical installation.
 - e. Completion of electrical installation.
 - f. Substantial Completion.
- D. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and final completion, and the following interim milestones:
 - 1. Temporary enclosure and space conditioning.
 - 2. Availability of field.
- E. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
 - 1. Unresolved issues.
 - 2. Unanswered Requests for Information.
 - 3. Rejected or unreturned submittals.
 - 4. Notations on returned submittals.
 - 5. Pending modifications affecting the Work and Contract Time.
- F. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, and equipment required to achieve compliance, and date by which recovery will be accomplished.
- G. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.

2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE (CPM SCHEDULE)

- A. General: Prepare network diagrams using AON (activity-on-node) format.
- B. CPM Schedule: Prepare Contractor's construction schedule using a time-scaled CPM network analysis diagram for the Work.

- 1. Develop network diagram in sufficient time to submit CPM schedule so it can be accepted for use no later than 7 days after date established for commencement of the Work.
 - a. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates, regardless of Architect's approval of the schedule.
- 2. Conduct educational workshops to train and inform key Project personnel, including subcontractors' personnel, in proper methods of providing data and using CPM schedule information.
- 3. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
- 4. Use "one workday" as the unit of time for individual activities. Indicate nonworking days and holidays incorporated into the schedule in order to coordinate with the Contract Time.
- C. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the startup network diagram, prepare a skeleton network to identify probable critical paths.
 - 1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:
 - a. Preparation and processing of submittals.
 - b. Mobilization and demobilization.
 - c. Purchase of materials.
 - d. Delivery.
 - e. Fabrication.
 - f. Utility interruptions.
 - g. Installation.
 - h. Work by Owner that may affect or be affected by Contractor's activities.
 - i. Testing.
 - j. Punch list and final completion.
 - k. Activities occurring following final completion.
 - 2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.
 - 3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
 - 4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.
 - a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.

- D. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using a network fragment to demonstrate the effect of the proposed change on the overall project schedule.
- E. Initial Issue of Schedule: Prepare initial network diagram from a sorted activity list indicating straight "early start-total float." Identify critical activities. Prepare tabulated reports showing the following:
 - 1. Contractor or subcontractor and the Work or activity.
 - 2. Description of activity.
 - 3. Main events of activity.
 - 4. Immediate preceding and succeeding activities.
 - 5. Early and late start dates.
 - 6. Early and late finish dates.
 - 7. Activity duration in workdays.
 - 8. Total float or slack time.
 - 9. Average size of workforce.
 - 10. Dollar value of activity (coordinated with the schedule of values).
- F. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:
 - 1. Identification of activities that have changed.
 - 2. Changes in early and late start dates.
 - 3. Changes in early and late finish dates.
 - 4. Changes in activity durations in workdays.
 - 5. Changes in the critical path.
 - 6. Changes in total float or slack time.
 - 7. Changes in the Contract Time.

2.3 REPORTS

- A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:
 - 1. List of subcontractors at Project site.
 - 2. List of separate contractors at Project site.
 - 3. Approximate count of personnel at Project site.
 - 4. Equipment at Project site.
 - 5. Material deliveries.
 - 6. High and low temperatures and general weather conditions, including presence of rain or snow.
 - 7. Accidents.
 - 8. Meetings and significant decisions.
 - 9. Unusual events (see special reports).
 - 10. Stoppages, delays, shortages, and losses.
 - 11. Meter readings and similar recordings.
 - 12. Emergency procedures.
 - 13. Orders and requests of authorities having jurisdiction.

- 14. Change Orders received and implemented.
- 15. Construction Change Directives received and implemented.
- 16. Services connected and disconnected.
- 17. Equipment or system tests and startups.
- 18. Partial completions and occupancies.
- 19. Substantial Completions authorized.
- B. Material Location Reports: At monthly intervals, prepare and submit a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site. Indicate the following categories for stored materials:
 - 1. Material stored prior to previous report and remaining in storage.
 - 2. Material stored prior to previous report and since removed from storage and installed.
 - 3. Material stored following previous report and remaining in storage.
- C. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

2.4 SPECIAL REPORTS

- A. General: Submit special reports directly to Owner within one day(s) of an occurrence. Distribute copies of report to parties affected by the occurrence.
- B. Reporting Unusual Events: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Contractor's Construction Schedule Updating: At bi-monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.
 - 1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
 - 2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
 - 3. As the Work progresses, indicate final completion percentage for each activity.

- B. Distribution: Distribute copies of approved schedule to Architect Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
 - 1. Post copies in Project meeting rooms and temporary field offices.
 - 2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

END OF SECTION 013200

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.
- B. Related Requirements:
 - 1. Section 012900 "Payment Procedures" for submitting Applications for Payment and the schedule of values.
 - 2. Section 013200 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
 - 3. Section 017823 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
 - 4. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
 - 5. Section 017900 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.

1.3 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."
- B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."
- C. File Transfer Protocol (FTP): Communications protocol that enables transfer of files to and from another computer over a network and that serves as the basis for standard Internet protocols. An FTP site is a portion of a network located outside of network firewalls within which internal and external users are able to access files.

D. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

1.4 ACTION SUBMITTALS

- A. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.
 - 1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
 - 2. Initial Submittal: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
 - 3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's construction schedule.
 - a. Submit revised submittal schedule to reflect changes in current status and timing for submittals.
 - 4. Format: Arrange the following information in a tabular format:
 - a. Scheduled date for first submittal.
 - b. Specification Section number and title.
 - c. Submittal category: Action; informational.
 - d. Name of subcontractor.
 - e. Description of the Work covered.
 - f. Scheduled date for Architect's final release or approval.
 - g. Scheduled date of fabrication.

1.5 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

- A. Architect's Digital Data Files: Electronic digital data files of the Contract Drawings will[**not**] be provided by Architect for Contractor's use in preparing submittals.
 - 1. Architect will furnish Contractor one set of digital data drawing files of the Contract Drawings for use in preparing Shop Drawings.
 - a. Architect makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.
 - b. Digital Drawing Software Program: The Contract Drawings are available in DWG, 2011 Version.
 - c. Contractor shall execute a data licensing agreement in the form of Agreement included in Project Manual.

- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
 - 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 - 2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
 - 3. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
 - a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
 - 1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
 - 2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
 - 3. Resubmittal Review: Allow 15 days for review of each resubmittal.
 - 4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 21 days for initial review of each submittal.
 - a. Concrete Reinforcing.
 - b. Structural Steel
 - c. Coordination Drawings
 - d. Interior Finish / Color Selection
- D. Paper Submittals: Place a permanent label or title block on each submittal item for identification.
 - 1. Indicate name of firm or entity that prepared each submittal on label or title block.
 - 2. Provide a space approximately 6 by 8 inches (150 by 200 mm) on label or beside title block to record Contractor's review and approval markings and action taken by Architect.
 - 3. Include the following information for processing and recording action taken:
 - a. Project name.
 - b. Date.
 - c. Name of Architect.
 - d. Name of Contractor.
 - e. Name of subcontractor.
 - f. Name of supplier.
 - g. Name of manufacturer.
 - h. Submittal number or other unique identifier, including revision identifier.

- 1) Submittal number shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 061000.01.A).
- i. Number and title of appropriate Specification Section.
- j. Drawing number and detail references, as appropriate.
- k. Location(s) where product is to be installed, as appropriate.
- 1. Other necessary identification.
- 4. Additional Paper Copies: Unless additional copies are required for final submittal, and unless Architect observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.
 - a. Submit one copy of submittal to concurrent reviewer in addition to specified number of copies to Architect.
- 5. Transmittal for Paper Submittals: Assemble each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect will discard submittals received from sources other than Contractor.
 - a. Transmittal Form for Paper Submittals: Provide locations on form for the following information:
 - 1) Project name.
 - 2) Date.
 - 3) Destination (To:).
 - 4) Source (From:).
 - 5) Name and address of Architect.
 - 6) Name of Construction Manager.
 - 7) Name of Contractor.
 - 8) Name of firm or entity that prepared submittal.
 - 9) Names of subcontractor, manufacturer, and supplier.
 - 10) Category and type of submittal.
 - 11) Submittal purpose and description.
 - 12) Specification Section number and title.
 - 13) Specification paragraph number or drawing designation and generic name for each of multiple items.
 - 14) Drawing number and detail references, as appropriate.
 - 15) Indication of full or partial submittal.
 - 16) Transmittal number, numbered consecutively.
 - 17) Submittal and transmittal distribution record.
 - 18) Remarks.
 - 19) Signature of transmitter.
- E. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:
 - 1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.

- 2. Name file with submittal number or other unique identifier, including revision identifier.
 - a. File name shall use project identifier and Specification Section number followed by a decimal point and then a sequential number (e.g., LNHS-061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., LNHS-061000.01.A).
- 3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect.
- 4. Transmittal Form for Electronic Submittals: Use electronic form acceptable to Architect, containing the following information:
 - a. Project name.
 - b. Date.
 - c. Name and address of Architect.
 - d. Name of Construction Manager.
 - e. Name of Contractor.
 - f. Name of firm or entity that prepared submittal.
 - g. Names of subcontractor, manufacturer, and supplier.
 - h. Category and type of submittal.
 - i. Submittal purpose and description.
 - j. Specification Section number and title.
 - k. Specification paragraph number or drawing designation and generic name for each of multiple items.
 - 1. Drawing number and detail references, as appropriate.
 - m. Location(s) where product is to be installed, as appropriate.
 - n. Related physical samples submitted directly.
 - o. Indication of full or partial submittal.
 - p. Transmittal number, numbered consecutively.
 - q. Submittal and transmittal distribution record.
 - r. Other necessary identification.
 - s. Remarks.
- 5. Metadata: Include the following information as keywords in the electronic submittal file metadata:
 - a. Project name.
 - b. Number and title of appropriate Specification Section.
 - c. Manufacturer name.
 - d. Product name.
- F. Options: Identify options requiring selection by Architect.
- G. Deviations and Additional Information: On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.
- H. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.

- 1. Note date and content of previous submittal.
- 2. Note date and content of revision in label or title block and clearly indicate extent of revision.
- 3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.
- I. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- J. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

- A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
 - 1. Submit electronic submittals via email as PDF electronic files.
 - a. Architect will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.
 - 2. Action Submittals: Submit seven paper copies of each submittal unless otherwise indicated. Architect will return six copies. (four copies will be returned for submittals involving another discipline. The Contractor shall submit additional copies as required for sub-contractor and record copies. The Contractor shall maintain one set of submittals on site for the Owner's record copy, in addition to the construction set of submittals.
 - 3. Informational Submittals: Submit two paper copies of each submittal unless otherwise indicated. Architect will not return copies.
 - 4. Certificates and Certifications Submittals: Provide a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
 - a. Provide a digital signature with digital certificate on electronically submitted certificates and certifications where indicated.
 - b. Provide a notarized statement on original paper copy certificates and certifications where indicated.
- B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
 - 1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.

- 2. Mark each copy of each submittal to show which products and options are applicable.
- 3. Include the following information, as applicable:
 - a. Manufacturer's catalog cuts.
 - b. Manufacturer's product specifications.
 - c. Standard color charts.
 - d. Statement of compliance with specified referenced standards.
 - e. Testing by recognized testing agency.
 - f. Application of testing agency labels and seals.
 - g. Notation of coordination requirements.
 - h. Availability and delivery time information.
- 4. For equipment, include the following in addition to the above, as applicable:
 - a. Wiring diagrams showing factory-installed wiring.
 - b. Printed performance curves.
 - c. Operational range diagrams.
 - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
- 5. Submit Product Data before or concurrent with Samples.
- 6. Submit Product Data in the following format:
 - a. PDF electronic file.
 - b. Three paper copies of Product Data unless otherwise indicated. Architect will return two copies.
- C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data, unless submittal based on Architect's digital data drawing files is otherwise permitted.
 - 1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Identification of products.
 - b. Schedules.
 - c. Compliance with specified standards.
 - d. Notation of coordination requirements.
 - e. Notation of dimensions established by field measurement.
 - f. Relationship and attachment to adjoining construction clearly indicated.
 - g. Seal and signature of professional engineer if specified.
 - 2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches (215 by 280 mm), but no larger than 30 by 42 inches (750 by 1067 mm).
 - 3. Submit Shop Drawings in the following format:
 - a. PDF electronic file.
 - b. Four or more opaque copies of each submittal. Architect will retain two copies; remainder will be returned.

- D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.
 - 1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
 - 2. Identification: Attach label on unexposed side of Samples that includes the following:
 - a. Generic description of Sample.
 - b. Product name and name of manufacturer.
 - c. Sample source.
 - d. Number and title of applicable Specification Section.
 - e. Specification paragraph number and generic name of each item.
 - 3. For projects where electronic submittals are required, provide corresponding electronic submittal of Sample transmittal, digital image file illustrating Sample characteristics, and identification information for record.
 - 4. Disposition: Maintain sets of approved Samples at Project site, available for qualitycontrol comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
 - a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
 - b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
 - 5. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
 - a. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.
 - 6. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
 - a. Number of Samples: Submit two sets of Samples. Architect will retain one Sample set; remainder will be returned.
 - 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.

- 2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.
- E. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
 - 1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
 - 2. Manufacturer and product name, and model number if applicable.
 - 3. Number and name of room or space.
 - 4. Location within room or space.
 - 5. Submit product schedule in the following format:
 - a. PDF electronic file.
- F. Coordination Drawing Submittals: Comply with requirements specified in Section 013100 "Project Management and Coordination."
- G. Contractor's Construction Schedule: Comply with requirements specified in Section 013200 "Construction Progress Documentation."
- H. Application for Payment and Schedule of Values: Comply with requirements specified in Section 012900 "Payment Procedures."
- I. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Section 014000 "Quality Requirements."
- J. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Section 017700 "Closeout Procedures."
- K. Maintenance Data: Comply with requirements specified in Section 017823 "Operation and Maintenance Data."
- L. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- M. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.
- N. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.

- O. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
- P. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- Q. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- R. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
- S. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
- T. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
 - 1. Name of evaluation organization.
 - 2. Date of evaluation.
 - 3. Time period when report is in effect.
 - 4. Product and manufacturers' names.
 - 5. Description of product.
 - 6. Test procedures and results.
 - 7. Limitations of use.
- U. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
- V. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
- W. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
- X. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

2.2 DELEGATED-DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
 - 1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.
- B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF electronic file and three paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
 - 1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

- A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.
- B. Project Closeout and Maintenance Material Submittals: See requirements in Section 017700 "Closeout Procedures."
- C. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 ARCHITECT'S ACTION

- A. Action Submittals: Architect will review each submittal, make marks to indicate corrections or revisions required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action.
- B. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.
- C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.

- D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- E. Submittals not required by the Contract Documents may be returned by the Architect without action.

END OF SECTION 013300

REQUEST FOR ELECTRONIC DRAWING FILES

PROJECT: University of South Carolina Softball Stadium Construction Architect's Project No.: 11.122.00 State Project No.: H27-6088-MJ

Data contained on these electronic files are part of Quackenbush Architects + Planners instruments of service and shall not be used by anyone receiving these files for any purpose other than a bid or submittal document. Any use of this file, either all or in-part, for other than its initial use as a bid or submittal document shall be full and sufficient cause to hold Quackenbush Architects + Planners (or their consultants) as author of the original electronic file harmless against any claim or liability resulting from any discrepancy, error or omission in the file's original or modified form.

Furthermore, you shall, to the fullest extent permitted by law, indemnify and hold Quackenbush Architects + Planners and their consultants harmless against all damages, liabilities or costs, including reasonable attorney's fees and defense costs, arising out of or resulting from your use of these electronic files.

Because information presented on the electronic files can be modified, unintentionally or otherwise, Quackenbush Architects + Planners reserves the right to remove all indications of ownership and/or involvement from each electronic display.

The transfer of the data or any copy of the data, in any form to a third party without the prior written consent of Quackenbush Architects + Planners shall not be permitted.

Under no circumstances shall delivery of the electronic files for use by you be deemed a sale by us, and we make no warranties, either express or implied of merchantability and fitness for any particular purpose. In no event shall Quackenbush Architects + Planners be liable for any loss of profit or any consequential damages as a result of your use or reuse of these electronic files.

Signing this letter indicates your agreement to the terms stated above and that you have the authority to bind your firm with respect to the terms stated above.

Accented and Agreed by				
Printed Name		Company		
Title		Date		
Signature				
Sheets Requested				
Sheet No.	Sheet Title			



Quackenbusharchitects.com

1217 Hampton Street Columbia SC 29201

SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
 - 1. Specific quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
 - 2. Specified tests, inspections, and related actions do not limit Contractor's other qualityassurance and -control procedures that facilitate compliance with the Contract Document requirements.
 - 3. Requirements for Contractor to provide quality-assurance and -control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.
 - 4. Specific test and inspection requirements are not specified in this Section.

1.3 DEFINITIONS

- A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect.
- C. Mockups: Full-size physical assemblies that are constructed on-site. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and, where indicated, qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified

installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.

- 1. Integrated Exterior Mockups: Mockups of the exterior envelope erected separately from the building but on Project site, consisting of multiple products, assemblies, and subassemblies.
- D. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.
- E. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
- F. Source Quality-Control Testing: Tests and inspections that are performed at the source, e.g., plant, mill, factory, or shop.
- G. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- I. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.
 - 1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).
- J. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.4 CONFLICTING REQUIREMENTS

- A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Architect for a decision before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.5 INFORMATIONAL SUBMITTALS

- A. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.
- B. Qualification Data: For Contractor's quality-control personnel.
- C. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility sent to authorities having jurisdiction before starting work on the following systems:
 - 1. Seismic-force-resisting system, designated seismic system, or component listed in the designated seismic system quality-assurance plan prepared by Architect.
 - 2. Main wind-force-resisting system or a wind-resisting component listed in the wind-force-resisting system quality-assurance plan prepared by Architect.
- D. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
- E. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
 - 1. Specification Section number and title.
 - 2. Entity responsible for performing tests and inspections.
 - 3. Description of test and inspection.
 - 4. Identification of applicable standards.
 - 5. Identification of test and inspection methods.
 - 6. Number of tests and inspections required.
 - 7. Time schedule or time span for tests and inspections.
 - 8. Requirements for obtaining samples.
 - 9. Unique characteristics of each quality-control service.

1.6 CONTRACTOR'S QUALITY-CONTROL PLAN

- A. Quality-Control Plan, General: Submit quality-control plan within 10 days of Notice to Proceed, and not less than five days prior to preconstruction conference. Submit in format acceptable to Architect. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities. Coordinate with Contractor's construction schedule.
- B. Quality-Control Personnel Qualifications: Engage qualified full-time personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.
 - 1. Project quality-control manager may also serve as Project superintendent.
- C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.

- D. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:
 - 1. Contractor-performed tests and inspections including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections.
 - 2. Special inspections required by authorities having jurisdiction and indicated on the "Statement of Special Inspections."
 - 3. Owner-performed tests and inspections indicated in the Contract Documents.
- E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring work into compliance with standards of workmanship established by Contract requirements and approved mockups.
- F. Monitoring and Documentation: Maintain testing and inspection reports including log of approved and rejected results. Include work Architect has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

1.7 REPORTS AND DOCUMENTS

- A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
 - 1. Date of issue.
 - 2. Project title and number.
 - 3. Name, address, and telephone number of testing agency.
 - 4. Dates and locations of samples and tests or inspections.
 - 5. Names of individuals making tests and inspections.
 - 6. Description of the Work and test and inspection method.
 - 7. Identification of product and Specification Section.
 - 8. Complete test or inspection data.
 - 9. Test and inspection results and an interpretation of test results.
 - 10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
 - 11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
 - 12. Name and signature of laboratory inspector.
 - 13. Recommendations on retesting and reinspecting.
- B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
 - 1. Name, address, and telephone number of technical representative making report.
 - 2. Statement on condition of substrates and their acceptability for installation of product.
 - 3. Statement that products at Project site comply with requirements.

- 4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
- 5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
- 6. Statement whether conditions, products, and installation will affect warranty.
- 7. Other required items indicated in individual Specification Sections.
- C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:
 - 1. Name, address, and telephone number of factory-authorized service representative making report.
 - 2. Statement that equipment complies with requirements.
 - 3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 - 4. Statement whether conditions, products, and installation will affect warranty.
 - 5. Other required items indicated in individual Specification Sections.
- D. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.8 QUALITY ASSURANCE

- A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- D. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar in material, design, and extent to those indicated for this Project.

- F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
 - 1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.
- G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
 - 1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
 - 2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.
- H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- J. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
 - 1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect.
 - 2. Notify Architect seven days in advance of dates and times when mockups will be constructed.
 - 3. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed during the construction at Project.
 - 4. Demonstrate the proposed range of aesthetic effects and workmanship.
 - 5. Obtain Architect's approval of mockups before starting work, fabrication, or construction.
 - a. Allow seven days for initial review and each re-review of each mockup.
 - 6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 - 7. Demolish and remove mockups when directed unless otherwise indicated.
- K. Integrated Exterior Mockups: Construct integrated exterior mockup as indicated on Drawings and specifications. Coordinate installation of exterior envelope materials and products for which mockups are required in individual Specification Sections, along with supporting materials.

1.9 QUALITY CONTROL

- A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
 - 1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
 - 2. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.
- B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not.
 - 1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
 - 2. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
 - a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
 - 3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
 - 4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
 - 5. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
 - 6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 013300 "Submittal Procedures."
- D. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.
- E. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

- F. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
 - 1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 - 2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
 - 3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
 - 4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
 - 5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
 - 6. Do not perform any duties of Contractor.
- G. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
 - 1. Access to the Work.
 - 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 - 3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
 - 4. Facilities for storage and field curing of test samples.
 - 5. Delivery of samples to testing agencies.
 - 6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
 - 7. Security and protection for samples and for testing and inspecting equipment at Project site.
- H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
 - 1. Schedule times for tests, inspections, obtaining samples, and similar activities.

1.10 SPECIAL TESTS AND INSPECTIONS

- A. Special Tests and Inspections: Owner will engage a qualified testing agency and special inspector to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, as indicated in Statement of Special Inspections attached to this Section, and as follows:
 - 1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviews the completeness and adequacy of those procedures to perform the Work.
 - 2. Notifying Architect and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.

- 3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect with copy to Contractor and to authorities having jurisdiction.
- 4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
- 5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
- 6. Retesting and reinspecting corrected work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

- 3.1 TEST AND INSPECTION LOG (Owner's Testing Agency)
 - A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
 - 1. Date test or inspection was conducted.
 - 2. Description of the Work tested or inspected.
 - 3. Date test or inspection results were transmitted to Architect.
 - 4. Identification of testing agency or special inspector conducting test or inspection.
 - B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's reference during normal working hours.

3.2 REPAIR AND PROTECTION

- A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
 - 1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 017300 "Execution."
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 014000

University of South Carolina Softball Stadium Construction BID SET

Seismic Requirements - Quality Assurance Plan (2009 IBC Section 1705.3)

- 1) Seismic Force Resisting Systems
 - a) Metal Building Frames
 - b) Structural Steel Not Specifically Detailed for Seismic Resistance
 - c) Ordinary Reinforced Masonry Shear Walls
 - d) Intermediate Reinforced Concrete Moment Frames
- 2) Additional Systems and Structures (2009 IBC Section 1705.3.3)
 - a) Anchorage of electrical equipment used for emergency or stand-by power systems.
- 3) Special inspections for the seismic force resisting systems and additional systems and structures above are specified in "Schedule of Special Inspections".
- 4) Testing:
 - a) Provide certificates of compliance for concrete masonry units in accordance with specification section 04810, paragraph 1.4A prior to the commencement of construction.
 - b) Testing of concrete is specified in specification section 03300, paragraph 3.17.
- 5) The type and frequency of special inspections required are on structural drawings.
- 6) Testing and special inspection reports shall be distributed weekly to the Architect, Contractor, Owner, and Structural Engineer.

Contractor's Statement of Responsibility Seismic Quality Assurance

To be completed by the General Contractor and every Subcontractor responsible for the construction of designated systems and components listed in the Seismic Quality Assurance Plan. Submit separate copies to the Building Official and the Owner.

Project Name:	Softball Stadium Construction
State Project No:	<u>H27-6088-MJ</u>

Owner: <u>University of South Carolina</u>

A Seismic Quality Assurance Plan as required by <u>Section 1709 of the 2009 International Building</u> <u>Code</u> has been defined for this project. The required Seismic Quality Assurance program entitled "Quality Assurance Plan for Seismic Resistance" is an attachment to Section 014000 – Quality Requirements of the Project Specifications. The program designates building elements covered and references requiring Special Inspections that are part of the Seismic Quality Assurance Plan.

As a Contractor responsible for the construction of the designated systems and components listed in the quality assurance plan, I acknowledge the following:

- 1. We acknowledge awareness of the special requirements contained in the quality assurance plan.
- 2. We acknowledge that control will be exercised to obtain conformance with the construction documents approved by the Office of State Engineer (OSE).
- 3. Procedures will be maintained for exercising control within our organization to ensure compliance for the method and frequency of reporting, and for the distribution of the reports. (Attach description of the procedures to be instituted.)
- 4. Person(s) in our organization exercising control of the quality assurance plan requirements and their qualifications are identified in the attachment provided. (Attach list of personnel with qualifications.)

Submitted by:

(Type or Print Name of Firm)

(Type or Print Name of Firm Owner, Partner or Corp. Sec.)

Signature

Date

Owner's Authorization:

Signature

Date

University of South Carolina Softball Stadium Construction BID SET

STATEMENT OF SPECIAL INSPECTIONS

Project Name:Softball Stadium ConstructionState Project No:H27-6088-MJ

Owner: University of South Carolina

Architect/Engineer: Quackenbush Architects + Planners, CHA

The following firms and/or individuals are designated to perform the Special Inspections of the material or work designated below. (*Ex: Foundations, Concrete, etc.*) The firms and/or individuals have the experience, qualifications, certifications and/or licenses required to perform the special inspections indicated.

Material/Work to be Inspected: Soils

Firm/Individual Name:	Inspection service to be provided by the Owner
Address:	Inspection Agency to be determined

Material/Work to be Inspected: Concrete

 Firm/Individual Name:
 Inspection service to be provided by the Owner

 Address:
 Inspection Agency to be determined

Material/Work to be Inspected: Masonry

 Firm/Individual Name:
 Inspection service to be provided by the Owner

 Address:
 Inspection Agency to be determined

 Material/Work to be Inspected:
 Structural Steel, Steel Deck

 Firm/Individual Name:
 Inspection service to be provided by the Owner

 Address:
 Inspection Agency to be determined

 Material/Work to be Inspected:
 Metal Building System

 Firm/Individual Name:
 Inspection service to be provided by the Owner

 Address:
 Inspection Agency to be determined

Responsibilities of the special inspectors are indicated on the attached Schedule of Special Inspections. Discrepancies shall be brought to the immediate attention of the Contractor so that corrective action can be taken in a timely manner. Copies of all test reports and test data shall be obtained from the inspectors by the A/E on a timely basis.

(Print or Type Name of A/E Representative)

(Signature)

(Date)

University of South Carolina Softball Stadium Construction BID SET

STATEMENT OF SPECIAL INSPECTIONS

Project Name:Softball Stadium ConstructionState Project No:H27-6088-MJ

Owner: <u>University of South Carolina</u>

Architect/Engineer: <u>Quackenbush Architects + Planners, RMF Engineers</u>

The following firms and/or individuals are designated to perform the Special Inspections of the material or work designated below. (*Ex: Anchoring, Hazardous Ductwork.*) The firms and/or individuals have the experience, qualifications, certifications and/or licenses required to perform the special inspections indicated.

Material/Work to be Inspected: <u>Mechanical & Plumbing Components</u>

 Firm/Individual Name:
 Inspection service to be provided by the Owner

 Address:
 Inspection Agency to be determined

Material/Work to be Inspected: Electrical Components

 Firm/Individual Name:
 Inspection service to be provided by the Owner

 Address:
 Inspection Agency to be determined

Responsibilities of the special inspectors are indicated on the attached Schedule of Special Inspections. Discrepancies shall be brought to the immediate attention of the Contractor so that corrective action can be taken in a timely manner. Copies of all test reports and test data shall be obtained from the inspectors by the A/E on a timely basis.

(Print or Type Name of A/E Representative)

(Signature)

(Date)

END OF SECTION 014100
SECTION 014200 - REFERENCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."
- D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."
- E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Install": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
- H. "Provide": Furnish and install, complete and ready for the intended use.
- I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.3 INDUSTRY STANDARDS

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if

bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

- B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
- C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
 - 1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.4 ABBREVIATIONS AND ACRONYMS

A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

AABC	Associated Air Balance Council www.aabc.com	(202) 737-0202
AAMA	American Architectural Manufacturers Association www.aamanet.org	(847) 303-5664
AASHTO	American Association of State Highway and Transportation Officials www.transportation.org	(202) 624-5800
AATCC	American Association of Textile Chemists and Colorists www.aatcc.org	(919) 549-8141
ABMA	American Bearing Manufacturers Association www.americanbearings.org	(202) 367-1155
ACI	American Concrete Institute (Formerly: ACI International) www.concrete.org	(248) 848-3700
ACPA	American Concrete Pipe Association www.concrete-pipe.org	(972) 506-7216
AEIC	Association of Edison Illuminating Companies, Inc. (The) www.aeic.org	(205) 257-2530
AF&PA	American Forest & Paper Association www.afandpa.org	(800) 878-8878 (202) 463-2700

University of South Carolina Architect's Project No. 11.122.00 Softball Stadium Construction State Project No. H27-6088-MJ BID SET 03/16/12 AGA American Gas Association (202) 824-7000 www.aga.org Air-Conditioning, Heating, and Refrigeration Institute (The) AHRI (703) 524-8800 www.ahrinet.org AI Asphalt Institute (859) 288-4960 www.asphaltinstitute.org AIA American Institute of Architects (The) (800) 242-3837 www.aia.org (202) 626-7300 American Institute of Steel Construction AISC (800) 644-2400 www.aisc.org (312) 670-2400 AISI American Iron and Steel Institute (202) 452-7100 www.steel.org AMCA Air Movement and Control Association International, Inc. (847) 394-0150 www.amca.org ANSI American National Standards Institute (202) 293-8020 www.ansi.org AOSA Association of Official Seed Analysts, Inc. (607) 256-3313 www.aosaseed.com APA Architectural Precast Association (239) 454-6989 www.archprecast.org API American Petroleum Institute (202) 682-8000 www.api.org Air-Conditioning & Refrigeration Institute ARI (See AHRI) American Refrigeration Institute ARI (See AHRI) ARMA Asphalt Roofing Manufacturers Association (202) 207-0917 www.asphaltroofing.org ASCE American Society of Civil Engineers (800) 548-2723 www.asce.org (703) 295-6300 ASCE/SEI American Society of Civil Engineers/Structural Engineering Institute (See ASCE)

University of South Carolina Softball Stadium Construction BID SET		Architect's Project No. 11.122.00 State Project No. H27-6088-MJ 03/16/12	
ASHRAE	American Society of Heating, Refrigerating and Air- Conditioning Engineers	(800) 527-4723	
	www.ashrae.org	(404) 636-8400	
ASME	ASME International (American Society of Mechanical Engineers) www.asme.org	(800) 843-2763 (973) 882-1170	
ASSE	American Society of Safety Engineers (The) www.asse.org	(847) 699-2929	
ASSE	American Society of Sanitary Engineering www.asse-plumbing.org	(440) 835-3040	
ASTM	ASTM International (American Society for Testing and Materials Internative www.astm.org	(610) 832-9500 tional)	
ATIS	Alliance for Telecommunications Industry Solutions www.atis.org	(202) 628-6380	
AWI	Architectural Woodwork Institute www.awinet.org	(571) 323-3636	
AWPA	American Wood Protection Association (Formerly: American Wood-Preservers' Association www.awpa.com	(205) 733-4077	
AWS	American Welding Society www.aws.org	(800) 443-9353 (305) 443-9353	
AWWA	American Water Works Association www.awwa.org	(800) 926-7337 (303) 794-7711	
BHMA	Builders Hardware Manufacturers Association www.buildershardware.com	(212) 297-2122	
BIA	Brick Industry Association (The) www.gobrick.com	(703) 620-0010	
BICSI	BICSI, Inc. www.bicsi.org	(800) 242-7405 (813) 979-1991	
BISSC	Baking Industry Sanitation Standards Committee www.bissc.org	(866) 342-4772	
CDA	Copper Development Association www.copper.org	(800) 232-3282 (212) 251-7200	

University of Sc Softball Stadiun BID SET	outh Carolina A	Architect's Project No. 11.122.00 State Project No. H27-6088-MJ 03/16/12
CEA	Consumer Electronics Association www.ce.org	(866) 858-1555 (703) 907-7600
CFFA	Chemical Fabrics & Film Association, Inc. www.chemicalfabricsandfilm.com	(216) 241-7333
CFSEI	Cold-Formed Steel Engineers Institute www.cfsei.org	(866) 465-4732 (202) 263-4488
CIMA	Cellulose Insulation Manufacturers Association www.cellulose.org	(888) 881-2462 (937) 222-2462
CISCA	Ceilings & Interior Systems Construction Association www.cisca.org	on (630) 584-1919
CISPI	Cast Iron Soil Pipe Institute www.cispi.org	(404) 622-0073
CLFMI	Chain Link Fence Manufacturers Institute www.chainlinkinfo.org	(301) 596-2583
СРА	Composite Panel Association www.pbmdf.com	(703) 724-1128
CRI	Carpet and Rug Institute (The) www.carpet-rug.org	(706) 278-3176
CRRC	Cool Roof Rating Council www.coolroofs.org	(866) 465-2523 (510) 485-7175
CRSI	Concrete Reinforcing Steel Institute www.crsi.org	(800) 328-6306 (847) 517-1200
CSA	CSA International (Formerly: IAS - International Approval Services) www.csa-international.org	(866) 797-4272 (416) 747-4000
CSI	Construction Specifications Institute (The) www.csinet.org	(800) 689-2900 (703) 684-0300
CTI	Cooling Technology Institute (Formerly: Cooling Tower Institute) www.cti.org	(281) 583-4087
CWC	Composite Wood Council (See CPA)	
DASMA	Door and Access Systems Manufacturers Association www.dasma.com	on (216) 241-7333

University of South Softball Stadium Co BID SET	Carolina	Architect's Project No. 11.122.00 State Project No. H27-6088-MJ 03/16/12
DHI	Door and Hardware Institute www.dhi.org	(703) 222-2010
ECA	Electronic Components Association www.ec-central.org	(703) 907-8024
ECAMA	Electronic Components Assemblies & Materials A (See ECA)	Association
EIA	Electronic Industries Alliance (See TIA)	
EIMA	EIFS Industry Members Association www.eima.com	(800) 294-3462 (703) 538-1616
EJMA	Expansion Joint Manufacturers Association, Inc. www.ejma.org	(914) 332-0040
ESD	ESD Association (Electrostatic Discharge Association) www.esda.org	(315) 339-6937
EVO	Efficiency Valuation Organization www.evo-world.org	(415) 367-3643 44 20 88 167 857
FM Approvals	FM Approvals LLC www.fmglobal.com	(781) 762-4300
FM Global	FM Global (Formerly: FMG - FM Global) www.fmglobal.com	(401) 275-3000
FSA	Fluid Sealing Association www.fluidsealing.com	(610) 971-4850
FSC	Forest Stewardship Council U.S. www.fscus.org	(612) 353-4511
GA	Gypsum Association www.gypsum.org	(301) 277-8686
GANA	Glass Association of North America www.glasswebsite.com	(785) 271-0208
GS	Green Seal www.greenseal.org	(202) 872-6400
HI	Hydraulic Institute www.pumps.org	(973) 267-9700

University of South Softball Stadium Co BID SET	Carolina An Instruction	rchitect's P State Projec	roject No. 11.122.00 ct No. H27-6088-MJ 03/16/12
HI/GAMA	Hydronics Institute/Gas Appliance Manufacturers Association (See AHRI)		
НММА	Hollow Metal Manufacturers Association (See NAAMM)		
HPVA	Hardwood Plywood & Veneer Association www.hpva.org	((703) 435-2900
HPW	H. P. White Laboratory, Inc. www.hpwhite.com	((410) 838-6550
IAPSC	International Association of Professional Security Co www.iapsc.org	nsultants ((415) 536-0288
ICBO	International Conference of Building Officials (See ICC)		
ICC	International Code Council www.iccsafe.org	((888) 422-7233 (202) 370-1800
ICEA	Insulated Cable Engineers Association, Inc. www.icea.net	((770) 830-0369
ICPA	International Cast Polymer Alliance www.icpa-hq.org	((703) 525-0511
ICRI	International Concrete Repair Institute, Inc. www.icri.org	((847) 827-0830
IEC	International Electrotechnical Commission www.iec.ch	2	41 22 919 02 11
IEEE	Institute of Electrical and Electronics Engineers, Inc. www.ieee.org	(The) ((212) 419-7900
IES	Illuminating Engineering Society (Formerly: Illuminating Engineering Society of Nort America) www.ies.org	(h	(212) 248-5000
IESNA	Illuminating Engineering Society of North America (See IES)		
IEST	Institute of Environmental Sciences and Technology www.iest.org	((847) 981-0100
IGMA	Insulating Glass Manufacturers Alliance www.igmaonline.org	((613) 233-1510

University of South Carolina Softball Stadium Construction BID SET		Architect's Project No. 11.122.00 State Project No. H27-6088-M. 03/16/12	
IGSHPA	International Ground Source Heat Pump Association www.igshpa.okstate.edu	n (405) 744-5175	
Intertek	Intertek Group (Formerly: ETL SEMCO; Intertek Testing Service I www.intertek.com	(800) 967-5352 NA)	
ISA	International Society of Automation (The) (Formerly: Instrumentation, Systems, and Automati Society) www.isa.org	(919) 549-8411 ion	
ISAS	Instrumentation, Systems, and Automation Society ((See ISA)	(The)	
ISFA	International Surface Fabricators Association (Formerly: International Solid Surface Fabricators Association) www.isfanow.org	(877) 464-7732 (801) 341-7360	
ISO	International Organization for Standardization www.iso.org	41 22 749 01 11	
ISSFA	International Solid Surface Fabricators Association (See ISFA)		
ITU	International Telecommunication Union www.itu.int/home	41 22 730 51 11	
KCMA	Kitchen Cabinet Manufacturers Association www.kcma.org	(703) 264-1690	
LMA	Laminating Materials Association (See CPA)		
LPI	Lightning Protection Institute www.lightning.org	(800) 488-6864	
MBMA	Metal Building Manufacturers Association www.mbma.com	(216) 241-7333	
MCA	Metal Construction Association www.metalconstruction.org	(847) 375-4718	
MFMA	Metal Framing Manufacturers Association, Inc. www.metalframingmfg.org	(312) 644-6610	
MHIA	Material Handling Industry of America www.mhia.org	(800) 345-1815 (704) 676-1190	

University of South Carolina Softball Stadium Construction BID SET		Architect's Project No. 11.122.00 State Project No. H27-6088-MJ 03/16/12	
MMPA	Moulding & Millwork Producers Association (Formerly: Wood Moulding & Millwork Producers Association) www.wmmpa.com	(800) 550-7889 (530) 661-9591	
MPI	Master Painters Institute www.paintinfo.com	(888) 674-8937 (604) 298-7578	
MSS	Manufacturers Standardization Society of The Valve a Fittings Industry Inc. www.mss-hq.org	and (703) 281-6613	
NAAMM	National Association of Architectural Metal Manufact www.naamm.org	curers (630) 942-6591	
NACE	NACE International (National Association of Corrosion Engineers Internat www.nace.org	(800) 797-6223 (281) 228-6200	
NADCA	National Air Duct Cleaners Association www.nadca.com	(202) 737-2926	
NAIMA	North American Insulation Manufacturers Association www.naima.org	n (703) 684-0084	
NCAA	National Collegiate Athletic Association (The) www.ncaa.org	(317) 917-6222	
NCMA	National Concrete Masonry Association www.ncma.org	(703) 713-1900	
NEBB	National Environmental Balancing Bureau www.nebb.org	(301) 977-3698	
NECA	National Electrical Contractors Association www.necanet.org	(301) 657-3110	
NeLMA	Northeastern Lumber Manufacturers Association www.nelma.org	(207) 829-6901	
NEMA	National Electrical Manufacturers Association www.nema.org	(703) 841-3200	
NETA	InterNational Electrical Testing Association www.netaworld.org	(888) 300-6382 (269) 488-6382	
NFHS	National Federation of State High School Association www.nfhs.org	s (317) 972-6900	

University of South Carolina Softball Stadium Construction BID SET		Architect's Project No. 11.122.0 State Project No. H27-6088-M 03/16/1	
NFPA	NFPA (National Fire Protection Association) www.nfpa.org	(800) 344-3555 (617) 770-3000	
NFRC	National Fenestration Rating Council www.nfrc.org	(301) 589-1776	
NHLA	National Hardwood Lumber Association www.nhla.com	(800) 933-0318 (901) 377-1818	
NLGA	National Lumber Grades Authority www.nlga.org	(604) 524-2393	
NOMMA	National Ornamental & Miscellaneous Metals Associ www.nomma.org	ation (888) 516-8585	
NRCA	National Roofing Contractors Association www.nrca.net	(800) 323-9545 (847) 299-9070	
NRMCA	National Ready Mixed Concrete Association www.nrmca.org	(888) 846-7622 (301) 587-1400	
NSF	NSF International (National Sanitation Foundation International) www.nsf.org	(800) 673-6275 (734) 769-8010	
NSPE	National Society of Professional Engineers www.nspe.org	(703) 684-2800	
NSSGA	National Stone, Sand & Gravel Association www.nssga.org	(800) 342-1415 (703) 525-8788	
PCI	Precast/Prestressed Concrete Institute www.pci.org	(312) 786-0300	
PDI	Plumbing & Drainage Institute www.pdionline.org	(800) 589-8956 (978) 557-0720	
RCSC	Research Council on Structural Connections www.boltcouncil.org		
RFCI	Resilient Floor Covering Institute www.rfci.com	(706) 882-3833	
SCTE	Society of Cable Telecommunications Engineers www.scte.org	(800) 542-5040 (610) 363-6888	
SDI	Steel Deck Institute www.sdi.org	(847) 458-4647	

University of South Softball Stadium Co BID SET	Carolina A A A A A A A A A A A A A A A A A A A	Architect's Project No. 11.122.00 State Project No. H27-6088-MJ 03/16/12
SDI	Steel Door Institute www.steeldoor.org	(440) 899-0010
SEI/ASCE	Structural Engineering Institute/American Society o Engineers (See ASCE)	f Civil
SIA	Security Industry Association www.siaonline.org	(866) 817-8888 (703) 683-2075
SJI	Steel Joist Institute www.steeljoist.org	(843) 293-1995
SMA	Screen Manufacturers Association www.smainfo.org	(773) 636-0672
SMACNA	Sheet Metal and Air Conditioning Contractors' Nation Association www.smacna.org	onal (703) 803-2980
SPFA	Spray Polyurethane Foam Alliance www.sprayfoam.org	(800) 523-6154
SPIB	Southern Pine Inspection Bureau www.spib.org	(850) 434-2611
SPRI	Single Ply Roofing Industry www.spri.org	(781) 647-7026
SSINA	Specialty Steel Industry of North America www.ssina.com	(800) 982-0355 (202) 342-8630
SSPC	SSPC: The Society for Protective Coatings www.sspc.org	(877) 281-7772 (412) 281-2331
SWI	Steel Window Institute www.steelwindows.com	(216) 241-7333
SWPA	Submersible Wastewater Pump Association www.swpa.org	(847) 681-1868
TCNA	Tile Council of North America, Inc. (Formerly: Tile Council of America) www.tileusa.com	(864) 646-8453
TEMA	Tubular Exchanger Manufacturers Association, Inc. www.tema.org	(914) 332-0040

University of South Carolina Softball Stadium Construction BID SET		Architect's Project No. 11.122.0 State Project No. H27-6088-M 03/16/1	
TIA	Telecommunications Industry Association (Formerly: TIA/EIA - Telecommunications Industr Association/Electronic Industries Alliance) www.tiaonline.org	(703) 907-7700 y	
TIA/EIA	Telecommunications Industry Association/Electroni Industries Alliance (See TIA)	c	
TMS	The Masonry Society www.masonrysociety.org	(303) 939-9700	
TPI	Truss Plate Institute www.tpinst.org	(703) 683-1010	
TPI	Turfgrass Producers International www.turfgrasssod.org	(800) 405-8873 (847) 649-5555	
TRI	Tile Roofing Institute www.tileroofing.org	(312) 670-4177	
UL	Underwriters Laboratories Inc. www.ul.com	(877) 854-3577	
UNI	Uni-Bell PVC Pipe Association www.uni-bell.org	(972) 243-3902	
USGBC	U.S. Green Building Council www.usgbc.org	(800) 795-1747	
WASTEC	Waste Equipment Technology Association www.wastec.org	(800) 424-2869 (202) 244-4700	
WCMA	Window Covering Manufacturers Association www.wcmanet.org	(212) 297-2122	
WDMA	Window & Door Manufacturers Association www.wdma.com	(800) 223-2301 (312) 321-6802	
WI	Woodwork Institute (Formerly: WIC - Woodwork Institute of California www.wicnet.org	(916) 372-9943 a)	
WMMPA	Wood Moulding & Millwork Producers Association (See MMPA)	I	

University of South Carolina Softball Stadium Construction BID SET

B. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

IAPMO	International Association of Plumbing and Mechanical Officials www.iapmo.org	(909) 472-4100
ICC	International Code Council www.iccsafe.org	(888) 422-7233
ICC-ES	ICC Evaluation Service, LLC www.icc-es.org	(800) 423-6587 (562) 699-0543

C. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

CPSC	Consumer Product Safety Commission www.cpsc.gov	(800) 638-2772 (301) 504-7923
DOC	Department of Commerce National Institute of Standards and Technology www.nist.gov	(301) 975-4040
DOE	Department of Energy www.energy.gov	(202) 586-9220
EPA	Environmental Protection Agency www.epa.gov	(202) 272-0167
FG	Federal Government Publications www.gpo.gov	(202) 512-1800
GSA	General Services Administration www.gsa.gov	(800) 488-3111 (202) 619-8925
LBL	Lawrence Berkeley National Laboratory Environmental Energy Technologies Division http://eetd.lbl.gov	(510) 486-4000
OSHA	Occupational Safety & Health Administration www.osha.gov	(800) 321-6742
SD	Department of State www.state.gov	(202) 647-4000
TRB	Transportation Research Board	(202) 334-2934

University of South Carolina Softball Stadium Construction BID SET		Architect's Project No. 11.122.00 State Project No. H27-6088-MJ 03/16/12
	National Cooperative Highway Research Program www.trb.org	
USDA	Department of Agriculture Agriculture Research Service U.S. Salinity Laboratory www.ars.usda.gov	(202) 720-3656
USDA	Department of Agriculture Rural Utilities Service www.usda.gov	(202) 720-2791
USDJ	Department of Justice Office of Justice Programs National Institute of Justice www.ojp.usdoj.gov	(202) 307-0703
USPS	United States Postal Service www.usps.com	(202) 268-2000

D. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

CFR	Code of Federal Regulations Available from Government Printing Office www.gpo.gov/fdsys	(866) 512-1800 (202) 512-1800
FED-STD	Federal Standard (See FS)	
FS	Federal Specification Available from Department of Defense Single Stock Point http://dodssp.daps.dla.mil	(215) 697-2664
	Available from Defense Standardization Program www.dsp.dla.mil	
	Available from General Services Administration www.gsa.gov	(800) 488-3111 (202) 619-8925
	Available from National Institute of Building Sciences/Whole Building Design Guide www.wbdg.org/ccb	(202) 289-7800

USAB	United States Access Board www.access-board.gov	(800) 872-2253 (202) 272-0080
USATBC B	U.S. Architectural & Transportation Barriers Compliance Board	
D	(See USAB)	

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 014200

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.
- B. Related Requirements:
 - 1. Section 011000 "Summary" for work restrictions and limitations on utility interruptions.

1.3 USE CHARGES

- A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Architect, testing agencies, and authorities having jurisdiction.
- B. Sewer Service: Pay sewer-service use charges for sewer usage by all entities for construction operations.
- C. Water Service: Pay water-service use charges for water used by all entities for construction operations.
- D. Electric Power Service: Pay electric-power-service use charges for electricity used by all entities for construction operations.

1.4 INFORMATIONAL SUBMITTALS

A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.

1.5 QUALITY ASSURANCE

A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.
- C. Accessible Temporary Egress: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

1.6 PROJECT CONDITIONS

A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 MATERIALS

- Chain-Link Fencing: Minimum 2-inch (50-mm), 0.148-inch- (3.8-mm-) thick, galvanized-steel, chain-link fabric fencing; minimum 8 feet high with galvanized-steel pipe posts; minimum 2-3/8-inch- (60-mm-) OD line posts and 2-7/8-inch- (73-mm-) OD corner and pull posts, with 1-5/8-inch- (42-mm-) OD top rails.
- B. Portable Chain-Link Fencing: Minimum 2-inch (50-mm), 0.148-inch- (3.8-mm-) thick, galvanized-steel, chain-link fabric fencing; minimum 8 feet high with galvanized-steel pipe posts; minimum 2-3/8-inch- (60-mm-) OD line posts and 2-7/8-inch- (73-mm-) OD corner and pull posts, with 1-5/8-inch- (42-mm-) OD top and bottom rails. Provide concrete bases for supporting posts.

2.2 TEMPORARY FACILITIES

- A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.
- B. Common-Use Field Office: Of sufficient size to accommodate needs of Owner, Architect, and construction personnel office activities and to accommodate Project meetings specified in other Division 01 Sections. Keep office clean and orderly. Furnish and equip offices as follows:
 - 1. Furniture required for Project-site documents including file cabinets, plan tables, plan racks, and bookcases.
 - 2. Conference room of sufficient size to accommodate meetings of 10 individuals. Provide electrical power service and 120-V ac duplex receptacles, with no fewer than one receptacle on each wall. Furnish room with conference table, chairs, and 4-foot- (1.2-m-) square tack and marker boards.
 - 3. Drinking water and private toilet.

- 4. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F (20 to 22 deg C).
- 5. Lighting fixtures capable of maintaining average illumination of 20 fc (215 lx) at desk height.
- C. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.
 - 1. Store combustible materials apart from building.

2.3 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.
- B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
 - 1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
 - 2. Heating Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
 - 3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return-air grille in system and remove at end of construction and clean HVAC system as required in Section 017700 "Closeout Procedures".

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service.
 - 1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.

- B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.
 - 1. Connect temporary sewers to municipal system as directed by authorities having jurisdiction.
- C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.
- D. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
- E. Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
- F. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.
 - 1. Provide dehumidification systems when required to reduce substrate moisture levels to level required to allow installation or application of finishes.
- G. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.
 - 1. Install electric power service overhead unless otherwise indicated.
- H. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
 - 1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
- I. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel. Install one telephone line(s) for each field office.
 - 1. At each telephone, post a list of important telephone numbers.
 - a. Police and fire departments.
 - b. Ambulance service.
 - c. Contractor's home office.
 - d. Contractor's emergency after-hours telephone number.
 - e. Architect's office.
 - f. Engineers' offices.
 - g. Owner's office.
 - h. Principal subcontractors' field and home offices.

- 2. Provide superintendent with cellular telephone or portable two-way radio for use when away from field office.
- J. Electronic Communication Service: Provide a desktop computer in the primary field office adequate for use by Architect and Owner to access Project electronic documents and maintain electronic communications.

3.3 SUPPORT FACILITIES INSTALLATION

- A. General: Comply with the following:
 - 1. Provide construction for temporary offices, shops, and sheds located within construction area or within 30 feet (9 m) of building lines that is noncombustible according to ASTM E 136. Comply with NFPA 241.
 - 2. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.
- B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations. Locate temporary roads and paved areas as indicated on Drawings.
 - 1. Provide dust-control treatment that is nonpolluting and nontracking. Reapply treatment as required to minimize dust.
- C. Traffic Controls: Comply with requirements of authorities having jurisdiction.
 - 1. Protect existing site improvements to remain including curbs, pavement, and utilities.
 - 2. Maintain access for fire-fighting equipment and access to fire hydrants.
- D. Parking: Provide temporary and use designated areas of Owner's existing parking areas for construction personnel.
- E. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
 - 1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
 - 2. Remove snow and ice as required to minimize accumulations.
- F. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.
 - 1. Identification Signs: Provide Project identification signs as indicated on Drawings.
 - 2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.
 - a. Provide temporary, directional signs for construction personnel and visitors.

- 3. Maintain and touchup signs so they are legible at all times.
- G. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 017300 "Execution."
- H. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
 - 1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.
- I. Temporary Elevator Use: Section 142400 "Hydraulic Elevators," for temporary use of new elevators.
- J. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.
- K. Temporary Use of Permanent Stairs: Use of new stairs for construction traffic will be permitted, provided stairs are protected and finishes restored to new condition at time of Substantial Completion.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.
- B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
 - 1. Comply with work restrictions specified in Section 011000 "Summary."
- C. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings.
 - 1. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree- or plant- protection zones.
 - 2. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
 - 3. Clean, repair, and restore adjoining properties and roads affected by erosion and sedimentation from Project site during the course of Project.
 - 4. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.
- D. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.

- E. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.
- F. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using environmentally safe materials.
- G. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people and animals from easily entering site except by entrance gates.
 - 1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations and As indicated on Drawings.
 - 2. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Furnish one set of keys to Owner.
- H. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each work day.
- I. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.
- J. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
 - 1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.

3.5 MOISTURE AND MOLD CONTROL

- A. Contractor's Moisture-Protection Plan: Avoid trapping water in finished work. Document visible signs of mold that may appear during construction.
- B. Exposed Construction Phase: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:
 - 1. Protect porous materials from water damage.
 - 2. Protect stored and installed material from flowing or standing water.
 - 3. Keep porous and organic materials from coming into prolonged contact with concrete.
 - 4. Remove standing water from decks.
 - 5. Keep deck openings covered or dammed.
- C. Partially Enclosed Construction Phase: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:

- 1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
- 2. Keep interior spaces reasonably clean and protected from water damage.
- 3. Periodically collect and remove waste containing cellulose or other organic matter.
- 4. Discard or replace water-damaged material.
- 5. Do not install material that is wet.
- 6. Discard, replace, or clean stored or installed material that begins to grow mold.
- 7. Perform work in a sequence that allows any wet materials adequate time to dry before enclosing the material in drywall or other interior finishes.
- D. Controlled Construction Phase of Construction: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:
 - 1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
 - 2. Use permanent HVAC system to control humidity.
 - 3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.
 - a. Hygroscopic materials that may support mold growth, including wood and gypsum-based products, that become wet during the course of construction and remain wet for 48 hours are considered defective.
 - b. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record readings beginning at time of exposure and continuing daily for 48 hours. Identify materials containing moisture levels higher than allowed. Report findings in writing to Architect.
 - c. Remove materials that can not be completely restored to their manufactured moisture level within 48 hours.

3.6 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.
 - 1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

- 1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
- 2. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
- 3. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017700 "Closeout Procedures."

END OF SECTION 015000

SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.
- B. Related Requirements:
 - 1. Section 012100 "Allowances" for products selected under an allowance.
 - 2. Section 012300 "Alternates" for products selected under an alternate.
 - 3. Section 012500 "Substitution Procedures" for requests for substitutions.
 - 4. Section 014200 "References" for applicable industry standards for products specified.

1.3 DEFINITIONS

- A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
 - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature, that is current as of date of the Contract Documents.
 - 2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
 - 3. Comparable Product: Product that is demonstrated and approved through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Basis-of-Design Product Specification: A specification in which a specific manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the specification.

1.4 ACTION SUBMITTALS

- A. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.
 - 2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Architect will notify Contractor of approval or rejection of proposed comparable product request within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
 - a. Form of Approval: As specified in Section 013300 "Submittal Procedures."
 - b. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.
- B. Basis-of-Design Product Specification Submittal: Comply with requirements in Section 013300 "Submittal Procedures." Show compliance with requirements.

1.5 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.
 - 1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
 - 2. If a dispute arises between contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
 - 1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
 - 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
 - 3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.

- 4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.
- C. Storage:
 - 1. Store products to allow for inspection and measurement of quantity or counting of units.
 - 2. Store materials in a manner that will not endanger Project structure.
 - 3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
 - 4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
 - 5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
 - 6. Protect stored products from damage and liquids from freezing.
 - 7. Provide a secure location and enclosure at Project site for storage of materials. Coordinate location with Owner.

1.7 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
 - 1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
 - 2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
 - 1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
 - 2. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.
 - 3. See other Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Section 017700 "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.

- 1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
- 2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
- 3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
- 4. Where products are accompanied by the term "as selected," Architect will make selection.
- 5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
- 6. Or Equal: For products specified by name and accompanied by the term "or equal," or "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.
- B. Product Selection Procedures:
 - 1. Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - 2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - 3. Products:
 - a. Restricted List: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will be considered.
 - b. Nonrestricted List: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product.
 - 4. Manufacturers:
 - a. Restricted List: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will be considered.
 - b. Nonrestricted List: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed, or a product by an unnamed manufacturer, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed manufacturer's product.
 - 5. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers.

Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.

- C. Visual Matching Specification: Where Specifications require "match Architect's sample", provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
 - 1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 012500 "Substitution Procedures" for proposal of product.
- D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 COMPARABLE PRODUCTS

- A. Conditions for Consideration: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with these requirements:
 - 1. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
 - 2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
 - 3. Evidence that proposed product provides specified warranty.
 - 4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
 - 5. Samples, if requested.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

SECTION 01 71 23 – FIELD ENGINEERING

PART 1 - GENERAL

1.1 Description

- Work included: Provide such field engineering services as are required for proper completion of A. the Work including, but not necessarily limited to:
 - Provide all staking required to construct the facility from coordinates established by the 1. Engineer.
 - 2. Establish proper line and levels for installation of utilities.
- Β. Related work:
 - Documents affecting work of this Section include, but are not necessarily limited to, 1. General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.
 - 2. Additional requirements for field engineering also may be described in other Sections of these Specifications.
 - 3.
 - Section 312200 Site Grading. Section 334100 Sewers: Storm Drainage 4.
 - 5. Section 333100 - Sewers: Sanitary Gravity

C. Work by others:

- The Engineer will establish reference control points for horizontal location of new 1 construction.
- 2. Not less than two benchmark elevations will be provided.

1.2 **Quality Assurance**

- A. Provide a competent survey party and surveying instruments for staking the work.
- Exercise proper precautions to verify the figures shown on the Drawings prior to laying out any B. part of the Work.
 - The Contractor will be held responsible for any errors therein that otherwise might have 1 been avoided.
 - 2. Promptly inform the Engineer of any error or discrepancies discovered in the Drawings or Specifications in order that proper corrections may be made.

1.3 **Procedures**

- Locate and protect control points before starting work on the site. A.
- Preserve permanent reference points during progress of the Work. Β.
- C. Do not change or relocate reference points or items of the Work without specific approval from the Engineer.
- D. Promptly advise the Engineer when a reference point is lost or destroyed, or requires relocation because of other changes in the Work.

END OF SECTION 017123

SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:
 - 1. Construction layout.
 - 2. Field engineering and surveying.
 - 3. Installation of the Work.
 - 4. Cutting and patching.
 - 5. Coordination of Owner-installed products.
 - 6. Progress cleaning.
 - 7. Starting and adjusting.
 - 8. Protection of installed construction.
- B. Related Requirements:
 - 1. Section 011000 "Summary" for limits on use of Project site.
 - 2. Section 013300 "Submittal Procedures" for submitting surveys.
 - 3. Section 017700 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.

1.3 DEFINITIONS

- A. Cutting: Removal of in-place construction necessary to permit installation or performance of other work.
- B. Patching: Fitting and repair work required to restore construction to original conditions after installation of other work.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For land surveyor.
- B. Certificates: Submit certificate signed by land surveyor certifying that location and elevation of improvements comply with requirements.

- C. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.
- D. Final Property Survey: Submit 1 copies showing the Work performed and record survey data.

1.5 QUALITY ASSURANCE

- A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.
- B. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
 - 1. Structural Elements: When cutting and patching structural elements, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection
 - 2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Operational elements include the following:
 - a. Primary operational systems and equipment.
 - b. Fire separation assemblies.
 - c. Air or smoke barriers.
 - d. Fire-suppression systems.
 - e. Mechanical systems piping and ducts.
 - f. Control systems.
 - g. Communication systems.
 - h. Fire-detection and -alarm systems.
 - i. Conveying systems.
 - j. Electrical wiring systems.
 - k. Operating systems of special construction.
 - 3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Other construction elements include but are not limited to the following:
 - a. Water, moisture, or vapor barriers.
 - b. Membranes and flashings.
 - c. Exterior curtain-wall construction.
 - d. Sprayed fire-resistive material.
 - e. Equipment supports.
 - f. Piping, ductwork, vessels, and equipment.
- g. Noise- and vibration-control elements and systems.
- 4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
- C. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections.
- B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
 - 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.
 - 1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services, and other utilities.
 - 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
 - 1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.

- 2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
- 3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
 - 1. Description of the Work.
 - 2. List of detrimental conditions, including substrates.
 - 3. List of unacceptable installation tolerances.
 - 4. Recommended corrections.
- D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Existing Utility Information: Furnish information to Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Architect according to requirements in Section 013100 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.
- B. General: Engage a land surveyor to lay out the Work using accepted surveying practices.
 - 1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
 - 2. Establish limits on use of Project site.

- 3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
- 4. Inform installers of lines and levels to which they must comply.
- 5. Check the location, level and plumb, of every major element as the Work progresses.
- 6. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
- 7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.
- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.
- D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.
- E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

3.4 FIELD ENGINEERING

- A. Identification: Owner will identify existing benchmarks, control points, and property corners.
- B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
 - 1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.
 - 2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.
- C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
 - 1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
 - 2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
 - 3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

D. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.

3.5 INSTALLATION

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
 - 1. Make vertical work plumb and make horizontal work level.
 - 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 - 3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
 - 4. Maintain minimum headroom clearance of 96 inches (2440 mm) in occupied spaces and 90 inches (2300 mm) in unoccupied spaces.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.
- F. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.
- G. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.
 - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
 - 2. Allow for building movement, including thermal expansion and contraction.
 - 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

- I. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- J. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.6 CUTTING AND PATCHING

- A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
 - 1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Temporary Support: Provide temporary support of work to be cut.
- C. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- D. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching according to requirements in Section 011000 "Summary."
- E. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas.
- F. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
 - 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 - 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 - 3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 - 4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
 - 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 - 6. Proceed with patching after construction operations requiring cutting are complete.
- G. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as

practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.

- 1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
- 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.
 - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
 - b. Restore damaged pipe covering to its original condition.
- 3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 - a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
- H. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.7 OWNER-INSTALLED PRODUCTS

- A. Site Access: Provide access to Project site for Owner's construction personnel.
- B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel.
 - 1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
 - 2. Preinstallation Conferences: Include Owner's construction personnel at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction personnel if portions of the Work depend on Owner's construction.

3.8 PROGRESS CLEANING

A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.

- 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
- 2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F (27 deg C).
- 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
 - a. Use containers intended for holding waste materials of type to be stored.
- 4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
 - 1. Remove liquid spills promptly.
 - 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 015000 "Temporary Facilities and Controls."
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.9 STARTING AND ADJUSTING

- A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- B. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Manufacturer's Field Service: Comply with qualification requirements in Section 014000 "Quality Requirements."

3.10 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION 017300

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
 - 1. Substantial Completion procedures.
 - 2. Final completion procedures.
 - 3. Warranties.
 - 4. Final cleaning.
 - 5. Repair of the Work.

B. Related Requirements:

- 1. Section 017300 "Execution" for progress cleaning of Project site.
- 2. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.
- 3. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
- 4. Section 017900 "Demonstration and Training" for requirements for instructing Owner's personnel.

1.3 ACTION SUBMITTALS

- A. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
- B. Certified List of Incomplete Items: Final submittal at Final Completion.

1.4 CLOSEOUT SUBMITTALS

- A. Certificates of Release: From authorities having jurisdiction.
- B. Certificate of Insurance: For continuing coverage.
- C. Field Report: For pest control inspection.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Schedule of Maintenance Material Items: For maintenance material submittal items specified in other Sections.

1.6 SUBSTANTIAL COMPLETION PROCEDURES

- A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's punch list), indicating the value of each item on the list and reasons why the Work is incomplete.
- B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
 - 1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 - 2. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.
 - 3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 - 4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect. Label with manufacturer's name and model number where applicable.
 - a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Architect's signature for receipt of submittals.
 - 5. Submit test/adjust/balance records.
 - 6. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
- C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
 - 1. Advise Owner of pending insurance changeover requirements.
 - 2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
 - 3. Complete startup and testing of systems and equipment.
 - 4. Perform preventive maintenance on equipment used prior to Substantial Completion.

- 5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 017900 "Demonstration and Training."
- 6. Advise Owner of changeover in heat and other utilities.
- 7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
- 8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
- 9. Complete final cleaning requirements, including touchup painting.
- 10. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.
 - 1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
 - 2. Results of completed inspection will form the basis of requirements for final completion.

1.7 FINAL COMPLETION PROCEDURES

- A. Submittals Prior to Final Completion: Before requesting final inspection for determining final completion, complete the following:
 - 1. Submit a final Application for Payment according to Section 012900 "Payment Procedures."
 - 2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
 - 3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
 - 4. Submit pest-control final inspection report.
- B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
 - 1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.8 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
 - 1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.
 - 2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
 - 3. Include the following information at the top of each page:
 - a. Project name.
 - b. Date.
 - c. Name of Architect.
 - d. Name of Contractor.
 - e. Page number.
 - 4. Submit list of incomplete items in the following format:
 - a. MS Excel electronic file. Architect will return annotated file.
 - b. PDF electronic file. Architect will return annotated file.

1.9 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated, or when delay in submittal of warranties might limit Owner's rights under warranty.
- B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.
- C. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.
 - 1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch (215-by-280-mm) paper.
 - 2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
 - 3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
- D. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 FINAL CLEANING

- A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
 - 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
 - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
 - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
 - c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
 - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
 - e. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
 - f. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 - g. Sweep concrete floors broom clean in unoccupied spaces.
 - h. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
 - i. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
 - j. Remove labels that are not permanent.

- k. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
- 1. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
- m. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
- n. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
- o. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
- p. Leave Project clean and ready for occupancy.
- C. Pest Control: Comply with pest control requirements in Section 015000 "Temporary Facilities and Controls." Prepare written report.
- D. Construction Waste Disposal: Comply with waste disposal requirements in Section 015000 "Temporary Facilities and Controls."

3.2 REPAIR OF THE WORK

- A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.
- B. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.
 - 1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
 - 2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that that already show evidence of repair or restoration.
 - a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.
 - 3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
 - 4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

END OF SECTION 017700

SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
 - 1. Operation manuals for systems, subsystems, and equipment.
 - 2. Product maintenance manuals.
 - 3. Systems and equipment maintenance manuals.
- B. Related Requirements:
 - 1. Section 013300 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.

1.3 DEFINITIONS

- A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.
- B. Subsystem: A portion of a system with characteristics similar to a system.

1.4 CLOSEOUT SUBMITTALS

- A. Manual Content: Operations and maintenance manual content is specified in individual Specification Sections to be reviewed at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
 - 1. Architect will comment on whether content of operations and maintenance submittals are acceptable.
 - 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
- B. Format: Submit operations and maintenance manuals in the following format:
 - 1. PDF electronic file. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to Architect.

- a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
- b. Enable inserted reviewer comments on draft submittals.
- 2. One paper copies. Include a complete operation and maintenance directory. Enclose title pages and directories in clear plastic sleeves. Architect will return.
- C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect will comment on whether general scope and content of manual are acceptable.
- D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect will return copy with comments.
 - 1. Correct or revise each manual to comply with Architect's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's comments and prior to commencing demonstration and training.

PART 2 - PRODUCTS

2.1 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

- A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
 - 1. Title page.
 - 2. Table of contents.
 - 3. Manual contents.
- B. Title Page: Include the following information:
 - 1. Subject matter included in manual.
 - 2. Name and address of Project.
 - 3. Name and address of Owner.
 - 4. Date of submittal.
 - 5. Name and contact information for Contractor.
 - 6. Name and contact information for Construction Manager.
 - 7. Name and contact information for Architect.
 - 8. Name and contact information for Commissioning Authority.
 - 9. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
 - 10. Cross-reference to related systems in other operation and maintenance manuals.

- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
 - 1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
- E. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
 - 1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
 - 2. File Names and Bookmarks: Enable bookmarking of individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.
- F. Manuals, Paper Copy: Submit manuals in the form of hard copy, bound and labeled volumes.
 - 1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch (215-by-280-mm) paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
 - a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
 - b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents, and indicate Specification Section number on bottom of spine. Indicate volume number for multiple-volume sets.
 - 2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
 - 3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment.
 - 4. Supplementary Text: Prepared on 8-1/2-by-11-inch (215-by-280-mm) white bond paper.
 - 5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.

- a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
- b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

2.2 OPERATION MANUALS

- A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
 - 1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
 - 2. Performance and design criteria if Contractor has delegated design responsibility.
 - 3. Operating standards.
 - 4. Operating procedures.
 - 5. Operating logs.
 - 6. Wiring diagrams.
 - 7. Control diagrams.
 - 8. Piped system diagrams.
 - 9. Precautions against improper use.
 - 10. License requirements including inspection and renewal dates.
- B. Descriptions: Include the following:
 - 1. Product name and model number. Use designations for products indicated on Contract Documents.
 - 2. Manufacturer's name.
 - 3. Equipment identification with serial number of each component.
 - 4. Equipment function.
 - 5. Operating characteristics.
 - 6. Limiting conditions.
 - 7. Performance curves.
 - 8. Engineering data and tests.
 - 9. Complete nomenclature and number of replacement parts.
- C. Operating Procedures: Include the following, as applicable:
 - 1. Startup procedures.
 - 2. Equipment or system break-in procedures.
 - 3. Routine and normal operating instructions.
 - 4. Regulation and control procedures.
 - 5. Instructions on stopping.
 - 6. Normal shutdown instructions.
 - 7. Seasonal and weekend operating instructions.
 - 8. Required sequences for electric or electronic systems.
 - 9. Special operating instructions and procedures.

- D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

2.3 PRODUCT MAINTENANCE MANUALS

- A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- C. Product Information: Include the following, as applicable:
 - 1. Product name and model number.
 - 2. Manufacturer's name.
 - 3. Color, pattern, and texture.
 - 4. Material and chemical composition.
 - 5. Reordering information for specially manufactured products.
- D. Maintenance Procedures: Include manufacturer's written recommendations and the following:
 - 1. Inspection procedures.
 - 2. Types of cleaning agents to be used and methods of cleaning.
 - 3. List of cleaning agents and methods of cleaning detrimental to product.
 - 4. Schedule for routine cleaning and maintenance.
 - 5. Repair instructions.
- E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
 - 1. Include procedures to follow and required notifications for warranty claims.

2.4 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.

- B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:
 - 1. Standard maintenance instructions and bulletins.
 - 2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
 - 3. Identification and nomenclature of parts and components.
 - 4. List of items recommended to be stocked as spare parts.
- D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
 - 1. Test and inspection instructions.
 - 2. Troubleshooting guide.
 - 3. Precautions against improper maintenance.
 - 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - 5. Aligning, adjusting, and checking instructions.
 - 6. Demonstration and training video recording, if available.
- E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
 - 1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
 - 2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
- F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
 - 1. Include procedures to follow and required notifications for warranty claims.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

- A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.
- B. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- C. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
 - 1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
 - 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- D. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
 - 1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
- E. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.
 - 1. Do not use original project record documents as part of operation and maintenance manuals.
 - 2. Comply with requirements of newly prepared record Drawings in Section 017839 "Project Record Documents."
- F. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 017823

SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for project record documents, including the following:
 - 1. Record Drawings.
 - 2. Record Specifications.
 - 3. Record Product Data.
 - 4. Miscellaneous record submittals.
- B. Related Requirements:
 - 1. Section 017300 "Execution" for final property survey.
 - 2. Section 017700 "Closeout Procedures" for general closeout procedures.
 - 3. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.3 CLOSEOUT SUBMITTALS

- A. Record Drawings: Comply with the following:
 - 1. Number of Copies: Submit one set(s) of marked-up record prints.
 - 2. Number of Copies: Submit copies of record Drawings as follows:
 - a. Initial Submittal:
 - 1) Submit one paper-copy set(s) of marked-up record prints.
 - 2) Submit PDF electronic files of scanned record prints and one of file prints.
 - 3) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
 - b. Final Submittal:
 - 1) Submit PDF electronic files of scanned record prints and three set(s) of prints.
 - 2) Print each drawing, whether or not changes and additional information were recorded.

- B. Record Specifications: Submit one paper copy or annotated PDF electronic files of Project's Specifications, including addenda and contract modifications.
- C. Record Product Data: Submit one paper copy or annotated PDF electronic files and directories of each submittal.
 - 1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.
- D. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous recordkeeping requirements and submittals in connection with various construction activities. Submit one paper copy or annotated PDF electronic files and directories of each submittal.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
 - 1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
 - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Accurately record information in an acceptable drawing technique.
 - c. Record data as soon as possible after obtaining it.
 - d. Record and check the markup before enclosing concealed installations.
 - e. Cross-reference record prints to corresponding archive photographic documentation.
 - 2. Content: Types of items requiring marking include, but are not limited to, the following:
 - a. Dimensional changes to Drawings.
 - b. Revisions to details shown on Drawings.
 - c. Depths of foundations below first floor.
 - d. Locations and depths of underground utilities.
 - e. Revisions to routing of piping and conduits.
 - f. Revisions to electrical circuitry.
 - g. Actual equipment locations.
 - h. Duct size and routing.
 - i. Locations of concealed internal utilities.
 - j. Changes made by Change Order or Construction Change Directive.
 - k. Changes made following Architect's written orders.
 - 1. Details not on the original Contract Drawings.
 - m. Field records for variable and concealed conditions.

- n. Record information on the Work that is shown only schematically.
- 3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
- 4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
- 5. Mark important additional information that was either shown schematically or omitted from original Drawings.
- 6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
 - 1. Record Prints: Organize record prints and newly prepared record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
 - 2. Format: Annotated PDF electronic file.
 - 3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
 - 4. Identification: As follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT RECORD DRAWINGS."
 - d. Name of Architect.
 - e. Name of Contractor.

2.2 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
 - 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 - 2. For each principal product, indicate whether record Product Data has been submitted in operation and maintenance manuals instead of submitted as record Product Data.
 - 3. Note related Change Orders, record Product Data, and record Drawings where applicable.
- B. Format: Submit record Specifications as paper copy.

2.3 RECORD PRODUCT DATA

A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.

- 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
- 2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
- 3. Note related Change Orders, record Specifications, and record Drawings where applicable.
- B. Format: Submit record Product Data as paper copy.
 - 1. Include record Product Data directory organized by Specification Section number and title, electronically linked to each item of record Product Data.

2.4 MISCELLANEOUS RECORD SUBMITTALS

- A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.
- B. Format: Submit miscellaneous record submittals as PDF electronic file.
 - 1. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

- A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.
- B. Maintenance of Record Documents and Samples: Store record documents and Samples in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Architect's reference during normal working hours.

END OF SECTION 017839

SECTION 017900 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
 - 1. Demonstration of operation of systems, subsystems, and equipment.
 - 2. Training in operation and maintenance of systems, subsystems, and equipment.

1.3 INFORMATIONAL SUBMITTALS

- A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
- B. Attendance Record: For each training module, submit list of participants and length of instruction time.

1.4 QUALITY ASSURANCE

- A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.
- B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 014000 "Quality Requirements," experienced in operation and maintenance procedures and training.

1.5 COORDINATION

A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.

- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
- C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Architect.

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:
 - 1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
 - a. System, subsystem, and equipment descriptions.
 - b. Performance and design criteria if Contractor is delegated design responsibility.
 - c. Operating standards.
 - d. Regulatory requirements.
 - e. Equipment function.
 - f. Operating characteristics.
 - g. Limiting conditions.
 - h. Performance curves.
 - 2. Documentation: Review the following items in detail:
 - a. Emergency manuals.
 - b. Operations manuals.
 - c. Maintenance manuals.
 - d. Project record documents.
 - e. Identification systems.
 - f. Warranties and bonds.
 - g. Maintenance service agreements and similar continuing commitments.
 - 3. Emergencies: Include the following, as applicable:
 - a. Instructions on meaning of warnings, trouble indications, and error messages.
 - b. Instructions on stopping.
 - c. Shutdown instructions for each type of emergency.
 - d. Operating instructions for conditions outside of normal operating limits.
 - e. Sequences for electric or electronic systems.

- f. Special operating instructions and procedures.
- 4. Operations: Include the following, as applicable:
 - a. Startup procedures.
 - b. Equipment or system break-in procedures.
 - c. Routine and normal operating instructions.
 - d. Regulation and control procedures.
 - e. Control sequences.
 - f. Safety procedures.
 - g. Instructions on stopping.
 - h. Normal shutdown instructions.
 - i. Operating procedures for emergencies.
 - j. Operating procedures for system, subsystem, or equipment failure.
 - k. Seasonal and weekend operating instructions.
 - 1. Required sequences for electric or electronic systems.
 - m. Special operating instructions and procedures.
- 5. Adjustments: Include the following:
 - a. Alignments.
 - b. Checking adjustments.
 - c. Noise and vibration adjustments.
 - d. Economy and efficiency adjustments.
- 6. Troubleshooting: Include the following:
 - a. Diagnostic instructions.
 - b. Test and inspection procedures.
- 7. Maintenance: Include the following:
 - a. Inspection procedures.
 - b. Types of cleaning agents to be used and methods of cleaning.
 - c. List of cleaning agents and methods of cleaning detrimental to product.
 - d. Procedures for routine cleaning
 - e. Procedures for preventive maintenance.
 - f. Procedures for routine maintenance.
 - g. Instruction on use of special tools.
- 8. Repairs: Include the following:
 - a. Diagnosis instructions.
 - b. Repair instructions.
 - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - d. Instructions for identifying parts and components.
 - e. Review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 017823 "Operation and Maintenance Data."
- B. Set up instructional equipment at instruction location.

3.2 INSTRUCTION

- A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.
- B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
 - 1. Architect will furnish an instructor to describe basis of system design, operational requirements, criteria, and regulatory requirements.
 - 2. Owner will furnish an instructor to describe Owner's operational philosophy.
 - 3. Owner will furnish Contractor with names and positions of participants.
- C. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
 - 1. Schedule training with Owner with at least seven days' advance notice.
- D. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.
- E. Cleanup: Collect used and leftover educational materials and remove from Project site. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

END OF SECTION 017900

SECTION 024116 - STRUCTURE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Demolition and removal of buildings and site improvements.
 - 2. Removing below-grade construction.
 - 3. Disconnecting, capping or sealing, and abandoning in-place and removing site utilities.
- B. Related Sections:
 - 1. Section 011000 "Summary" for use of the premises and phasing requirements.

1.3 DEFINITIONS

A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged.

1.4 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.
- B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.
 - 1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.5 INFORMATIONAL SUBMITTALS

- A. Schedule of Building Demolition Activities: Indicate the following:
 - 1. Detailed sequence of demolition work, with starting and ending dates for each activity.
 - 2. Temporary interruption of utility services.
 - 3. Shutoff and capping or re-routing of utility services.

- B. Predemolition Photographs: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by demolition operations.
- C. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.
- D. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

1.6 QUALITY ASSURANCE

- A. Refrigerant Recovery Technician Qualifications: Certified by EPA-approved certification program.
- B. Regulatory Requirements: Comply with governing EPA notification regulations before beginning demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- C. Standards: Comply with ANSI/ASSE A10.6 and NFPA 241.
- D. Predemolition Conference: Conduct conference at Project site.
 - 1. Inspect and discuss condition of construction to be demolished.
 - 2. Review structural load limitations of existing structures.
 - 3. Review and finalize building demolition schedule and verify availability of demolition personnel, equipment, and facilities needed to make progress and avoid delays.
 - 4. Review and finalize protection requirements.
 - 5. Review procedures for noise control and dust control.
 - 6. Review procedures for protection of adjacent buildings.
 - 7. Review items to be salvaged and returned to Owner.

1.7 PROJECT CONDITIONS

- A. Buildings to be demolished will be vacated and their use discontinued before start of the Work.
- B. Buildings immediately adjacent to demolition area will be occupied. Conduct building demolition so operations of occupied buildings will not be disrupted.
 - 1. Provide not less than 72 hours' notice of activities that will affect operations of adjacent occupied buildings.
 - 2. Maintain access to existing walkways, exits, and other facilities used by occupants of adjacent buildings.
 - a. Do not close or obstruct walkways, exits, or other facilities used by occupants of adjacent buildings without written permission from authorities having jurisdiction.

- C. Owner assumes no responsibility for buildings and structures to be demolished.
 - 1. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
 - 2. Before building demolition, Owner will remove the following items:
 - a. Loose equipment and furniture.
- D. Hazardous Materials: A hazardous material survey has been performed by the Owner and results are included in this bid package. Contractor should be aware that additional materials may be encountered as work progresses which are suspect of containing hazardous materials. If these materials are encountered, do not disturb; immediately notify Architect and Owner. Staff from the Owner's Hazardous Materials group will be present at the pre-construction meeting and will discuss survey findings and appropriate procedures with the Contractor.
- E. On-site storage or sale of removed items or materials is not permitted.
- F. Contractor is responsible to remove or re-route all utilities indicated / shown to avoid conflict with new construction
- G. Owner may elect to salvage or remove by other means some major items prior to beginning of construction. Examples are (but not limited to): field lighting, batting cage structure, field netting. If items are not removed prior to contract, Contractor is still responsible to remove them under this contract. If parts or components are removed prior to this contract, Contractor is still responsible to removing remaining components (e.g. conduit at lighting or foundation at batting cage).
- H. Items noted to be demolished are to be removed in their entirety. Contractor is responsible for visiting site prior to bidding.

1.8 COORDINATION

A. Arrange demolition schedule so as not to interfere with Owner's on-site operations or operations of adjacent occupied buildings.

PART 2 - PRODUCTS (Not Used)

2.1 SOIL MATERIALS

A. Satisfactory Soils: Comply with requirements in Section 312200 "Site Grading."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting demolition operations.

- B. Review Project Record Documents of existing construction provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.
- C. Engage a professional engineer to perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during building demolition operations.
 - 1. Steel Tendons: Locate tensioned steel tendons and include recommendations for detensioning.

3.2 PREPARATION

- A. Refrigerant: Remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction before starting demolition.
- B. Existing Utilities: Locate, identify, disconnect, and seal or cap off indicated utilities serving buildings and structures to be demolished.
 - 1. Owner will arrange to shut off indicated utilities when requested by Contractor.
 - 2. If removal, relocation, or abandonment of utility services will affect adjacent occupied buildings, then provide temporary utilities that bypass buildings and structures to be demolished and that maintain continuity of service to other buildings and structures.
 - 3. Cut off pipe or conduit a minimum of 24 inches (610 mm) below grade. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing according to requirements of authorities having jurisdiction.
- C. Existing Utilities: See plumbing and electrical Sections for shutting off, disconnecting, removing, and sealing or capping utilities. Do not start demolition work until utility disconnecting and sealing have been completed and verified in writing.
- D. Temporary Shoring: Provide and maintain interior and exterior shoring, bracing, or structural support to preserve stability and prevent unexpected movement or collapse of construction being demolished.
 - 1. Strengthen or add new supports when required during progress of demolition.

3.3 PROTECTION

- A. Existing Facilities: Protect adjacent walkways, loading docks, building entries, and other building facilities during demolition operations. Maintain exits from existing buildings.
- B. Existing Utilities: Maintain utility services to remain and protect from damage during demolition operations.
 - 1. Do not interrupt existing utilities serving adjacent occupied or operating facilities unless authorized in writing by Owner and authorities having jurisdiction.
 - 2. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and authorities having jurisdiction.

- a. Provide at least 72 hours' notice to occupants of affected buildings if shutdown of service is required during changeover.
- C. Temporary Protection: Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction and as indicated. Comply with requirements in Section 015000 "Temporary Facilities and Controls."
 - 1. Protect adjacent buildings and facilities from damage due to demolition activities.
 - 2. Protect existing site improvements, appurtenances, and landscaping to remain.
 - 3. Erect a plainly visible fence around drip line of individual trees or around perimeter drip line of groups of trees to remain.
 - 4. Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 - 5. Provide protection to ensure safe passage of people around building demolition area and to and from occupied portions of adjacent buildings and structures.
 - 6. Protect walls, windows, roofs, and other adjacent exterior construction that are to remain and that are exposed to building demolition operations.
 - 7. Erect and maintain dustproof partitions and temporary enclosures to limit dust, noise, and dirt migration to occupied portions of adjacent buildings.
- D. Remove temporary barriers and protections where hazards no longer exist. Where open excavations or other hazardous conditions remain, leave temporary barriers and protections in place.

3.4 DEMOLITION, GENERAL

- A. General: Demolish indicated buildings and site improvements completely. Use methods required to complete the Work within limitations of governing regulations and as follows:
 - 1. Do not use cutting torches until work area is cleared of flammable materials. Maintain portable fire-suppression devices during flame-cutting operations.
 - 2. Maintain fire watch during and for at least 24 hours after flame cutting operations.
 - 3. Maintain adequate ventilation when using cutting torches.
 - 4. Locate building demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
- B. Engineering Surveys: During demolition, perform surveys to detect hazards that may result from building demolition activities.
- C. Site Access and Temporary Controls: Conduct building demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 - 1. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
 - 2. Use water mist and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations. Do not use water when it may damage

adjacent construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.

D. Explosives: Use of explosives is not permitted.

3.5 DEMOLITION BY MECHANICAL MEANS

- A. Proceed with demolition of structural framing members systematically, from higher to lower level. Complete building demolition operations above each floor or tier before disturbing supporting members on the next lower level.
- B. Remove debris from elevated portions of the building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
 - 1. Remove structural framing members and lower to ground by method suitable to minimize ground impact and dust generation.
- C. Below-Grade Construction: Demolish foundation walls and other below-grade construction that are within footprint of new construction and extending 5 feet (1.5 m) outside footprint indicated for new construction. Abandon below-grade construction outside this area.
 - 1. Remove below-grade construction, including basements, foundation walls, and footings, completely.
- D. Existing Utilities: Demolish existing utilities and below-grade utility structures that are within 5 feet (1.5 m) outside footprint indicated for new construction. Abandon utilities outside this area only as noted on the drawings.
 - 1. Fill abandoned utility structures with recycled pulverized concrete according to backfill requirements in Division 31.
- E. Existing Utilities: Demolish and remove existing utilities and below-grade utility structures.

3.6 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete: Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least 3/4 inch (19 mm) at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.
- B. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, then remove concrete between saw cuts.
- C. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, then remove masonry between saw cuts.
D. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.

3.7 SITE RESTORATION

- A. Below-Grade Areas: Rough grade below-grade areas ready for further excavation or new construction.
- B. Below-Grade Areas: Completely fill below-grade areas and voids resulting from building demolition operations with satisfactory soil materials according to backfill requirements in Division 31.
- C. Site Grading: Uniformly rough grade area of demolished construction to a smooth surface, free from irregular surface changes. Provide a smooth transition between adjacent existing grades and new grades.

3.8 REPAIRS

A. Promptly repair damage to adjacent buildings caused by demolition operations.

3.9 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove demolition waste materials from Project site and legally dispose of them in an EPAapproved landfill acceptable to authorities having jurisdiction.
 - 1. Do not allow demolished materials to accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Do not burn demolished materials.

3.10 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by building demolition operations. Return adjacent areas to condition existing before building demolition operations began.
 - 1. Clean roadways of debris caused by debris transport.

END OF SECTION 024116

HAZARDOUS TEST REPORTS FROM USC ATTACHED

FM00359338

USC Work Order

Description HAZMAT CHECKS IN PREPARATION FOR DEMOLITION

Site	COLUMBIA	Assigned To	JPROVENCE	
Building		Crew	HAZMAT	
Floor	Room:	Start Date	P	riority ⁵
Equipment		Due date	13-APR-11	
		Request Date	14-MAR-11 b	y KALLEY
Request #	FM00359338 Description HAZMAT C	HECKS IN PREPARA	TION FOR DEMOLITION	l
Parent WO #				
CP Number	CP00317994 SOFTBALL STADIUM CO	NSTRUCTION		
State/Interna	I Project Number H27-6088			
Requestor	DERRICK,ANN	Project Manager	DERRICK, ANN	
Telephone	777-5811	Telephone	777-5811	
Alternate		Estimated Cost	\$ 672.00	
Telephone		Billing	FIXED PRICE	
Non-Availabl	e Time	53100-W785-57120	(SOFTBALL STADIUM	CONSTRUCTION)
Task List				
WILL DEMOL	ISH THE GRAY OLD PRESS BOX, THE NEWER P	RESS BOX, THE EN	TIRE STADIUM (CONCR	ETE AREA W
DATE WORK	STARTED	CAUSE		
DATE WORK	COMPLETED	CONDITION		
EQUIPMENT				
CLOSING RE	MARKS			
BENCHSTOC	CK MATERIALS			
Qty	Description			Price Per Unit

Supervisor's Approval

4. CONCRETE

Note Date	Title
29-FEB-12	HAZMAT SURVEY RESULTS
SURVEY DATE	:1-19-2012
INSPECTOR #:	DARRYL WASHINGTON II BI-00568
STATUS: THE I	FOLLOWING MATERIALS HAVE BEEN TESTED FOR ASBESTOS AND LEAD MATERIALS RESULTS FOLLOWS
RUBBER FLOC	RING (BOTH DUGOUTS IN PLACE)- NEGATIVE FOR ASBESTOS CONTAINING MATERIALS
3 TAB SHINGLI	E (PRESS BOX)- NEGATIVE FOR ASBESTOS CONTAINING MATERIALS
FELT (PRESS	BOX)- NEGATIVE FOR ASBESTOS CONTAINING MATERIALS
NON SUSPECT	MATERIALS ON THIS JOB SITE
1. METAL 2. WOOD 3. SAND	

FM00359338

5. BRICK

INSPECTORS LOOKED INSIDE HOME TEAMS INDOOR LOCKER ROOM AND DID NOT SEE ANY SUSPECT MATERIAL. THE DOOR OF THE SPACE WAS METAL WITH NO SUSPECT MATERIAL IN PLACE. ALL WALLS APPEAR TO BE CONCRETE WALL MATERIAL IN PLACE ON BOTH SIDES. THE OPEN BATTING CAGE DOES NOT HAVE ANY SUSPECT MATERIALS IN PLACE. THE WATER LINES ARE BARE PIPING IN THE LOCKER ROOM.

LEAD BASE PAINT SUMMARY

BLACK HANDRAIL PAINT - NEGATIVE FOR LEAD BASE PAINT

BLACK POLES IN PLACE - NEGATIVE FOR LEAD BASE PAINT

WALLS OF BOTH DUGOUTS- NEGATIVE FOR LEAD BASE PAINT

RED SHELVES BOTH DUGOUTS - NEGATIVE FOR LEAD BASE PAINT

TREAD IN STANDS - RED- NEGATIVE FOR LEAD BASE PAINT

IF YOU ENCOUNTER ANY SUSPECT MATERIALS IN PLACE AND DEEM IT SUSPECT FOR ASBESTOS OR LEAD PLEASE STOP WORK AND CALL THE ASBESTOS PROGRAM MANGER FOR FURTHER TESTING OR ABATEMENT

REFER TO THE SURVEY RESULTS DOCUMENT ATTACHED TO THE WO FOR DETAILED INFORMATION.

Reading No	Time Type	Duration Units	Sequence	Component	Substrate	Side (Condition	Color	Site	Inspector	Floor Room	Misc 1 Misc 2 Results	Depth Index Action I	evel PbC	PbC Error PbL	PbL Error PbK	PbK Error
557	1/19/2012 12:09 PAINT	0.93 mg / cm ^2	Final	WALL	CONCRETE	1	NTACT	RED	SOFTBALL FEILD	D WASHINGTON	HOME DUGOUT	Negative	10	0.7 < LOD	0.8 < LOD	0.33 < LOD	0.8
558	1/19/2012 12:09 PAINT	2.31 mg / cm ^2	Final	WALL	CONCRETE	1	NTACT	RED	SOFTBALL FEILD	D WASHINGTON	HOME DUGOUT	Negative	1	0.7 < LOD	0.03 < LOD	0.03 < LOD	0.47
559	1/19/2012 12:11 PAINT	1.4 mg / cm ^2	Final	WALL	CONCRETE	1	NTACT	RED	SOFTBALL FEILD	D WASHINGTON	HOME DUGOUT	Negative	1	0.7 < LOD	0.03 < LOD	0.03 < LOD	0.65
560	1/19/2012 12:11 PAINT	1.39 mg / cm ^2	Final	WALL	CONCRETE	1	NTACT	RED	SOFTBALL FEILD	D WASHINGTON	HOME DUGOUT	Negative	1	0.7 < LOD	0.03 < LOD	0.03 < LOD	0.56
561	1/19/2012 12:11 PAINT	4.21 mg / cm ^2	Final	WALL	CONCRETE		NTACT	RED	SOFTBALL FEILD	D WASHINGTON	HOME DUGOUT	Negative	1	0.7 < LOD	0.03 < LOD	0.03 < LOD	0.23
562	1/19/2012 12:11 PAINT	1.39 mg / cm ^2	Final	WALL	CONCRETE		NIACI	RED	SOFTBALL FEILD	DWASHINGTON	HOME DUGOUT	Negative	1.53	0.7 < LOD	0.05 < LOD	0.05 < LOD	0.59
563	1/19/2012 12:11 PAINT	0.93 mg / cm ^2	Final	WALL	CONCRETE		NIACI	RED	SOFTBALL FEILD	D WASHINGTON	HOME DUGOUT	Negative	1	0.7 < LOD	0.04 < LOD	0.04 < LOD	0.85
504	1/19/2012 12:15 PAINT	1.88 mg / cm ^2	Find	WALL	CONCRETE		NTACT	RED	SOFTBALL FEILD	DWASHINGTON	HOME DUGOUT	Negative	1.14	0.7 < LOD	0.03 < LOD	0.03 < LOD	0.58
505	1/19/2012 12:15 PAINT	1.87 mg / cm ^2	Find	WALL	WOOD		NTACT	RED	SOFTBALL FEILD	DWASHINGTON	HOME DUGOUT	Negative	1	0.7 < LOD	0.03 < LOD	0.03 < LOD	0.03
500	1/19/2012 12:14 PAINT	0.95 mg / cm A2	Final	SHELVES	WOOD		NTACT	RED	SOFTBALL FEILD	DWASHINGTON	HOME DUGOUT	Negative	1	0.7 < LOD	0.03 < LOD	0.03 < LOD	0.59
507	1/10/2012 12:14 PAINT	0.93 mg / cm A2	Final	CHEIVES	WOOD		NTACT	RED	SOFTBALL FEILD	DWASHINGTON	HOME DUGOUT	Negative	1	0.7 < 100	0.03 < LOD	0.03 < LOD	0.40
569	1/19/2012 12:14 PAINT 1/19/2012 12:14 PAINT	0.93 mg / cm ^2	Final	SHELVES	WOOD		NTACT	RED	SOFTBALL FEILD	D WASHINGTON	HOME DUGOUT	Negative	11	0.7 < 100	0.04 < LOD	0.05 < 100	0.01
570	1/19/2012 12:14 PAINT	3.75 mg / cm ^2	Final	SHELVES	WOOD	÷	NTACT	RED	SOFTBALL FEILD	D WASHINGTON	HOME DUGOUT	Negative	1.1	0.7 < 100	0.03 < 100	0.03 < 100	0.47
570	1/19/2012 12:14 PAINT	0.94 mg / cm ^2	Final	SHELVES	WOOD	÷	NTACT	RED	SOFTBALL FEILD	D WASHINGTON	HOME DUGOUT	Negative	1	0.7 < 100	0.03 < 100	0.03 < 100	0.15
572	1/19/2012 12:15 PAINT	1.4 mg / cm ^2	Final	FENCE POLES	METAI	i	NTACT	BLACK	SOFTBALL FEILD	D WASHINGTON	HOME DUGOUT	Negative	3.51	0.7 < 100	0.38 < LOD	0.38 < LOD	1.05
573	1/19/2012 12:15 PAINT	1.88 mg / cm ^2	Final	FENCE POLES	METAL	i	NTACT	BLACK	SOFTBALL FEILD	D WASHINGTON	HOME DUGOUT	Negative	5.42	0.7 < LOD	0.43 < LOD	0.43 < LOD	1.05
574	1/19/2012 12:15 PAINT	1.4 mg / cm ^2	Final	FENCE POLES	METAL	i	NTACT	BLACK	SOFTBALL FEILD	D WASHINGTON	HOME DUGOUT	Negative	1.51	0.7 < LOD	0.19 < LOD	0.19 < LOD	1.05
575	1/19/2012 12:16 PAINT	1.87 mg / cm ^2	Final	FENCE POLES	METAL	i	NTACT	BLACK	SOFTBALL FEILD	D WASHINGTON	HOME DUGOUT	Negative	2.15	0.7 < LOD	0.4 < LOD	0.4 < LOD	0.9
576	1/19/2012 12:16 PAINT	1.87 mg / cm ^2	Final	FENCE POLES	METAL	1	NTACT	BLACK	SOFTBALL FEILD	D WASHINGTON	HOME DUGOUT	Negative	2.1	0.7 < LOD	0.22 < LOD	0.22 < LOD	1.05
577	1/19/2012 12:16 PAINT	2.32 mg / cm ^2	Final	FENCE POLES	METAL	1	NTACT	BLACK	SOFTBALL FEILD	D WASHINGTON	HOME DUGOUT	Negative	5.31	0.7 < LOD	0.56 < LOD	0.56 < LOD	1.05
578	1/19/2012 12:16 PAINT	1.88 mg / cm ^2	Final	FENCE POLES	METAL	1	NTACT	BLACK	SOFTBALL FEILD	D WASHINGTON	HOME DUGOUT	Negative	2.87	0.7 < LOD	0.27 < LOD	0.27 < LOD	1.05
579	1/19/2012 12:16 PAINT	1.41 mg / cm ^2	Final	RAILS	METAL	1	NTACT	BLACK	SOFTBALL FEILD	D WASHINGTON	HOME DUGOUT	Negative	1.69	0.7 < LOD	0.34 < LOD	0.34 < LOD	1.05
580	1/19/2012 12:17 PAINT	1.42 mg / cm ^2	Final	RAILS	METAL	1	NTACT	BLACK	SOFTBALL FEILD	D WASHINGTON	HOME DUGOUT	Negative	1.83	0.7 < LOD	0.41 < LOD	0.41 < LOD	1.2
581	1/19/2012 12:17 PAINT	1.89 mg / cm ^2	Final	RAILS	METAL	1	NTACT	BLACK	SOFTBALL FEILD	D WASHINGTON	HOME DUGOUT	Negative	5.54	0.7 < LOD	0.9 < LOD	1.08 < LOD	0.9
582	1/19/2012 12:17 PAINT	1.42 mg / cm ^2	Final	RAILS	METAL	1	NTACT	BLACK	SOFTBALL FEILD	D WASHINGTON	HOME DUGOUT	Negative	1.69	0.7 < LOD	0.3 < LOD	0.3 < LOD	1.2
583	1/19/2012 12:17 PAINT	5.62 mg / cm ^2	Final	RAILS	METAL	1	NTACT	BLACK	SOFTBALL FEILD	D WASHINGTON	HOME DUGOUT	Negative	3.64	0.7 < LOD	0.31 < LOD	0.31 0.8	0.2
584	1/19/2012 12:17 PAINT	1.88 mg / cm ^2	Final	RAILS	METAL	1	NTACT	BLACK	SOFTBALL FEILD	D WASHINGTON	HOME DUGOUT	Negative	2.16	0.7 < LOD	0.36 < LOD	0.36 < LOD	1.2
585	1/19/2012 12:17 PAINT	2.83 mg / cm ^2	Final	RAILS	METAL	1	NTACT	BLACK	SOFTBALL FEILD	D WASHINGTON	HOME DUGOUT	Negative	4.35	0.7 < LOD	0.37 < LOD	0.37 < LOD	0.75
586	1/19/2012 12:18 PAINT	2.82 mg / cm ^2	Final	RAILS	METAL	1	NTACT	BLACK	SOFTBALL FEILD	D WASHINGTON	HOME DUGOUT	Negative	4.67	0.7 < LOD	0.46 < LOD	0.46 < LOD	0.75
587	1/19/2012 12:19 PAINT	1.87 mg / cm ^2	Final	RAILS	METAL	1	NTACT	BLACK	SOFTBALL FEILD	D WASHINGTON	STANDS	Negative	1	0.7 < LOD	0.03 < LOD	0.03 < LOD	1.05
588	1/19/2012 12:19 PAINT	1.87 mg / cm ^2	Final	RAILS	METAL	1	NTACT	BLACK	SOFTBALL FEILD	D WASHINGTON	STANDS	Negative	1	0.7 < LOD	0.03 < LOD	0.03 < LOD	0.9
589	1/19/2012 12:20 PAINT	1.87 mg / cm ^2	Final	RAILS	METAL	1	NTACT	BLACK	SOFTBALL FEILD	D WASHINGTON	STANDS	Negative	1	0.7 < LOD	0.03 < LOD	0.03 < LOD	1.05
590	1/19/2012 12:20 PAINT	1.87 mg / cm ^2	Final	RAILS	METAL	1	NTACT	BLACK	SOFTBALL FEILD	D WASHINGTON	STANDS	Negative	1	0.7 < LOD	0.04 < LOD	0.04 < LOD	1.35
591	1/19/2012 12:20 PAINT	1.89 mg / cm ^2	Final	RAILS	METAL		NTACT	BLACK	SOFTBALL FEILD	D WASHINGTON	STANDS	Negative	1	0.7 < LOD	0.03 < LOD	0.03 < LOD	0.9
592	1/19/2012 12:20 PAINT	1.87 mg / cm ^2	Final	RAILS	METAL		NTACT	BLACK	SOFTBALL FEILD	D WASHINGTON	STANDS	Negative	1	0.7 < LOD	0.03 < LOD	0.03 < LOD	1.2
593	1/19/2012 12:20 PAINT	1.4 mg / cm ^2	Final	RAILS	METAL		NIACI	BLACK	SOFTBALL FEILD	DWASHINGTON	STANDS	Negative	1	0.7 < LOD	0.04 < LOD	0.04 < LOD	1.35
594	1/19/2012 12:20 PAINT	1.87 mg / cm ^2	Final	RAILS	NETAL		NTACT	BLACK	SOFTBALL FEILD	DWASHINGTON	STANDS	Negative	1	0.7 < LOD	0.03 < LOD	0.03 < LOD	0.9
595	1/19/2012 12:21 PAINT	1.87 mg / cm ^2	Final	RAILS	NETAL		NTACT	BLACK	SOFTBALL FEILD	DWASHINGTON	STANDS	Negative	1	0.7 < LOD	0.03 < LOD	0.03 < LOD	0.9
596	1/19/2012 12:21 PAINT	1.86 mg / cm ^2	Final	RAILS	METAL		NTACT	BLACK	SOFTBALL FEILD	D WASHINGTON	STANDS	Negative	2 50	0.7 < LOD	0.03 < LOD	0.03 < LOD	1.05
597	1/19/2012 12:21 PAINT	3.17 mg / cm A2	Final	RAILS	METAL		NTACT	BLACK	SOFTBALL FEILD	D WASHINGTON	STANDS	Regative	3.59	0.7 0.7	0.1 0.2	0.02 1.1	0.2
500	1/10/2012 12:22 PAINT	29.5 mg / cm A2	Final	DAILS	METAL		NTACT	BLACK	SOFTBALL FEILD	DWASHINGTON	STANDS	Nogativo	2.55	0.7 < 100	0.02 < 1.00	0.03 < 100	0.2
599	1/19/2012 12:22 PAINT 1/10/2012 12:23 PAINT	1.65 mg / cm ^2	Final	RAILS	METAL		NTACT	BLACK	SOFTBALL FEILD	D WASHINGTON	STANDS	Negative	1	0.7 < 100	0.03 < LOD	0.03 < LOD	1.05
601	1/10/2012 12:23 FAINT	1.97 mg/cm ^2	Final	RAILS	METAL		NTACT	BLACK	SOFTBALL FEILD	D WASHINGTON	STANDS	Negative	1	0.7 < 100	0.03 < LOD	0.03 < LOD	1.05
602	1/19/2012 12:23 PAINT	1.41 mg / cm ^2	Final	RAILS	METAI	i	NTACT	BLACK	SOFTBALL FEILD	D WASHINGTON	STANDS	Negative	1	0.7 < 100	0.04 < 100	0.04 < 100	1.05
603	1/19/2012 12:24 PAINT	1.87 mg / cm ^2	Final	RAILS	METAL	i	NTACT	BLACK	SOFTBALL FEILD	D WASHINGTON	STANDS	Negative	1	0.7 < LOD	0.03 < LOD	0.03 < LOD	0.9
604	1/19/2012 12:24 PAINT	1.87 mg / cm ^2	Final	TREADS	CONCRETE	1	NTACT	RED	SOFTBALL FEILD	D WASHINGTON	STANDS	Negative	1	0.7 < LOD	0.03 < LOD	0.03 < LOD	0.5
605	1/19/2012 12:25 PAINT	2.32 mg / cm ^2	Final	TREADS	CONCRETE	1	NTACT	RED	SOFTBALL FEILD	D WASHINGTON	STANDS	Negative	2.08	0.7 < LOD	0.04 < LOD	0.04 < LOD	0.5
606	1/19/2012 12:25 PAINT	4.66 mg / cm ^2	Final	TREADS	CONCRETE	1	NTACT	RED	SOFTBALL FEILD	D WASHINGTON	STANDS	Negative	1.96	0.7 < LOD	0.03 < LOD	0.03 0.26	0.16
607	1/19/2012 12:26 PAINT	2.79 mg / cm ^2	Final	TREADS	CONCRETE	1	NTACT	RED	SOFTBALL FEILD	D WASHINGTON	STANDS	Negative	1	0.7 < LOD	0.03 < LOD	0.03 < LOD	0.53
608	1/19/2012 12:26 PAINT	2.82 mg / cm ^2	Final	TREADS	CONCRETE	1	NTACT	RED	SOFTBALL FEILD	D WASHINGTON	STANDS	Negative	1	0.7 1.6	6 0.8 < LOD	0.03 1.6	0.8
609	1/19/2012 12:26 PAINT	1.4 mg / cm ^2	Final	TREADS	CONCRETE	1	NTACT	RED	SOFTBALL FEILD	D WASHINGTON	STANDS	Negative	1	0.7 < LOD	0.03 < LOD	0.03 < LOD	0.67
610	1/19/2012 12:26 PAINT	1.87 mg / cm ^2	Final	TREADS	CONCRETE	1	NTACT	RED	SOFTBALL FEILD	D WASHINGTON	STANDS	Negative	1	0.7 < LOD	0.03 < LOD	0.03 < LOD	0.61
611	1/19/2012 12:27 PAINT	1.87 mg / cm ^2	Final	TREADS	CONCRETE	1	NTACT	RED	SOFTBALL FEILD	D WASHINGTON	STANDS	Negative	1	0.7 < LOD	0.03 < LOD	0.03 < LOD	0.64
612	1/19/2012 12:28 PAINT	2.34 mg / cm ^2	Final	TREADS	CONCRETE	1	NTACT	RED	SOFTBALL FEILD	D WASHINGTON	STANDS	Negative	1	0.7 < LOD	0.03 < LOD	0.03 < LOD	0.51
613	1/19/2012 12:28 PAINT	1.87 mg / cm ^2	Final	TREADS	CONCRETE	1	NTACT	RED	SOFTBALL FEILD	D WASHINGTON	STANDS	Negative	1.46	0.7 < LOD	0.04 < LOD	0.04 < LOD	0.53
614	1/19/2012 12:28 PAINT	3.73 mg / cm ^2	Final	TREADS	CONCRETE	1	NTACT	RED	SOFTBALL FEILD	D WASHINGTON	STANDS	Negative	2.79	0.7 1.4	0.4 < LOD	0.04 1.4	0.4
615	1/19/2012 12:29 PAINT	5.12 mg / cm ^2	Final	TREADS	CONCRETE	1	NTACT	RED	SOFTBALL FEILD	D WASHINGTON	STANDS	Negative	2.46	0.7 < LOD	0.03 < LOD	0.03 0.5	0.2
616	1/19/2012 12:29 PAINT	1.87 mg / cm ^2	Final	TREADS	CONCRETE	1	NTACT	RED	SOFTBALL FEILD	D WASHINGTON	STANDS	Negative	1	0.7 < LOD	0.03 < LOD	0.03 < LOD	0.56
617	1/19/2012 12:29 PAINT	5.15 mg / cm ^2	Final	TREADS	CONCRETE	1	NTACT	RED	SOFTBALL FEILD	D WASHINGTON	STANDS	Negative	1	0.7 < LOD	0.03 < LOD	0.03 0.28	0.15
618	1/19/2012 12:29 PAINT	1.87 mg / cm ^2	Final	TREADS	CONCRETE	1	NTACT	RED	SOFTBALL FEILD	D WASHINGTON	STANDS	Negative	1.02	0.7 < LOD	0.03 < LOD	0.03 < LOD	0.73
619	1/19/2012 12:33 PAINT	2.79 mg / cm ^2	Final	WALL	CONCRETE		NTACT	RED	SOFTBALL FEILD	D WASHINGTON	DUGOUT AWAY	Negative	1.73	0.7 < LOD	0.04 < LOD	0.04 < LOD	0.51
620	1/19/2012 12:33 PAINT	1.87 mg / cm ^2	Final	WALL	CONCRETE		NIACI	RED	SOFTBALL FEILD	DWASHINGTON	DUGOUT AWAY	Negative	1	0.7 < LOD	0.03 < LOD	0.03 < LOD	0.58
621	1/19/2012 12:33 PAINT	1.86 mg / cm ^2	Final	WALL	CONCRETE		NIACI	RED	SOFTBALL FEILD	DWASHINGTON	DUGOUT AWAY	Negative	1.22	0.7 < LOD	0.03 < LOD	0.03 < LOD	0.57
622	1/19/2012 12:33 PAINT	1.87 mg / cm ^2	Final	WALL	CONCRETE		NIACI	RED	SOFTBALL FEILD	DWASHINGTON	DUGOUT AWAY	Negative	1.56	0.7 < LOD	0.04 < LOD	0.04 < LOD	0.59
623	1/19/2012 12:34 PAINT	5.15 mg / cm ^2	Final	WALL	CONCRETE		NTACT	RED	SOFTBALL FEILD	DWASHINGTON	DUGOUT AWAY	Negative	3.91	0.7 < LOD	0.04 < LOD	0.04 < LOD	0.19
624	1/19/2012 12:34 PAINT	1.86 mg / cm ^2	Final	WALL	CONCRETE		NTACT	RED	SOFTBALL FEILD		DUGOUT AWAY	Negative	1	0.7 < LOD	0.03 < LOD	0.03 < LOD	0.46
625	1/10/2012 12:34 PAINT	5.17 mg / cm ^2	Final	WALL	CONCRETE		NTACT	RED	SOFTBALL FEILD		DUGOUT AWAY	Negative	2.04	0.7 < LOD	0.03 < LOD	0.05 < LOD	0.22
626	1/10/2012 12:34 PAINT	0.47 mg / cm ^2	Filldl	WALL	CONCRETE		NTACT	RED	SOFTBALL FEILD		DUGOUT AWAY	Negative	1	0.7 < LOD	0.00 < LOD	0.00 < LOD	1.24
620	1/19/2012 12:34 PAINT	2.52 mg / cm ^2	Final	RAUS	METAI		NTACT	RIACK	SOFTBALL FEILD		DUGOUT AWAY	Negative	10	0.7 < LOD	0.03 < LOD	0.03 < LOD	0.54 1 ∩⊏
620	1/19/2012 12:33 FAINT	1.91 mg / cm ^2	Final	RAILS	METAL		NTACT	BLACK	SOFTBALL FEILD	DWASHINGTON	DUGOUT AWAT	Negative	1.7	0.7 < 100	0.36 < LOD	0.38 < LOD	1.03
630	1/19/2012 12:35 PAINT	1.87 mg / cm ^?	Final	RAILS	METAL		NTACT	BLACK	SOFTBALL FEILD	D WASHINGTON	DUGOLIT AWAY	Negative	1 14	0.7 < 100	0.12 < 100	0.12 < 100	0.5
631	1/19/2012 12:35 PAINT	1.87 mg / cm ^2	Final	RAILS	METAI	i	NTACT	BLACK	SOFTBALL FEILD	D WASHINGTON	DUGOUT AWAY	Negative	1	0.7 < 100	0,08 < 100	0.08 < 100	1.05
632	1/19/2012 12:36 PAINT	1.4 mg / cm ^2	Final	RAILS	METAL	i	NTACT	BLACK	SOFTBALL FEILD	D WASHINGTON	DUGOUT AWAY	Negative	1.71	0.7 < LOD	0.3 < LOD	0.3 < LOD	0.9
633	1/19/2012 12:36 PAINT	1.42 mg / cm ^2	Final	RAILS	METAL	i	NTACT	BLACK	SOFTBALL FEILD	D WASHINGTON	DUGOUT AWAY	Negative	1.44	0.7 < LOD	0.29 < LOD	0.29 < LOD	1.05

Reading No	Time Type	Duration Units	Sequence	Component	Substrate	Side Con	ndition	Color !	Site Ins	spector	loor Roo	m Misc 1 Misc 2	Results	Depth Index	Action Level PbC	PbC Error PbL	PbL Error PbK	PbK Error
1196	3/9/2012 16:52 PAIN	- 3.9 mg / cm ^2	Final	WALL	CONCRETE	GOO	OD (GRAY S	SBF RU	JSSELL	DUT		Negative	1.3	0.7 < LOD	0.03 < LOD	0.03 < LOD	0.9
1197	3/9/2012 16:53 PAIN	5.21 mg / cm ^2	Final	WALL	CONCRETE	GOO	OD (GRAY S	SBF RU	JSSELL	DUT		Negative	2.12	0.7 < LOD	0.03 < LOD	0.03 < LOD	0.75
1198	3/9/2012 16:53 PAIN	9.12 mg / cm ^2	Final	WALL	CONCRETE	GOO	OD (GRAY S	SBF RU	JSSELL	DUT		Negative	1.7	0.7 < LOD	0.03 < LOD	0.03 < LOD	0.4
1199	3/9/2012 16:53 PAIN	- 10.41 mg / cm ^2	Final	WALL	CONCRETE	GOO	DOD (GRAY S	SBF RU	JSSELL	DUT		Negative	2.75	0.7 < LOD	0.03 < LOD	0.03 < LOD	0.4



Bulk Asbestos Analysis

By Polarized Light Microscopy EPA Method: 600/R-93/116 and 600/M4-82-020



Customer: University of South Carolina 743 Greene St Columbia, SC 29208 Attn: Ed Pitts Darryl Washington



Project: Press Box

Sample ID	Description	Ashestas		Fibrous	No	n-Fibrous	Attributes
Lab Sample ID	Lab Notes	Aspestos	C	omponents	Co	mponents	Treatment
1	Dark 3tab shingles	None Detected	15%	Fiber Glass	85%	Other	Black, Gray Non Fibrous Heterogeneous
1203123PLM_1							Dissolved
2	Dark 3tab shingles	None Detected	15%	Fiber Glass	85%	Other	Black, Gray Non Fibrous Heterogeneous
1203123PLM_2							Dissolved
3	Dark 3tab shingles	None Detected	15%	Fiber Glass	85%	Other	Black, Gray Non Fibrous Heterogeneous
1203123PLM_3	TEM						Dissolved
4	Black felt paper	None Detected	70%	Cellulose	30%	Other	Black Fibrous Heterogeneous
1203123PLM_4							Dissolved, Teased
5	Black felt paper	None Detected	70%	Cellulose	30%	Other	Black Fibrous Heterogeneous
1203123PLM_5	1						Dissolved, Teased
6	Black felt paper	None Detected	70%	Cellulose	30%	Other	Black Fibrous Heterogeneous
1203123PLM_6	TEM						Dissolved, Teased

Disclaimer: Due to the nature of the EPA 600 method, asbestos may not be detected in samples containing low levels of asbestos. We strongly recommended that analysis of floor tiles, verniculite, and/or heterogeneous soil samples be conducted by TEM for confirmation of "None Detected" by PLM. This report relates only to the samples tested and may not be reproduced, except in full, without the written approval of SAI. This report may not be used by the client to claim product endorsement by NVLAP or any other agency of the LLS, government. Estimated MPL is 0.1%.

Byron Stroble (6)

Analyst

Nathaniel Durham, MS or Approved Signatory

Scientific Analytical Institute, Inc. 302-L Pomona Dr. Greensboro, NC 27407 (336) 292-3888



Scientific Analytical Institute

302-L Pomona Dr. Greensboro, NC 27407 Phone: 336.292.3888 Fax: 336.292.3313 www.sailab.com lab@sailab.com



Company Contact I	nformation	Darah	Washing	top	Asbest	os Test Typ	es]
Company: Un of	S.C.	Contact: 803-	917-029	1 PI	JM EPA 60	(/R-93/116	\mathbf{S}	1
Address: 743 2	reene \$	Phone :EJP	¥	Pe	ositive stop	Ł		
Cola &	,C. 29208	Fax : 8 = 3 -	917.051	7 PI	.M Point C	unt		
nen er en endersteller feldlige of derstellen er engenne er engenne for endersteller. Er endersteller e	n (Managara annar - Mana Integra page) - Company ann an gun annar an an 2011 annar ann 	Email 🔲:	999 (de - Constanto Vertrador e de de 1993) de 1 de como e apartamista como	PC	'M NIOSH	7400		
Nale Add Artistication of Artistication Apple All Manager (Comparing a second s		Regeler in die Herrichten die seinen Herrichten auf die Antonie Antonie Antonie Antonie Antonie Antonie Antoni		TL	EM ATTERA			
Billing/Invoice Info	rmation	Turn Arou	nd Times	TI	EM Level II			
Company: Un of	S.C	90 Min.	48 Hours	TI	M NIOSIT	74()2		
Contact:	d eine en ververennen ververennen von Altersfeitigen die privateinen von des rekensitienen v	3 Hours	72 Hours	TI	EM Bulk Qi	alitative		
Address:	a ya na na ay ya na ayyonna na kanaga gaga na ana ay ana ay	6 Hours	06 Hours	TL	M Bulk Ch	atfield	*	SCA
n	an manyar manyar da manyanan di banganan di kata ngganan kata nanyar ng kata ng kata ng kata ng kata ng kata ng	12 Hours	120 Hours	TE	EM Bulk Qu	antitative		
yn ywydd yn chwyr yn y definiania yn ynhol Mangyr a chwyr a far yn yr y ar yn yn y farannau yn yn yn yn yn yn y	 Management (Sector and all Consecution) respectively. International Consecution of the providence of the sector and the Consecution of the sector of the sect	24 Hours 🛛	144 ⁺ Hours	TI	M Wipe A	STM D6480-99		
ан адаалаа на Варадина на Харесски, конструкции на селото на селото на чисти на селото на селото на селото на Ч	Волунтур и настальны интерпации с национерогов'я флантельно уделя Воля Малана, то так и на тр г	e angeneral securement y a reconstruction of the second sector of the second sector of the second sector of the	· · · · · · · · · · · · · · · · · · ·	11	M Microva	CASTM D5755-02		
PO Number:	ארוויקא אוריקא איז איז איז איז איז איז איז איז איז אי	er rek SUSSIA en 1999 SUSSIA SIN en 1999 en sen en sen en sen de 1600 metalok		TE	M Water B	PA 100.2		
Project Name/Number:	Priss Roy.	n i denganarin () perindar nggroß (). Takké nampu nut us attaké nam pi des félade	a moner d (W Watersprage), - NY Watersprage (Likelangegere), -	Ou	her:			
		a de la companya e companya e a companya de la comp		k			<u></u> ,	
Sample ID #	Description/L	ocation	Volume/2	Area		Comments		
	4							
angen na sang ang ang ang ang ang ang ang ang ang		NA SE NE NA ARTINE EN ANTRALIS AN ANTRE EN ANTR						
		ar mail de la communação de communa da presenta entre e 4984 444				and a second		
	· • • • • • • • • • • • • • • • • • • •	nannanga,			1			
*** * ********************************	BALLING BALLE A AFTERNOLLE AF ANTONIALIS VARIANS AND A VARIANT AND A VARIANTA AND A VARI	······································					{	
		a, mayarangana wa shi sayan san ama ama ama ku sayah dari ana ayyar. Kamana ang sayar ku						
алық ж. уталарына — алалары қ., таларынық транолос, транолос, т. ж. (т. е) n marc o marco com de la calego antenno de la comunicación de la comunicación de la comunicación de la comunicación de	a - sa ina artefa a - ar strainadh an - 1949 Andelada a trionnasana an sin	anna 1977 - Anna 1983 - Frank Carl			anan an		
				ing all care in factors				
n namen namen and and namen and a subscription of the	nen - son armenen an fan Frankreisen y Frankreisen gewon - yr ando os o o af enskalder e	and the first first measurement of party sectors and a sector of the sector of the sector of the sector of the						
TRATILE OFFICE CONTRACTOR CONTRACTOR OF T	a k y y skonome - y anne part - H némerye a statementer - H	and parameters and a second statement of the second of the second se						
		1. 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1				an Annal Martin, and a support of a support of a support of a support	 	
						and the second		
1			A-		Total #	of Samples 1)	
Relinquished	by Date/	Time	Received	by		Date/Tim	e	
	1							

Scientific Analytical Institute

adacte

Accepted

Page of



SOFTBALL FIELD PRESSBOX Building #_____

Sample Analysis Type of Analysis: Lead / Asbestos Date: 02-23-2012

24 HRS Turn Around Time

Area	Sample ID	Material Sampled	Material Location	F/NF	Cond	Quantity	Pot to Disturb
A	1	DARK 3TAB SHINGLES	ROOFING MATERIAL OF GREY PRESSBOX @ FIELD	NF	G	375 SQ FT	LOW
Α	2	DARK 3TAB SHINGLES	ROOFING MATERIAL OF GREY PRESSBOX @ FIELD	NF	G	375 SQ FT	LOW
Α	3	DARK 3TAB SHINGLES	ROOFING MATERIAL OF GREY PRESSBOX @ FIELD	NF	G	375 SQ FT	LOW
В	4	BLACK FELT PAPER	ROOFING MATERIAL OF GREY PRESSBOX @ FIELD	NF	G	375 SQ FT	LOW
В	5	BLACK FELT PAPER	ROOFING MATERIAL OF GREY PRESSBOX @ FIELD	NF	G	375 SQ FT	LOW
В	6	BLACK FELT PAPER	ROOFING MATERIAL OF GREY PRESSBOX @ FIELD	NF	G	375 SQ FT	LOW
license #	ASBI-00568 #	FM0038615 FM#	3 Signature DM	Reques	ANN D	ERRICK	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
Fax # 80	Send lab Ed Pitts 80 720 College Columbia, S EHP@fmc.s 3-777-3990	results in PDF format as soon a03-777-3296Darryl WashingtSt.720 College St.C 29208Columbia, SC 2c.eduWashinDH@fm	is possible to: ////////////////////////////////////				



Bulk Asbestos Analysis by Transmission Electron Microscopy

Chatfield SOP 1988-02 Rev. 1

Client: University of South Carolina 743 Greene St Columbia, SC 29208

Attn: Darryl Washington

Lab Order ID: 1203191 Analysis ID: 1203191_TBS **Date Received:** 2/27/2012 **Date Reported:** 2/28/2012

Project: Press Box

Sample ID Lab Sample ID	Description Lab Notes	Organic (Wt. %)	Acid Sol. (Wt. %)	Asbestos (Wt. %)	LCL-UCL (Wt. %)
3 1203191TBS_1	Dark 3tab shingles	2.2%	-%	None Dete	cted
б 1203191ТВ5_2	Black felt paper	97%	-%	None Dete	cted

Matt Thomas (2)

Analyst

Approved Signatory

Scientific Analytical Institute, Inc. 302-L Pomona Dr. Greensboro, NC 27407 (336) 292-3888

Scient 302-L Po Phone: 3. www.sa	E fic Analytical In omona Dr. Greensboro, 1 36.292.3888 Fax: 336. ailab.com lab@sail	stitute NC 27407 292.3313 ab.com	Lab U Lab C Client	se Only Order ID:	3723
Company Contact Informat	tion Dar	Wah	Tol	Asbestos Test	Types
Company: Un of S.C.	· Contact: 8 0 3	3-917-02	9/ PC	M EPA 600/R-93/116	5
Address: 743 Dream	x Ar Phone □:Ed	P,H.s	Po	sitive stop	
Cola & C. 2	9208 Fax 1:803	- 917.05	17 PL	M Point Count	
	Email []:		i pc	M NIOSI 1 7400	
	аланын Эллан алан алар аран на амь умени (мандынын) ана ана маа алар алар алар ал	alfer under Reichten um anteile der Bernis immer Prinz der Bernisten under	TE	MAHERA	
Billing/Invoice Information	Turn Ai	round Times		M Level II	
Company Un of S.C	90 Min.	48 Flours	- 118	M NEOS 1 7402	
Contact	3 Hours	72 Hours		M Bulk Qualitative	
Address:	6 Hours	96 Hours		M Balk Chutield	<u>*</u>
				M Bulk Quantitative	
	24 Hours			M Wipe ASTM D6480-	00
	anna - Andre marret annananna V al sarar a dhàire V Manna an Anna an Anna an An			M Microvae ASTM D5	755-02
PO Number:				M Water 13PA 100,2	
Project Name/Number: Pros	Buy		Oth	er:	
Sample ID # D	escription/Location	volume	Area	Comme	
n - manage an easy take take analy - competentiation - require a signature of the residue of Andrews	un na baharapat da managa da tre nara karara kuma kemananan mari mananti ta gar amportas perabilitat t	· · · · · · · · · · · · · · · · · · ·			
	n an a Bailean (ann 1 a an amailte in A baileinneach - Fhilinin Arridonin an A-Aid An Array - A				naaraan ah karaan ka karaan
	namman saite, i travelante dei dense der ei de andersette entrationisticationer annammen d			The second	
	naar vaa ee sidd maaaaanne e e ferrenna ferrenna faar daaraa ee saa da dii boroon saaar oo siddaaraaan faar mayn me 				
				1	
· · · · · · · · · · · · · · · · · · ·					
	un on administration and an appropriate programmed dependence is a state. I want and a state				
	·				• • • • • • • • • • • • • • • • • • •
1997 (1997) - 1997 (1997) - 1997 (1997) - 1997 (1997) - 1997 (1997) - 1997 (1997) - 1997 (1997) - 1997 (1997) - 1997 (1997) - 1997	· · · · · · · · · · · · · · · · · · ·				
	میں موجود اور میں مردور میں میں میں میں اور		9	Total # of Sampl	<u>cs 10</u>
Relinquished by	Date/Time	Receiver	l by	Dat	tc/Time
ւ ՀՀ տախկատում հայտարություն, արդառնագում է գտացում է գտացում է ու ՀՀՀ է ենք		JAKA M		-2-29 9	
		<u> </u>			-
		According to 17	./	Page	of
Accepted	4				





Area	Sample ID	Material Sampled	Material Location	F/NF	Cond	Quantity	Pot to Disturb
A	1	DARK 3TAB SHINGLES	ROOFING MATERIAL OF GREY PRESSBOX @ FIELD	NF	G	375 SQ FT	LOW
A	2	DARK 3TAB SHINGLES	ROOFING MATERIAL OF GREY PRESSBOX @ FIELD	NF	G	375 SQ FT	LOW
Α	3	DARK 3TAB SHINGLES	ROOFING MATERIAL OF GREY PRESSBOX @ FIELD	NF	G	375 SQ FT	LOW
8	4	BLACK FELT PAPER	ROOFING MATERIAL OF GREY PRESSBOX @ FIELD	NF	G	375 SQ FT	LOW
в	5	BLACK FELT PAPER	ROOFING MATERIAL OF GREY PRESSBOX @ FIELD	NF	G	375 SQ FT	LOW
В	6	BLACK FELT PAPER (-40-	ROOFING MATERIAL OF GREY PRESSBOX @ FIELD	NF	G	375 SQ FT	LOW
A License #	\SBI-00568	FM003861 FM#	53 Signature DM	Reques		ERRICK	

Fax # 803-777-3990



Bulk Asbestos Analysis by Transmission Electron Microscopy

Chatfield SOP 1988-02 Rev. 1

Client: University of South Carolina 743 Greene St Columbia, SC 29208

Attn: Darryl Washington

1201237 Lab Order ID: Analysis ID: 1201237_TBS **Date Received:** 1/25/2012 **Date Reported:** 1/26/2012

Project: Softball Field

Sample ID	Description	Organic	Acid Sol.	Asbestos	LCL-UCL
Lab Sample ID	Lab Notes	(Wt. %)	(Wt. %)	(Wt. %)	(Wt. %)
6	Black rubber flooring	89%	-%	None Dete	cted
1201237TBS_1					

Matt Thomas (1)

Analyst

Approved Signatory

Scientific Analytical Institute, Inc. 302-L Pomona Dr. Greensboro, NC 27407 (336) 292-3888



Scientific Analytical Institute 302-L Pomona Dr. Greensboro, NC 27407 Phone: 336.292.3888 Fax: 336.292.3313 lab@sailab.com www.sailab.com

Lab Use Onl	'y
Lab Order 1	D:
Clicnt Code	:

Company Contact	t Information]	As	pestos Test Typ	es
Company: Un o	185	Contact: D, W	achington	PLM E	A 600/R-93/116	B,
Address:		Phone D: 90 3 .	917-0291	Positive	stop 🕅	
		Fax 🗋:		PLM PC	int Count	
		Email 📃:		PCM N	OSH 7400	
				TEM A	IERA	
Billing/Invoice Inf	ormation	Turn Aro	und Times	TEM L	vel II	
Company: Un of	8.0	90 Min.	48 Hours	TEM N	OSH 7402	
Contact: Dany	2 Washington	3 Hours	72 Hours	TEM B	ik Qualitative	
Address.	, 	6 Hours	96 Hours	TEM B	ilk Chatfield	
		12 Hours	120 Hours	TEM BI	k Quantitative	
		24 Hours	144 Hours	TEM W	pe ASTM D6480-99	
				TEM M	crovac ASTM D5755-02	
PO Number:				TEM W	ater EPA 100.2	
Project Name/Numbe	r: Solthe	le Fiel	4	Other:		
Sample ID #	N	Location	Volumo/A	r 00	Commonto	
	Description		Volume/A	ICa	Comments	
						-
				1-		
						
		<u></u>	D	\mathcal{T}^{101}	al # or samples o	-
Relinquishe	d by Dat	e/ Ime	Received b	8	Date/In	ne Apro
			-Inthe	Je_	Ka4 101	M
			-	V	Pageof	.
Scientific Analytical Institute						
			Rejected) (<u>)</u>		



(23)

Building #

Type of Analysis: Lead Asbestos Date: 01-13-2012

Tum Around Time

rea	Sample ID	Material Sampled	Material Location	F/NF	Cond	Quantity	Pot to Disturb
۲	-	BLACK RUBBER FLOORING	AWAY SIDE FLOORING OF DUGOUT	NF	U	200 SQ FT	row
×	5	BLACK RUBBER FLOORING	AWAY SIDE FLOORING OF DUGOUT	L Z	U	200 SQ FT	row
4	e	BLACK RUBBER FLOORING	AWAY SIDE FLOORING OF DUGOUT	۲	U	200 SQ FT	ΓΟΜ
×	4	BLACK RUBBER FLOORING	HOME SIDE FLOORING OF DUGOUT	Ľ	თ	200 SQ FT	row
۲	5	BLACK RUBBER FLOORING	HOME SIDE FLOORING OF DUGOUT	RF	ს	200 SQ FT	ΓΟΜ
4	9	BLACK RUBBER FLOORING	HOME SIDE FLOORING OF DUGOUT	Å	U	200 SQ FT	row
cense #	4 ASBI-0056l	8 FM4615	53 Signature	Reques	ANN D	ERRICK	
	Send lat Ed Pitts 8	oresults in PDF format as soon a 203-777-3296 Darryl Washingt	as possible to: ton 803-777-2399 Ty Russell 803-777-1208	-			1
	720 College	: St. 720 College St.	720 College St.				

Columbia, SC 29208 EHP@fmc.sc.edu Fax # 803-777-3990

Columbia, SC 29208 WashinDH@fmc.sc.edu

Columbia, SC 29208 NTRusse@fmc.sc.cdu



Bulk Asbestos Analysis

By Polarized Light Microscopy EPA Method: 600/R-93/116 and 600/M4-82-020



Customer: University of South Carolina 743 Greene St Columbia, SC 29208 Attn: Darryl Washington



Project: Softball Field

Sample ID	Description	Ashestas	Fibrous	Non-Fibrous	Attributes
Lab Sample ID	Lab Notes	ASUCSIUS	Components	Components	Treatment
1	Black rubber flooring	None Detected		100% Other	Black, White Non Fibrous Heterogeneous
1201173PLM_1					Ashed
2	Black rubber flooring	None Detected		100% Other	Black, White Non Fibrous Heterogeneous
1201173PLM_2	-				Ashed
3	Black rubber flooring	None Detected		100% Other	Black, White Non Fibrous Heterogeneous
1201173PLM_3					Ashed
4	Black rubber flooring	None Detected		100% Other	Black, White Non Fibrous Heterogeneous
1201173PLM_4	-				Ashed
5	Black rubber flooring	None Detected		100% Other	Black, White Non Fibrous Heterogeneous
1201173PLM_5	-				Ashed
6	Black rubber flooring	None Detected		100% Other	Black, White Non Fibrous Heterogeneous
1201173PLM_6					Ashed

Disclaimer: Due to the nature of the EPA 600 method, asbestos may not be detected in samples containing low levels of asbestos. We strongly recommended that analysis of floor tiles, verniculite, and/or heterogeneous soil samples be conducted by TEM for confirmation of "None Detected" by PLM. This report relates only to the samples tested and may not be reproduced, except in full, without the written approval of SAI. This report may not be used by the client to claim product endorsement by NVLAP or any other agency of the US agvernment. Estimated MDL is 0.1%.

Byron Stroble (6)

1

Analyst

Nathaniel Durham, MS or Approved Signatory

Scientific Analytical Institute, Inc. 302-L Pomona Dr. Greensboro, NC 27407 (336) 292-3888



Scientific Analytical Institute 302-L Pomona Dr. Greensboro, NC 27407 Phone: 336.292.3888 Fax: 336.292.3313 www.sailab.com lab@sailab.com

Lab Use C	nly
Lab Orde	r ID:
Client Co	de:

Company Contact Information			Asb	estos Test Typ	es
Company: Un of & C	Contact: D. W 🦡	husto	PLM EP	A 600/R-93/116	K,
Address:	Phone 1:80 3 -91	7-0291	Positive s	itop 🙀	
	Fax []:		PLM Pdi	nt Count	
	Email 🗌:		PCM NK	DSH 7400	
	· · · · · · · · · · · · · · · · · · ·		TEM AL	ERA	
Billing/Invoice Information	Turn Around	l Times	TEM Lev	rel 11	
Company: Un of S.C.	90 Min. 🗌 48 I	Hours	TEM NIK	DSH 7402	
Contact: Daniel Washington	3 Hours 272 H	lours	TEM Bul	k Qualitative	
Address:	6 Hours 🗌 96 H	lours	TEM Bul	k Chatfield	
	12 Hours 1 120	Hours	TEM Bu	k Quantitative	
	24 Hours 🗙 144	Hours	TEM Wi	e ASTM D6480-99	
	n - fa - viù		TEM Mic	rovac ASTM D5755-02	
PO Number:	······		TEM Wat	er EPA 100.2	
Project Name/Number: Solthe	4 Field		Other:	nene	
The second se					
Sample ID # Description/L	location	Volume/A	rea	Comments	
			_		
	······································				
	an () , an anna an fha an an ann ann an an ann an ann an ann an a				

		-			
		1	Tota	# of Samples 6	
Relinguished by Date	/Time	Received by	2	Date/Tim	e
		ALVE	an .	LOU INK	m
	,		ye I	-an 19/	<i>"</i>
		۹ ۰			
Scientific Analytical Institute		Accepted	4	Page of	
		number 1	1		
		Selere 1			



SOFTBALL FEILD	Sample Analysis 01-13-2012	24 HRS
Building #	Type of Analysis: Lead Asbestos Date:	Turn Around Time

Area	Sample ID	Material Sampled	Material Location	F/NF	Cond	Quantity	Pot to Disturb
Α	1	BLACK RUBBER FLOORING	AWAY SIDE FLOORING OF DUGOUT	NF	G	200 SQ FT	LOW
A	2	BLACK RUBBER FLOORING	AWAY SIDE FLOORING OF DUGOUT	NF	G	200 SQ FT	LOW
A	3	BLACK RUBBER FLOORING	AWAY SIDE FLOORING OF DUGOUT	NF	G	200 SQ FT	LOW
Α	4	BLACK RUBBER FLOORING	HOME SIDE FLOORING OF DUGOUT	NF	G	200 SQ FT	LOW
Α	5	BLACK RUBBER FLOORING	HOME SIDE FLOORING OF DUGOUT	NF	G	200 SQ FT	LOW
Α	6	BLACK RUBBER FLOORING	For TS HOME SIDE FLOORING OF DUGOUT	NF	G	200 SQ FT	LOW
1							
							
License	ASBI-00568 #	FM0038615 FM#	3 Signature Off	_Reques	ANN Di tor	ERRICK	

Send lab results in PDF format as soon as possible to:

Ed Pitts803-777-3296Darryl Washington803-777-2399720 College St.720 College St.Columbia, SC 29208Columbia, SC 29208EHP@fmc.sc.eduWashinDH@fmc.sc.edu

Ty Russell 803-777-1208 720 College St. Columbia, SC 29208

NTRusse@fmc.sc.edu

Fax # 803-777-3990

SECTION 033000 CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section specifies cast-in place concrete, including formwork, reinforcing, mix design, placement procedures, and finishes.
- B. Concrete paving and walks are specified in Division 2.
- C. Precast concrete is specified in other Division 3 Sections.
- D. Mechanical finishes and concrete floor toppings are specified in other Division 3 Sections.

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Product data for proprietary materials and items, including reinforcement and forming accessories, admixtures, patching compounds, waterstops, joint systems, curing compounds, fly ash, and others as requested by Engineer.
- C. Shop drawings for reinforcement, fabrication, bending, and placement of concrete reinforcement. Comply with ACI SP-66 (88), "ACI Detailing Manual," showing bar schedules, stirrup spacing, diagrams of bent bars, and arrangement of concrete reinforcement. Include special reinforcement required for openings through concrete structures.
 - 1. The shop drawings are interpretations of and are supplemental to the Contract Drawings and Specification. Their intent is to demonstrate to the Architect/Engineer that the Contractor has understood the design concept, and to provide the detailed information necessary for the fabrication, assembly and installation of the products or materials specified. Neither the shop drawings nor comments placed on them by the Architect/Engineer shall be construed as being change orders. If any deviations, discrepancies or conflicts between the shop drawings and the Contract Drawings and Specification are discovered, either prior to or after the shop drawings have been reviewed, the Design Drawings and Specification shall govern and shall be followed.
 - 2. Shop drawings shall conform to the requirements of the Contract Documents and shall be in accordance with ACI 315. The Contractor shall not be relieved of responsibility for any deviation from the requirements of the Contract Documents by the Architect's/Engineer's approval of the shop drawings unless the Contractor has specifically informed the Architect/Engineer in writing of such deviation at the time of submission and the Architect/Engineer has given written approval to the specific deviation. The Contractor

shall not be relieved from responsibility for errors or omissions in the shop drawings by the Architect's or Engineer's approval thereof. The Contractor shall direct specific attention by a hand-drawn "Cloud," on re-submitted shop drawings, to revisions other than those requested by the Architect/Engineer on previous submittals.

- 3. Drawings which require resubmittal shall have revisions clearly delineated by enclosing only the revised areas within a free-hand drawn "CLOUD."
- 4. Processing Time: The Contractor shall allow up to 21 days between the time shop drawings are received by the Engineer of Record and the time they are sent back to the Contractor.
- 5. Contract Documents shall not be incorporated into shop drawings.
- D. Submit laboratory test reports for concrete materials and mix design tests.
- E. Construction and Control Joints not shown on drawings.

1.4 QUALITY ASSURANCE

- A. Codes and Standards: Comply with provisions of following codes, specifications, and standards, except where more stringent requirements are shown or specified:
 - 1. ACI 318, "Building Code Requirements for Reinforced Concrete."
 - 2. Concrete Reinforcing Steel Institute (CRSI), "Manual of Standard Practice."
 - 3. ACI 301, "Specification for Structural Concrete for Buildings."
- B. Materials and installed work may require testing and retesting at any time during progress of work. Retesting of rejected materials for installed work, shall be done at Contractor's expense.
- C. Pre-Construction Conference: Conduct conference at Project site to comply with requirements of Division 1 Section "Project Meetings" and the following.
- D. At least two weeks prior to submittal of design mixes, conduct a meeting to review detailed requirements for preparing concrete design mixes and to determine procedures for satisfactory concrete operations. Review requirements for submittals, status of coordinating work, and availability of materials. Establish preliminary work progress schedule and procedures for materials inspection, testing, and certifications. Request that representatives of each entity directly concerned with cast-in-place concrete attend conference, including, but not limited to, the following:
 - 1. General Contractor.
 - 2. Laboratory responsible for concrete design mixes.
 - 3. Laboratory responsible for field quality control.
 - 4. Ready-mix concrete producer.
 - 5. Concrete subcontractor.
 - 6. Reinforcing Contractor.
 - 7. Primary admixture manufacturers.
 - 8. Architect or Owner's representative.
- E. When proprietary items are used, follow manufacturer's recommendations.

- F. Materials, fabrication and erection procedures and concrete operations are subject to inspection and test in mill, shop and field, conducted by the Owner's Testing and Inspection Agency. Such inspections and tests will not relieve Contractor of his responsibility for providing materials and fabrication procedures in compliance with specified requirements. The inspections and tests, which the Owner's Testing and Inspection Agency performs, shall be at the expense of the Owner. Contractor shall provide free access to material stockpiles, facilities and the Work. Contractor shall cooperate with the Owner's Testing and Inspection Agency at all times.
- G. The Contractor shall notify the Owner's Representative 48 hours before placing concrete in order to give the Owner's Representative an opportunity to inspect the formwork, reinforcing, and related items prior to placement of the concrete.

PART 2 - PRODUCTS

2.1 FORM MATERIALS

- A. Forms for Exposed Finish Concrete: Plywood, metal, metal-framed plywood faced, or other acceptable panel-type materials, to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practicable sizes to minimize number of joints and to conform to joint system shown on drawings.
 - 1. Use plywood complying with U.S. Product Standard PS-1 "B-B (Concrete Form) Plywood," Class I, Exterior Grade or better, mill-oiled and edge-sealed, with each piece bearing legible inspection trademark.
- B. Forms for Cylindrical Columns and Supports: Metal, fiberglass-reinforced plastic, or paper or fiber tubes. Provide paper or fiber tubes of laminated plies with water-resistant adhesive and wax-impregnated exterior for weather and moisture protection. Provide units with sufficient wall thickness to resist wet concrete loads without deformation.
- C. Form Coatings: Provide commercial formulation form-coating compounds with a maximum VOC of 350 g/l that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
- D. Form Ties: Factory-fabricated, adjustable-length, removable or snap-off metal form ties, designed to prevent form deflection and to prevent spalling concrete upon removal. Provide units that will leave no metal closer than 1-1/2 inches to exposed surface.
 - 1. Provide ties that, when removed, will leave holes not larger than 1-inch diameter in concrete surface.

2.2 REINFORCING MATERIALS

- A. Reinforcing Bars: ASTM A 615, Grade 60, deformed.
- B. Steel Wire: ASTM A 82, plain, cold-drawn steel.
- C. Welded Wire Fabric: ASTM A 185.
- D. Welded Deformed Steel Wire Fabric: ASTM A 497.

- E. Supports for Reinforcement: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Use wire-bar-type supports complying with CRSI specifications.
 - 1. For slabs-on-grade, use supports with sand plates or horizontal runners where base material will not support chair legs.

2.3 CONCRETE MATERIALS

- A. Portland Cement: ASTM C 150, Type I.
 - 1. High-Early Strength Portland Cement: ASTM C 150, Type III.
 - 2. Use one brand of cement throughout project unless otherwise acceptable to Engineer.
- B. Fly Ash: ASTM C 618, Type F, Loss of Ignition (L.O.I.) 3 percent maximum.
- C. Normal Weight Aggregates: ASTM C 33 and as herein specified. Provide aggregates from a single source for exposed concrete.
 - 1. For exterior exposed surfaces, do not use fine or coarse aggregates containing spallingcausing deleterious substances.
 - 2. Local aggregates not complying with ASTM C 33 but that special tests or actual service have shown to produce concrete of adequate strength and durability may be used when acceptable to Engineer.
- D. Water: Drinkable.
- E. Admixtures, General: Provide admixtures for concrete that contain not more than 0.1 percent chloride ions.
- F. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to, the following:
 - a. "Air-Mix" or "Perma-Air," Euclid Chemical Co.
 - b. "Darex AEA" or "Daravair," W.R. Grace & Co.
 - c. "MB-VR" or "Micro-Air," Master Builders, Inc.
 - d. "Sealtight AEA," W.R. Meadows, Inc.
 - e. "Sika AER," Sika Corp.
- G. Mid Range Water-Reducing Admixture: ASTM C 494, Type A or F.
- H. High-Range Water-Reducing Admixture (Super Plasticizer): ASTM C 494, Type F or Type G.
- I. Water-Reducing, Retarding Admixture: ASTM C 494, Type D.

J. Fibrous Reinforcement: Engineered polypropylene fibers designed for secondary reinforcement of concrete slabs.

2.4 RELATED MATERIALS

- A. Waterstops: Provide flat, dumbbell-type or centerbulb-type waterstops at construction joints and other joints as indicated. Size to suit joints.
- B. Absorptive Cover: Burlap cloth made from jute or kenaf, weighing approximately 9 oz. per sq. yd., complying with AASHTO M 182, Class 2.
- C. Moisture-Retaining Cover: One of the following, complying with ASTM C 171.
 - 1. Waterproof paper.
 - 2. Polyethylene film.
 - 3. Polyethylene-coated burlap.
- D. Concrete Cure-Seal Hardener: One of the following:
 - 1. "Ashford Formula," Concrete distribution, Inc.
 - 2. "Seal Hard," L&M Construction Chemicals, Inc.
 - 3. "Sikafloor Pro Seal W," Sika Corporation.
- E. Evaporation Control: Monomolecular film-forming compound applied to exposed concrete slab surfaces for temporary protection from rapid moisture loss.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to, the following:
 - a. "Eucobar," Euclid Chemical Co.
 - b. "E-Con," L&M Construction Chemicals, Inc.
 - c. "Confilm," Master Builders, Inc.
- F. Bonding Compound: Polyvinyl acetate or acrylic base.
- G. Preformed Joint Filler:
 - 1. Shall be performed joint filler conforming to ASTM D1751 and Federal Specification HH-F-341F, Type I.
- H. Joint Sealer:
 - 1. Shall conform to ASTM D1850 or Federal Specification SS-S-1401.
 - 2. Contractor shall confirm compatibility with joint filler material, hardeners and curing compounds.

2.5 PROPORTIONING AND DESIGN OF MIXES

A. Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 301. If trial batch method used, use an independent testing

facility acceptable to Engineer for preparing and reporting proposed mix designs. The testing facility shall not be the same as used for field quality control testing.

- 1. Limit use of fly ash to not exceed 15 percent of cement content by weight.
- B. Submit written reports to Engineer of each proposed mix for each class of concrete at least 15 days prior to start of work. Do not begin concrete production until proposed mix designs have been reviewed by Engineer.
- C. Design mixes to provide normal weight concrete with properties, as indicated on drawings.
- D. Adjustment to Concrete Mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant, as accepted by Engineer. Laboratory test data for revised mix design and strength results must be submitted to and accepted by Engineer before using in work.
- E. Pumped Concrete:
 - 1. If concrete is intended to be pumped, comply with ACI 304.2 recommendations and the following requirements:
 - a. Perform at Contractor's expense a field pumping test to confirm pumpability prior to approval of mix design and prior to placement.
 - b. 3" to 4" slump. Slumps greater than 4" will be rejected. The loss in slump during pumping shall not exceed two inches.
 - c. Tests shall be taken at truck discharge and point of final placement. However, concrete quality will be determined at point of placement.

2.6 ADMIXTURES

- A. Use water-reducing admixture or high-range water-reducing admixture (Superplasticizer) in concrete as required for placement and workability.
- B. Use nonchloride accelerating admixture in concrete slabs placed at ambient temperatures below 50EF (10EC).
- C. Use high-range water-reducing admixture (HRWR) in pumped concrete, concrete for industrial slabs, architectural concrete and concrete with water/cement ratios below 0.50.
- D. Use air-entraining admixture in exterior exposed concrete unless otherwise indicated. Add airentraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having total air content with a tolerance of plus or minus 1-1/2 percent as indicated on Structural Drawings
- E. Use admixtures for water reduction and set control in strict compliance with manufacturer's directions.

- F. Water-Cement Ratio: Provide concrete for following conditions with maximum water-cement (W/C ratios as follows:
 - 1. Subjected to freezing and thawing; W/C 0.45.

2.7 CONCRETE MIXING

- A. Provide batch ticket for each batch discharged and used in work, indicating project identification name and number, date, mix type, mix time, quantity, and amount of water introduced.
- B. Ready-Mix Concrete: Comply with requirements of ASTM C 94, and as specified.
 - 1. When air temperature is between 85EF (30EC) and 90EF (32EC), reduce mixing and delivery time from 1-1/2 hours to 75 minutes, and when air temperature is above 90EF (32EC), reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 GENERAL

A. Coordinate the installation of joint materials and vapor retarders with placement of forms and reinforcing steel.

3.2 FORMS

- A. General: Design, erect, support, brace, and maintain formwork to support vertical and lateral, static and dynamic loads that might be applied until concrete structure can support such loads. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation, and position. Maintain formwork construction tolerances complying with ACI 347.
- B. Construct forms to sizes, shapes, lines, and dimensions shown and to obtain accurate alignment, location, grades, level, and plumb work in finished structures. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features required in work. Use selected materials to obtain required finishes. Solidly butt joints and provide backup at joints to prevent leakage of cement paste.
- C. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, reglets, recesses, and the like, for easy removal.
- D. Provide temporary openings where interior area of formwork is inaccessible for cleanout, for inspection before concrete placement, and for placement of concrete. Securely brace temporary openings and set tightly to forms to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- E. Chamfer exposed corners and edges as indicated, using wood, metal, PVC, or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.

- F. Provisions for Other Trades: Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of openings, recesses, and chases from trades providing such items. Accurately place and securely support items built into forms.
- G. Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, or other debris just before concrete is placed. Retighten forms and bracing before concrete placement as required to prevent mortar leaks and maintain proper alignment.

3.3 VAPOR RETARDER/BARRIER INSTALLATION

- A. General: Following leveling and tamping of granular base for slabs on grade, place vapor retarder/barrier sheeting with longest dimension parallel with direction of pour.
- B. Lap joints 6 inches and seal vapor barrier joints with manufacturers' recommended mastic and pressure-sensitive tape.

3.4 PLACING REINFORCEMENT

- A. General: Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars," for details and methods of reinforcement placement and supports and as herein specified.
 - 1. Avoiding cutting or puncturing vapor retarder during reinforcement placement and concreting operations.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials that reduce or destroy bond with concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers, as approved by Engineer. Pulling Welded Wire Fabric into position during concrete placement will not be permitted.
- D. Place reinforcement to obtain at least minimum coverages for concrete protection. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.
- E. Install welded wire fabric in as long lengths as practicable. Lap adjoining pieces at least one full mesh and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.
- F. Welding or tackwelding of reinforcement shall not be allowed.

3.5 JOINTS

- A. Construction Joints: Locate and install construction joints as indicated or, if not indicated, locate so as not to impair strength and appearance of the structure, as acceptable to Engineer.
- B. Place construction joints perpendicular to main reinforcement. Continue reinforcement across construction joints except as otherwise indicated. Do not continue reinforcement through sides of strip placements.

- C. Use bonding agent on existing concrete surfaces that will be joined with fresh concrete.
- D. Waterstops: Provide waterstops in construction joints as indicated. Install waterstops to form continuous diaphragm in each joint. Make provisions to support and protect exposed waterstops during progress of work. Field-fabricate joints in waterstops in accordance with manufacturer's printed instructions.
- E. Isolation Joints in Slabs-on-Ground: Construct isolation joints in slabs-on-ground at points of contact between slabs-on-ground and vertical surfaces, such as column pedestals, foundation walls, grade beams, and elsewhere as indicated.
- F. Contraction (Control) Joints in Slabs-on-Ground: Construct contraction joints in slabs-on-ground to form panels of patterns as shown. Use saw cuts 1/8 inch wide by 1/4 slab depth or inserts 1/4 inch wide by 1/4 of slab depth, unless otherwise indicated.

3.6 INSTALLATION OF EMBEDDED ITEMS

- A. General: Set and build into work anchorage devices and other embedded items required for other work that is attached to or supported by cast-in-place concrete. Use setting drawings, diagrams, instructions, and directions provided by suppliers of items to be attached thereto.
- B. Forms for Slabs: Set edge forms, bulkheads, and intermediate screed strips for slabs to obtain required elevations and contours in finished surfaces. Provide and secure units to support screed strips using strike-off templates or compacting-type screeds.

3.7 PREPARATION OF FORM SURFACES

- A. General: Coat contact surfaces of forms with an approved, nonresidual, low-VOC, form-coating compound before reinforcement is placed.
- B. Do not allow excess form-coating material to accumulate in forms or to come into contact with inplace concrete surfaces against which fresh concrete will be placed. Apply in compliance with manufacturer's instructions.
- C. Tape all joints in forms for exposed finish concrete.

3.8 CONCRETE PLACEMENT

- A. Inspection: Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast in. Notify other crafts to permit installation of their work; cooperate with other trades in setting such work.
- B. General: Comply with ACI 304, "Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete," and as herein specified.
- C. Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete that has hardened sufficiently to cause the formation of seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as herein specified. Deposit concrete to avoid segregation at its final location.

- D. Placing Concrete in Forms: Deposit concrete in forms in horizontal layers not deeper than 24 inches and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.
 - 1. Consolidate placed concrete by mechanical vibrating equipment supplemented by handspading, rodding, or tamping. Use equipment and procedures for consolidation of concrete in accordance with ACI 309.
 - 2. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than visible effectiveness of machine. Place vibrators to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of mix.
- E. Placing Concrete Slabs: Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until the placing of a panel or section is completed. Saturate base course prior to placement. Do not place concrete in standing water.
 - 1. Consolidate concrete during placing operations so that concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 - 2. Bring slab surfaces to correct level with straightedge and strike off. Use bull floats or darbies to smooth surface, free of humps or hollows. Do not disturb slab surfaces prior to beginning finishing operations.
 - 3. Maintain reinforcing and embedded items in proper position during concrete placement.
- F. Cold-Weather Placing: Comply with provisions of ACI 306 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
- G. When air temperature has fallen to or is expected to fall below 40EF (4EC), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50EF (10EC) and not more than 80EF (27EC) at point of placement.
 - 1. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 - 2. Do not use calcium chloride, salt, and other materials containing antifreeze agents or chemical accelerators unless otherwise accepted in mix designs.
 - 3. Provisions shall be made for maintaining the concrete at a minimum temperature of not less than 50EF and not more than 85EF for a period of at least seven (7) days.
 - 4. Use of non-vented heaters shall not be permitted. At the end of the curing period, gradually reduce the temperature at a rate not to exceed 1 degree per hour until the temperature within the enclosure equals the temperature outside the enclosure, in accordance with ACI 306.
- H. Hot-Weather Placing: When hot weather conditions exist that would seriously impair quality and strength of concrete, place concrete in compliance with ACI 305 and as herein specified.

- 1. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90EF (32EC). Mixing water may be chilled, or chopped ice may be used to control temperature provided water equivalent of ice is calculated to total amount of mixing water. Use of liquid nitrogen to cool concrete is Contractor's option.
- 2. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedment in concrete.
- 3. Fog spray forms, reinforcing steel, and subgrade just before concrete is placed.
- 4. Use water-reducing retarding admixture when required by high temperatures, low humidity, or other adverse placing conditions, when acceptable to Engineer.

3.9 FINISH OF FORMED SURFACES

- A. Rough Form Finish: For formed concrete surfaces not exposed to view in the finish work or concealed by other construction. This is the concrete surface having texture imparted by form-facing material used, with the holes and defective areas repaired and patched and fins and other projections exceeding 1/4 inch in height rubbed down or chipped off.
- B. Smooth Form Finish: For formed concrete surfaces exposed to view or to be covered with a coating material applied directly to concrete, or a covering material applied directly to concrete, such as waterproofing, dampproofing, veneer plaster, painting, or other similar system. This is an as-cast concrete surface obtained with selected form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch defective areas with fins and other projections completely removed and smoothed.
- C. Smooth Rubbed Finish: Provide smooth rubbed finish to scheduled concrete surfaces, which have received smooth form finish treatment, not later than one day after form removal.
 - 1. Moisten concrete surfaces and rub with carborundum brick or other abrasive until a uniform color and texture is produced. Do not apply cement grout other than that created by the rubbing process.
- D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces, strike-off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.10 MONOLITHIC SLAB FINISHES

- A. Scratch Finish: Apply scratch finish to monolithic slab surfaces to receive concrete floor topping or mortar setting beds for tile, portland cement terrazzo, and other bonded applied cementitious finish flooring material, and as otherwise indicated.
- B. After placing slabs, plane surface to tolerances for floor flatness (Ff) of 15 and floor levelness (Fl) of 13. Slope surfaces uniformly to drains where required. After leveling, roughen surface before final set with stiff brushes, brooms, or rakes.

- C. Float Finish: Apply float finish to monolithic slab surfaces to receive trowel finish and other finishes as hereinafter specified; slab surfaces to be covered with membrane or elastic waterproofing, membrane or elastic roofing, or sand-bed terrazzo; and as otherwise indicated.
 - After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating. Begin floating, using float blades or float shoes only, when surface water has disappeared, when concrete has stiffened sufficiently to permit operation of power-driven floats, or both. Consolidate surface with power-driven floats or by hand-floating if area is small or inaccessible to power units. Check and level surface plane to tolerances of Ff 18 -Fl 15. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.
- D. Trowel Finish: Apply trowel finish to monolithic slab surfaces to be exposed to view and slab surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile, paint, or other thin film finish coating system.
 - 1. After floating, begin first trowel finish operation using a power-driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final hand-troweling operation, free of trowel marks, uniform in texture and appearance, and with surface leveled to tolerances of Ff 20 Fl 17. Grind smooth surface defects that would telegraph through applied floor covering system.
- E. Trowel and Fine Broom Finish: Where ceramic or quarry tile is to be installed with thin-set mortar, apply trowel finish as specified, then immediately follow with slightly scarifying surface by fine brooming.
- F. Nonslip Broom Finish: Apply nonslip broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.
 - 1. Immediately after float finishing, slightly roughen concrete surface by brooming with fiberbristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.
- G. Nonslip Aggregate Finish: Apply nonslip aggregate finish to concrete stair treads, platforms, ramps, sloped walks, and elsewhere as indicated.
- H. After completion of float finishing and before starting trowel finish, uniformly spread 25 lbs. of dampened nonslip aggregate per 100 sq. ft. of surface. Tamp aggregate flush with surface using a steel trowel, but do not force below surface. After broadcasting and tamping, apply trowel finishing as herein specified.
- I. After curing, lightly work surface with a steel wire brush, or an abrasive stone, and water to expose nonslip aggregate.

3.11 CONCRETE CURING AND PROTECTION

A. General: Comply with ACI 301 and ACI 308 and as herein described; protect freshly placed concrete from premature drying and excessive cold or hot temperatures. In hot, dry, and windy weather, protect concrete from rapid moisture loss before and during finishing operations with an evaporation-control material. Apply in accordance with manufacturer's instructions after screeding and bull floating, but before power floating and troweling.

- B. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Weather permitting, keep continuously moist for not less than 7 days. If initial cure is not possible due to weather and curing is to be by application of curing compound use high solids curing compound as specified.
- C. Curing Methods: Perform curing of concrete by curing and sealing compound, by moist curing, by moisture-retaining cover curing, and by combinations thereof, as herein specified.
- D. Provide moisture curing by following methods.
 - 1. Keep concrete surface continuously wet by covering with water.
 - 2. Use continuous water-fog spray.
 - 3. Cover concrete surface with specified absorptive cover, thoroughly saturate cover with water, and keep continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with 4-inch lap over adjacent absorptive covers.
- E. Provide moisture-cover curing as follows:
 - 1. Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 3 inches and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
- F. Provide curing and sealing compound to exposed interior slabs and to exterior slabs, walks, and curbs as follows:
 - 1. Apply specified curing and sealing compound to concrete slabs as soon as final finishing operations are complete (within 2 hours and after surface water sheen has disappeared). Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's directions. Recoat areas subjected to heavy rainfall within 3 hours after initial application. Maintain continuity of coating and repair damage during curing period.
 - 2. Use membrane curing compounds that will not affect surfaces to be covered with finish materials applied directly to concrete.
- G. Curing Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces, by moist curing with forms in place for full curing period or until forms are removed. If forms are removed, continue curing by methods specified above, as applicable.
- H. Curing Unformed Surfaces: Cure unformed surfaces, such as slabs, floor topping, and other flat surfaces, by application of appropriate curing method.

3.12 SHORES AND SUPPORTS

- A. General: Comply with ACI 347 for shoring and reshoring in multistory construction, and as herein specified.
- B. Extend shoring from ground to roof for structures 4 stories or less, unless otherwise permitted.

- C. Remove shores and reshore in a planned sequence to avoid damage to partially cured concrete. Locate and provide adequate reshoring to support work without excessive stress or deflection.
- D. Keep reshores in place a minimum of 15 days after placing upper tier, and longer if required, until concrete has attained its required 28-day strength and heavy loads due to construction operations have been removed.

3.13 REMOVAL OF FORMS

- A. General: Formwork not supporting weight of concrete, such as sides of beams, walls, columns, and similar parts of the work, may be removed after cumulatively curing at not less than 50EF (10EC) for 24 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form-removal operations, and provided curing and protection operations are maintained.
- B. Formwork supporting weight of concrete, such as beam soffits, joists, slabs, and other structural elements, may not be removed in less than 14 days and until concrete has attained at least 75 percent of design minimum compressive strength at 28 days. Determine potential compressive strength of inplace concrete by testing field-cured specimens representative of concrete location or members.
- C. Form-facing material may be removed 4 days after placement only if shores and other vertical supports have been arranged to permit removal of form-facing material without loosening or disturbing shores and supports.

3.14 REUSE OF FORMS

- A. Clean and repair surfaces of forms to be reused in work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-coating compound as specified for new formwork.
- B. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close joints. Align and secure joint to avoid offsets. Do not use "patched" forms for exposed concrete surfaces except as acceptable to Engineer.

3.15 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place. Mix, place, and cure concrete as herein specified, to blend with in-place construction. Provide other miscellaneous concrete filling shown or required to complete work.
- B. Equipment Bases and Foundations: Provide machine and equipment bases and foundations, as shown on drawings. Set anchor bolts for machines and equipment to template at correct elevations, complying with certified diagrams or templates of manufacturer furnishing machines and equipment.
- C. Steel Pan Stairs: Provide concrete fill for steel pan stair treads and landings and associated items. Cast-in safety inserts and accessories as shown on drawings. Screed, tamp, and finish concrete surfaces as scheduled.

3.16 CONCRETE SURFACE REPAIRS

- A. Patching Defective Areas: Repair and patch defective areas with cement mortar immediately after removal of forms, when acceptable to Engineer.
 - 1. Cut out honeycomb, rock pockets, voids over 1/4 inch in any dimension, and holes left by tie rods and bolts, down to solid concrete but in no case to a depth of less than 1 inch. Make edges of cuts perpendicular to the concrete surface. Thoroughly clean, dampen with water, and brush-coat the area to be patched with specified bonding agent. Place patching mortar before bonding compound has dried.
 - 2. For exposed-to-view surfaces, blend white portland cement and standard portland cement so that, when dry, patching mortar will match color surrounding. Provide test areas at inconspicuous location to verify mixture and color match before proceeding with patching. Compact mortar in place and strike-off slightly higher than surrounding surface.
- B. Repair of Formed Surfaces: Remove and replace concrete having defective surfaces if defects cannot be repaired to satisfaction of Engineer. Surface defects, as such, include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets, fins and other projections on surface, and stains and other discolorations that cannot be removed by cleaning. Flush out form tie holes, fill with dry-pack mortar, or precast cement cone plugs secured in place with bonding agent.
 - 1. Repair concealed formed surfaces, where possible, that contain defects that affect the durability of concrete. If defects cannot be repaired, remove and replace concrete.
- C. Repair of Unformed Surfaces: Test unformed surfaces, such as monolithic slabs, for smoothness and verify surface plane to tolerances specified for each surface and finish. Correct low and high areas as herein specified. Test unformed surfaces sloped to drain for trueness of slope and smoothness by using a template having required slope.
 - 1. Repair finished unformed surfaces that contain defects that affect durability of concrete. Surface defects, as such, include crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through nonreinforced sections regardless of width, spalling, popouts, honeycomb, rock pockets, and other objectionable conditions.
 - 2. Correct high areas in unformed surfaces by grinding after concrete has cured at least 14 days.
 - 3. Correct low areas in unformed surfaces during or immediately after completion of surface finishing operations by cutting out low areas and replacing with patching compound. Finish repaired areas to blend into adjacent concrete. Proprietary underlayment compounds may be used when acceptable to Architect.
 - 4. Repair defective areas, except random cracks and single holes not exceeding 1 inch in diameter, by cutting out and replacing with fresh concrete. Remove defective areas to sound concrete with clean, square cuts and expose reinforcing steel with at least 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding compound. Mix patching concrete of same materials to provide concrete of same type or class as original concrete. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

- D. Perform structural repairs with prior approval of Engineer for method and procedure, using specified epoxy adhesive and mortar.
- E. Repair methods not specified above may be used, subject to acceptance of Engineer.

3.17 QUALITY CONTROL TESTING DURING CONSTRUCTION

- A. General: The Owner will employ a testing laboratory to perform tests and to submit test reports.
- B. Sampling and testing for quality control during placement of concrete may include the following, as directed by Engineer.
- C. Sampling Fresh Concrete: ASTM C 172, except modified for slump to comply with ASTM C 94.
 - 1. Slump: ASTM C 143; one test at point of discharge for each day's pour and each set of compressive strength test specimens of each type of concrete; additional tests when concrete consistency seems to have changed.
 - 2. Air Content: ASTM C 173, volumetric method for lightweight or normal weight concrete; ASTM C 231 pressure method for normal weight concrete; one for each day's pour and each set of compressive strength test specimens of each type of air-entrained concrete.
 - 3. Concrete Temperature: Test hourly when air temperature is 40EF (4EC) and below, when 80EF (27EC) and above, and each time a set of compression test specimens is made.
 - 4. Compression Test Specimen: ASTM C 31; one set of 4 standard cylinders for each compressive strength test, unless otherwise directed. Mold and store cylinders for laboratory-cured test specimens except when field-cure test specimens are required. Tests for verification of early strength gain are at the Contractor's option and expense.
 - 5. Compressive Strength Tests: ASTM C 39; one set for each day's pour exceeding 5 cu. yds. plus additional sets for each 50 cu. yds. more than the first 25 cu. yds. of each concrete class placed in any one day, or for each 5,000 sq. ft. of surface area placed; one specimen tested at 7 days, two specimens tested at 28 days, and one specimen retained in reserve for later testing if required.
 - 6. When frequency of testing will provide fewer than 5 strength tests for a given class of concrete, conduct testing from at least 5 randomly selected batches or from each batch if fewer than 5 are used.
 - 7. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor and ready-mix producer shall evaluate current operations and provide corrective procedures for protecting and curing the in-place concrete.
 - 8. Strength level of concrete will be considered satisfactory if averages of sets of three consecutive strength test results equal or exceed specified compressive strength, and no individual strength test result falls below specified compressive strength by more than 500 psi.
 - 9. Unit weight: ASTM C138; One (1) test for each strength test for lightweight concrete only.

- D. Test results will be reported in writing to Architect, Structural Engineer, Ready-Mix Producer, and Contractor within 24 hours after tests. Reports of compressive strength tests shall contain the project identification name and number, date of concrete placement, name of concrete testing service, concrete type and class, location of concrete batch in structure, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7-day tests and 28-day tests.
- E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted but shall not be used as the sole basis for acceptance or rejection.
- F. Additional Tests: The testing service will make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure, as directed by Engineer. Testing service may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed. Contractor shall pay for such tests when unacceptable concrete is verified, including all inspection and Engineering fees when non-conforming work is verified.

END OF SECTION
SECTION 033005 - CAST-IN-PLACE CONCRETE FOR SITE WORK

PART 1 - GENERAL

- 1.1 DESCRIPTION
 - A. Work included: Provide cast-in-place concrete, including formwork and reinforcement, where shown on the Drawings, as specified herein, and as needed for a complete and proper installation.
 - B. Related work:
 - 1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.
 - 2. Section 03250 Concrete Specialty Items.

1.2 QUALITY ASSURANCE

--

- A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- B. Reference standards: Comply with the following codes, specifications and standards, except as otherwise shown or specified:
 - 1. American Concrete Institute (ACI) Publications:
 - -- ACI 301 Specification for Structural Concrete for Buildings
 - -- ACI 305 Recommended Practice for Hot Weather Concreting
 - -- ACI 306 Recommended Practice for Cold Weather Concreting
 - -- ACI 315 Manual of Standard Practice for Detailing Reinforced Concrete Structures
 - ACI 318 Building Code Requirements for Reinforced Concrete
 - -- ACI 347 Recommended Practice for Concrete Framework
 - 2. American Society for Testing and Materials (ASTM) Publications:
 - -- A185 Welded Steel Wire Fabric for Concrete Reinforcement
 - -- A615 Deformed and Plain Billet Steel Bars for Concrete Reinforcement
 - -- C31 Making and Curing Concrete Test Specimens in the Field
 - -- C33 Concrete Aggregates
 - -- C39-72 Compressive Strength of Cylindrical Concrete Specimens
 - -- C94 Ready-Mixed Concrete
 - -- C150 Portland Cement
 - -- C260 Air-Entraining Admixtures for Concrete

3. Concrete Reinforcing Steel Institute (CRSI):

- -- "Manual of Standard Practice"
- 4. American Welding Society (AWS) Publication:
 - -- D12.1-61 Welding Reinforcement Steel, Metal Inserts and Connections in Reinforced Concrete
- C. Testing agency: A testing laboratory will be retained by the Owner to perform material evaluation tests required by these specifications.
- D. Qualifications of contractors performing concrete work: Minimum of two (2) years experience on comparable concrete projects.

- E. Plant qualification: Plant equipment and facilities shall meet all requirements of the Check List for Certification of Ready Mixed Concrete Production Facilities of the National Ready Mixed Concrete Association and ASTM C94.
- 1.3 **SUBMITTALS**
 - A. Comply with the pertinent provisions of Section 013300.
 - Β. Within 15 calendar days after receiving the Owner's Notice to Proceed, submit proposed mix designs for approval.
 - Proportions shall be determined by means of laboratory tests of concrete made with the 1. cement and aggregate proposed for use. Provide report in detail from an approved testing laboratory showing 7-day and 28-day
 - 2. strengths obtained using materials proposed.
 - Required average strength above specified strength: 3.
 - Determinations of required average strength above specified strength (f'c) shall a. be in accordance with ACI 318 and ACI 301.
 - b. Establish the required average strength of the design mix using the materials proposed to be employed. Standard deviations shall be determined by thirty tests. Average strength used for selecting proportions shall exceed specified strength (f'c) by at least:

400 psi	Standard deviation is less than 300
550 psi	Standard deviation is 300 to 400
700 psi	Standard deviation is 400 to 500
900 psi	Standard deviation is 500 to 600
1200 psi	Standard deviation is above 600 or unknown

- When the ready-mix producer does not have a record of past performance, the c. combination of materials and the proportions selected shall be selected from trial mixes having proportions and consistencies suitable for the work using at least three (3) different water/cement ratios which will produce a range of strengths encompassing those required. Average strength required shall be 1200 psi above specified strength.
- 4. Cost of this work shall be borne by the Contractor.
- C. Manufacturer's data: Submit manufacturer's specification with application instructions for proprietary materials and items, including curing compound, form release agents, admixtures, patching compounds, and others as required by the Engineer.
- D. Shop drawings: Submit the following shop drawings to the Engineer for approval before work is started:
 - Reinforcing steel drawings: Prepare in accordance with ACI 315. Indicate bending 1. diagrams, assembly diagrams, splicing and laps of bars, dimensions and details of bar reinforcing and accessories.
 - 2. Cementitious coating.

1.4 PRODUCT HANDLING

- A. Comply with pertinent provisions of Section 016000.
- B. Store reinforcement in a manner that will avoid excessive rusting or coating by grease, oil, dirt and other objectionable materials.
- C. Keep reinforcement in separate piles or racks so as to avoid loss of identification after bundles are broken.

PART 2 - PRODUCTS

- 2.1 FORMS
 - A. Use form materials conforming to ACI 347.
 - Β. Form lumber: Use lumber of sufficient quality and grade, size and stiffness to adequately support the work and ensure dimensional accuracy.
 - C. Form ties: Use form ties which do not leave an open hole through the concrete and which permit neat and solid patching at every hole.
 - Use ties with cones that allow a 1" break back and facilitate patching. 1.
 - On structures containing water or other liquid or below grade structures, use embedded 2. rod ties with integral waterstops in addition to cones.
 - Through-bolts that utilize a removable tapered sleeve in water containing and below grade applications: Use mechanical EPDM rubber plugs to seal holes made after removal of taper ties. Acceptable product is X-Plug by the Greenstreak Group, Inc. 800-325-9504. Follow manufacturers' instructions for installation. Friction fit plugs are 3. not allowed.
 - 4. Wire ties and wood spreaders will not be permitted.
 - D. Form coatings: Form release coating shall be neat oil with surface wetting agent or chemical release agent which effectively prevents absorption of moisture, prevents bonding with concrete, is non-staining to concrete and leaves the concrete with a paintable surface.
 - On surfaces to receive an applied coating, use a residual free chemical form release agent 1. which is compatible with the applied coating and will not prevent the applied finish from satisfactorily bonding to the concrete.
 - E. Chamfer strips: Chamfer strips shall be wood or polyvinyl strips or approved equal, designed to be nailed in the forms to provide a 3/4" chamfer (unless indicated otherwise) at all exposed edges and corners of concrete members.

2.2 REINFORCEMENT

- A. Comply with the following as minimums:
 - 1. Bars: ASTM A615, Grade 60, unless otherwise shown on the Drawings, using deformed bars for Number 3 and larger.
 - 2. Welded wire fabric: ASTM A185.
 - Use sheet (mat) welded wire fabric only. a.
 - b. Welded wire fabric supplied in rolls will not be accepted. Bending: ACI 315 and ACI 318.
 - 3.
- Fabricate reinforcement to the required shapes and dimensions, within fabrication tolerances Β. stated in the CRSI "Manual of Standard Practices".
- C. Do not use reinforcement having any of the following defects:
 - Bar lengths, depths, or bends exceeding the specified fabricating tolerances. 1.
 - Bends or kinks not indicated on the Drawings or required for this Work.
 - 2. 3. Bars with excessive rust, scale, dirt, oil or other defects which will reduce the bond or the effective cross section of the bar.

- D. Furnish all support bars, tie bars, chairs, bolsters, etc. required for properly supporting and spacing bars in the forms.
 - 1. For slabs on grade, use supports with stand plates or horizontal runners where wetted base materials will not support chair legs. Other supports must be approved by the Engineer.
 - 2. For exposed-to-view concrete surfaces, where legs of supports are in contact with forms, provide supports with legs which are hot-dip galvanized, plastic protected or stainless steel.
 - 3. Supply supports for welded wire fabric as follows:

Welded Wire Fabric Support Spacing

Welded Wire Reinforcement (diameter)	Welded Wire Spacing (inches)	Maximum Support Spacing (feet)
W9 or larger	12 and greater	4
W5 to W8	12 and greater	3
W9 and larger	Less than 12	3
W4 to W8	Less than 12	2
Less than W4	Less than 12	1.5

- E. Tie wire: FS QQ-W-461, annealed steel, black, 16 gauge minimum.
- F. Welding electrodes: AWS A5.1, low hydrogen, E70 series.
- G. Splice devices: Shall be sized to develop one hundred twenty-five (125%) percent of yield strength of bar.

2.3 CONCRETE MATERIALS

- A. Cement: Use portland cement: ASTM C150, Type I, Type I-P or Type II, low alkali.
 - 1. Where concrete will be exposed to sewage, use Type II or I-P cement.
 - Fly ash shall conform to ASTM C618, Class C or F.
 Fly ash content shall not exceed 20% by weight of
 - 3. Fly ash content shall not exceed 20% by weight of the total amount of cementitious materials (portland cement plus fly ash).
- B. Aggregates:
 - 1. Fine aggregate: Conform to ASTM C33.
 - 2. Coarse aggregate: Conform to ASTM C33, Size #57.
- C. Water: Clean and potable and free from injurious amounts of deleterious materials.
- D. Admixtures:
 - 1. Air entraining admixture: ASTM C260.

- 2. Water reducing, set controlling admixture: Conform to ASTM C494.
- 3.
- a. Type A water reducing.
 b. Type D water reducing and retarding.
 Superplasticizers: Conform to ASTM C494, Types F and G.
 a. Use superplasticizers in thin section placements and in areas of congested reinforcing and/or embedded items, or where otherwise approved by the Engineer.
 - Use where conventional consolidation techniques are impractical. b.
- 4. Do not use admixtures containing calcium chloride.
- E. Fiber reinforcing:
 - 1. Use fiber reinforcing where indicated on the drawings.
 - Provide polypropylene or co-polymer fibers as manufactured by High Tech Fibers, Inc., 2. Fibermesh Company or an approved equal.
 - Where required, use fiber reinforcing at a rate of 2.0 lbs. per cubic yard unless another 3. rate is indicated on the drawings.
- F. Curing compounds:
 - On all vertical and formed surfaces, construction joints, basin slabs, surfaces to receive 1. an applied coating or finish, and other surfaces except as otherwise indicated or specified, use a non-residual, non-staining curing compound conforming to ASTM C309 Type 1 and 1D. Acceptable products are:
 - L&M Cure by L&M Construction Chemicals, Inc. Horn WB-75 by A.C. Horn Company. a.
 - b.
 - Sonosil by Sonneborn, Inc. c.
 - Approved equal. d.
 - On building floor slabs not otherwise receiving an applied coating or finish and on other 2. flatwork as indicated on the Drawings, provide an acrylic copolymer curing and sealing compound conforming to ASTM C309 Type 1 and the following:
 - Non-yellowing. a.
 - b. Minimum 20% solids.
 - Maximum unit moisture loss in accordance with ASTM C156 0.40 kg./sq.m at c. 72 hours.
 - Acceptable products are Dress & Seal by L&M Construction Chemicals, Inc., d. Clear Seal Standard by A. C. Horn Company, Kure-N-Seal 0800 by Sonneborn, Inc., or approved equal.

2.4 CONCRETE MIXES

- Provide concrete with the compressive strengths shown on the Drawings. When such strengths A. are not shown on the Drawings, provide the following 28-day strengths as minimum:
 - 1. All structural concrete except as indicated in Nos. 2 and 3 below or as 4000 psi noted otherwise on the plans
 - 2. All sidewalks, curbs and gutters, and unreinforced foundations 4000 psi
 - Thrust blocking, backfill or encasement for piping, and concrete fill 3. 2500 psi 5000 psi
 - 4. Prestressed or precast concrete:
- Β. Maximum water cement ratios:

4000 psi concrete	0.5
3000 psi concrete	0.53
2500 psi concrete	0.67

D.

C. Entrained air:

3000 and 4000 psi concrete	$5\% \pm 1\%$
2500 psi concrete	Not Required
Slump:	

3000 and 4000 psi concrete	4" ± 1"
2500 psi concrete	5" ± 1"

- E. Production of concrete:
 - 1. General: Concrete shall be ready mixed and shall be batched, mixed and transported in accordance with ASTM C94 except as otherwise indicated.
 - 2. Monitor time and mix proportions by plant delivery slips.
 - 3. Air entraining admixtures: Add air entraining admixture into the mixture as a solution and measure by means of an approved mechanical dispensing device.
 - 4. Water reducing and retarding admixture: Add water reducing and retarding admixture and measure as recommended by the manufacturer.
 - 5. Addition of water to the mix upon arrival at the job site shall not exceed that necessary to compensate for a 1" loss in slump, nor shall the design maximum water-cement ratio be exceeded. Water shall not be added to the batch at any later time.
 - 6. Weather conditions: Control temperature of mix as required by ACI 306 "Cold Weather Concreting" and by ACI 305 "Hot Weather Concreting".

PART 3 - EXECUTION

- 3.1 SURFACE CONDITIONS
 - A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.
 - B. Water, mud, organic, and other detrimental material shall be removed from excavations before concrete is deposited.
 - C. Notify the Engineer prior to placing concrete and place no concrete until the formwork, reinforcing and embedded items have been observed by the Engineer.

3.2 FORMWORK

- A. General:
 - 1. Construct forms in conformance with ACI 347.
 - 2. Design, erect, support, brace and maintain formwork so it will safely support vertical and lateral loads which might be applied until such loads can be supported safely by the concrete structure.
 - 3. Construct forms to the exact sizes, shapes, lines and dimensions shown, and as required to obtain accurate alignment, location, grades, level and plumb work in the finished structure.
 - 4. Provide formwork sufficiently tight to prevent leakage of cement paste during concrete placement. Solidly butt joints and provide backup material at joints as required to prevent leakage and prevent fins.

- B. Form construction and erection:
 - Construct forms in conformance with ACI 347. 1.
 - 2. Provide for openings, offsets, keyways, recesses, moldings, reglets, chamfers, blocking, screeds, bulkheads, anchorages, inserts and other embedded items as required.
 - 3. Hold inner and outer forms for vertical concrete together with combination steel ties and spreaders approved by the Engineer.
 - 4. Unless specifically stated otherwise, provide 3/4" chamfer at all exposed edges of concrete.
 - Provide temporary openings in the formwork where necessary to facilitate cleaning and 5. inspection of the formwork.
 - Coat form contact surfaces with approved form coating compound prior to placing 6. reinforcing steel.
 - Do not allow excess form coating material to accumulate in the forms or to come in 7. contact with reinforcing surfaces which will bond to fresh concrete.
 - Side forms for footings may be omitted, and concrete may be placed directly against 8. excavation only when requested by the Contractor and approved by the Engineer.
 - 9. Provide a positive means of adjustment of shores and struts and ensure that all settlement is taken up during concrete placing.
 - Construct blockouts and formed openings of sufficient size and proper location to permit 10. final alignment of items within it or passing through it.
 - Allow sufficient space for grouting, packing or sealing around any items a. penetrating the opening as may be required to ensure watertightness.
 - b. Provide openings with continuous keyways with waterstops where required, and provide a slight flare to facilitate grouting and the escape of entrapped air during grouting.
 - c. Provide only blockouts or openings that are shown on the drawings or otherwise approved by the Engineer.
- C. Formwork reuse: Reuse only forms that are in good condition and which maintain a uniform surface texture on expose concrete surfaces.
 - Apply a light sanding as necessary to obtain a uniform texture. 1.
 - 2. Plug unused tie holes and penetrations flush with the form surface.
- D. Removal of forms:
 - 1. Do not disturb or remove forms until the concrete has hardened sufficiently to permit form removal with complete safety. Do not remove shoring until the member has acquired sufficient strength to support its own weight, the load upon it, and the added load of construction.
 - 2. Do not remove forms before the following minimum times without prior approval from the Engineer:
 - Sides of footings or slabs on grade 24 hrs a. 48 hrs
 - Walls not supporting load b.
 - Vertical sides of beams c.
 - Columns not supporting load d.
 - Suspended slabs or beam bottoms (forms only) e.
 - In determining the minimum stripping times, consider only the cumulative time during which the ambient temperature of the air surrounding the concrete is above 50°. 3.
 - 4. Do not remove shoring for suspended slabs or beams until the concrete has reached 75% of the specified 28 day strength.
 - 5. When reshoring or backshoring is permitted or required, plan the operations in advance and submit procedures to the Engineer for approval.
 - Design and plan all reshoring operations to support all construction loading and a. in accordance with ACI 347.
 - Exercise care in removing forms from finished concrete surfaces so that surfaces are not 6. marred or gouged and that corners are true, sharp and unbroken.

48 hrs

48 hrs

10 days

- 7. Do not permit steel spreaders, form ties, or other metal to project from or be visible on any concrete surface except where so shown on the drawings.
- 8. Whenever the formwork is removed during the curing period, continue to cure the exposed concrete by one of the methods specified herein.

3.3 EMBEDDED ITEMS

- A. Embedded items: Set anchor bolts and other embedded items accurately and securely in position in the forms until the concrete is placed and set.
 - 1. Use templates where practical for all anchor bolts.
 - 2. Check locations of all anchor bolt and special castings prior to placing concrete and verify locations after concreting.
- B. Piping cast in concrete:
 - 1. Install and secure sleeves, wall pipes and pipe penetrations before placing concrete.
 - 2. Do not weld or otherwise attach piping to reinforcing steel.
 - 3. Support piping to be encased in concrete securely and on firm foundation so as to prevent movement or settlement during concreting.
- C. Locate electrical conduit so that it will not impair the strength of the construction.
 - 1. Do not use conduits running within (not passing through) a slab, wall or beam that are larger in outside diameter than 1/3 overall concrete thickness unless otherwise approved by the Engineer.
 - 2. Do not space conduits closer than three conduit diameters apart unless otherwise approved by the Engineer.

3.4 REINFORCEMENT

- A. General: Comply with the specified codes and standards and Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars" for details and methods of reinforcement placement and supports and as herein specified.
 - 1. Clean reinforcement and remove loose dust and mill scale, earth, and other materials which reduce or destroy bond with concrete.
 - 2. Position and secure reinforcement against displacement by forms, construction, and the concrete placement operations.
 - 3. Use adequate number of ties to secure reinforcing.
 - 4. Do not weld or field bend reinforcing without prior approval by the Engineer.
- B. Placing reinforcing:
 - 1. Provide and install all chairs, runners, bolsters, standees and other accessories in sufficient quantities to satisfactorily position the reinforcing and hold it in place during concrete placement.
 - 2. Support reinforcing for slabs on ground on chairs or bolsters with stand plates or a properly sized concrete cube.
 - a. Use concrete bricks as supports only as approved by the Engineer.
 - 3. Secure and tie dowels in place prior to placing concrete. Do not press dowels into wet concrete.

- C. Concrete cover: Unless otherwise indicated on the drawings or specified herein, install reinforcing with clear concrete coverage in conformance with ACI 318.
 - All reinforcement, regardless of size, exposed to water or sewage shall have 2" cover. Place reinforcement a minimum of 2" clear of any openings or metal pipe or fittings. 1. 2.
- Splicing reinforcement: Splice reinforcement steel in accordance with the latest revisions of ACI D. 318 "Building Code Requirements for Reinforced Concrete" unless shown otherwise on the drawings.
 - 1. All splices at wall corners or intersections and at wall and foundation intersections shall be Class B tension splices per ACI 3-18, Sections 12.2.2 and 12.15.
 - 2. All other splices of vertical or horizontal steel in walls shall be Class B tension splices as per ACI 318 per ACI 318, Sections 12.2.2 and 12.15.
 - Horizontal ring steel in circular, non-prestressed concrete tanks shall be Class B tension 3. splices and the splices shall be staggered so that no more than 50% of the bars are spliced at any one location.
 - 4. All welded or mechanical splicing devices shall develop 125% of the yield strength of the bar.
 - 5. Column vertical bars shall lap 30 bar diameters with dowels at the base of the column unless otherwise noted. Dowels shall be the same size and quantity as column vertical bars unless otherwise noted.
 - All splices not otherwise shown or specified shall be Class B tension lap splices per ACI 6. 318, Sections 12.2.2 and 12.15.
- E. Tolerances: Place bars in the locations indicated within the tolerances conforming to the CRSI "Manual of Standard Practice".
- F. Welded wire mesh: Install welded wire fabric in as long of a length as practicable and lay flat before placing concrete.
 - Use only mat welded wire fabric. Do not use welded wire fabric from rolls. 1.
 - 2. 3. Support and tie mesh to prevent movement during concrete placement.
 - Lap adjoining pieces at least one full mesh and lace splices with wire.
 - 4. Provide, at a minimum, supports for welded wire fabric according to the Table in Section 2.2.D.3. Confirm the adequacy of the support spacings listed therein for the anticipated construction loads. Increase the number of supports, if necessary, to assure that the final position of the welded wire fabric will conform to that shown on the drawings.
 - Do not place welded wire fabric on the subbase surface and then hook or "pull up" the 5. reinforcement during concrete placement.
 - 6. Do not lay welded wire fabric on top of the freshly placed concrete and then "walk it" into place.

3.5 PLACING CONCRETE

- A. Preparation:
 - Remove foreign matter accumulated in the forms. 1.
 - 2. Rigidly close openings left in the formwork.
 - 3. Wet wood forms sufficiently to tighten up cracks. Wet other material sufficiently to maintain workability of the concrete.
 - 4. Use only clean tools.
 - Provide and maintain sufficient tools and equipment on hand to facilitate uninterrupted 5. placement of the concrete.
 - 6. Before commencing concrete, inspect and complete installation of formwork, reinforcing steel and all items to be embedded or cast-in.
- B. Conveying:

- 1. Transport and handle concrete from the truck to the place of final deposit as rapidly as practicable by methods which will prevent segregation or loss of ingredients to maintain the quality of the concrete.
- 2. Provide equipment for lifting, dumping, chuting, pumping or conveying the concrete, of such size and design as to ensure a practically continuous flow of concrete at the delivery and without separation of materials.
- 3. Use hopers and elephant trunks where necessary to prevent the free fall of concrete for more than 4'.
- 4. Do not use concrete that is not placed within 1-1/2 hours after water is first introduced into the mix unless the slump is such that it meets the specified limits without the addition of water to the batch.
- C. Placing:
 - Deposit concrete as nearly as practicable in its final location so as to avoid separation 1. due to rehandling and flowing.
 - 2. Deposit concrete in horizontal layers not deeper than 2', avoiding inclined layers.
 - 3. Place concrete at such a manner that concrete upon which fresh concrete is deposited is still plastic.
 - 4. Bring slab surfaces to the correct level with screeds set to the proper elevation.
- D. Hot weather placement: Place concrete in hot weather in accordance with ACI 305 "Hot Weather Concreting" and as specified herein.
 - 1. Do not place concrete whose temperature exceeds 100°F.
 - 2. 3. Thoroughly wet forms and reinforcing prior to placement of concrete.
 - Use additional set retarder as necessary to increase set time.
 - 4. Limit the size of the pour where it may reduce the likelihood of cold joints due to reduced set time.
 - 5. Shade the fresh concrete as soon as possible after placing.
 - 6. Start curing as soon as the concrete is sufficiently hard to permit without damage.
- E. Cold weather placement: Place concrete in cold weather in accordance with ACI 306 and as specified herein.
 - Except when authorized specifically by the Engineer, do not place concrete when the 1. atmospheric temperature is below 40°F.
 - When cold weather placement is approved by the Engineer, heat either the mixing water 2. or aggregate or both so that the concrete temperature is between 65°F and 85°F.
 - Protect the freshly placed concrete by adequate housing or covering and provide heat to maintain a temperature of not less than 50°F for not less than four days. 3.
 - 4. Do not add salts, chemicals, or other materials to the concrete mix to lower the freezing point of the concrete.
- F. Consolidation:
 - 1. Consolidate each layer of concrete immediately after placing, by use of internal concrete
 - vibrators supplemented by hand spading, rodding, or tamping. a. Use vibrators having a 2" head diameter and a minimum frequency of 8000 vibrations per second.
 - Provide sufficient number of vibrators to properly consolidate the concrete, b. keeping up with placement operations.
 - Provide at least one spare vibrator on site. с.
 - Insert and withdraw vibrators at points approximately 18" apart.
 - 2. 3. Do not vibrate forms or reinforcement.
 - 4. Do not use vibrators to transport concrete inside the forms.

3.6 **PROTECTION**

- A. Protect the surface finish of newly placed concrete from damage by rainwater or construction traffic.
- B. Do not apply design loads to structures until the concrete has obtained the specified strength.
 - 1. Do not backfill against walls until they have reached the specified strength and all supporting or bracing walls, slabs, etc. have also reached the specified strength, unless otherwise permitted by the Engineer.
 - 2. Protect structures from construction overloads.

3.7 CURING

- A. Beginning immediately after placement, protect concrete from premature drying, excessively hot and cold temperatures and mechanical injury.
- B. Continuously cure concrete for a period of not less than 7 days after placement.
 - 1. When seven-day cylinder breaks indicate, in the opinion of the Engineer, the possibility of low strength concrete, provide additional curing as per the request of the Engineer.
 - 2. When temperatures during the curing period fall below 40°F, provide additional curing time as directed by the Engineer.
- C. Unless otherwise directed by the Engineer, cure concrete not in contact with forms in accordance with one of the following procedures:
 - 1. Ponding or sprinkling: Keep entire concrete surface wet by continuously sprinkling or by allowing water to pond, covering all surfaces.
 - 2. Wet burlap: Thoroughly wet and cover all concrete surfaces with wet burlap mats as soon as the concrete has set sufficiently to avoid marring the surface.
 - . Keep the burlap continuously wet during the curing period.
 - 3. Curing blankets: Thoroughly wet concrete surfaces to be cured and cover with curing blankets as soon as the concrete has set sufficiently to avoid marring the surface.
 - a. Weight the blankets down to maintain close contact with the concrete surface.
 - b. Use sheets of waterproof kraft paper with the joints between sheets taped continuously; or
 - c. Use sheets of 4 mil or thicker polyethylene with the joints between sheets continuously taped.
 - 4. Wet sand: Apply a layer of sand over the entire surface and keep it continuously wet.
 - 5. Curing compound: Apply curing compound immediately after completion of the finish on uniformed surfaces and within two hours after removal of forms on formed surfaces.
 - a. Spray the entire surface with two coats of liquid curing compound, applying the second coat in the direction of 90° to the first coat.
 - b. Apply compound in accordance with the manufacturer's instructions to cover the surface with a uniform film which will seal thoroughly.
- D. Hot weather: When necessary, provide wind breaks, shading, fog spraying, sprinkling, ponding or wet covering with a light colored material applying as quickly as concrete hardening and finishing operations will allow.

3.8 CONCRETE FINISHING

- A. Finish schedule: Unless otherwise indicated on the drawings, finish all concrete surfaces in accordance with the following schedule:
 - 1. Form finish: Formed surfaces not ordinarily exposed to view, including:

2.

- Interior walls of open tanks below a line one foot lower than the lowest normal a. water level.
- The underside of slabs not exposed to view. b.
- c. Walls below grade. Cementitious coating: All formed surfaces exposed to view including:
 - Interior walls of tanks above a line one foot lower than the lowest normal water a. level.
 - The underside of slabs, soffits, etc. exposed to view. b.
- Float finish: Slab surfaces not exposed to view or not receiving an applied thin finish, 3. including:
 - Bottom slabs of tanks or structures containing water sewage or other liquid. a.
 - Foundations not exposed to view. b.
 - Roof slabs to be covered with insulation and/or built-up roofing. с.
- Trowel finish: Interior slab surfaces exposed to view or to receive an applied thin film 4. coating or floor finish, including: a. Interior, indoor slabs and floors of buildings.

 - Surfaces on which mechanical equipment moves. b.
 - Floors receiving vinyl tile, resilient flooring, carpet, paint, etc. с.
- 5. Broom finish: Exterior, outdoor slabs exposed to view including:
 - Outdoor floor slabs and walkways. a.
 - Other floors which may become wet or otherwise require a non-skid surface. b.
 - Sidewalks and concrete pavements. c.
- Scratch finish: Surfaces which are to receive a thick topping or additional concrete cast 6. against them including:
 - Surfaces receiving concrete equipment pads. a.
 - b. Floors receiving concrete topping.
 - Construction joints not otherwise keyed. c.
- Edge finish: Exposed edges of slabs not receiving chamfer including: 7.
 - Sidewalk edges and joints. a.
 - Pavement edges and joints. b.
 - Other slab edges not chamfered. c.
- Β. Finishing procedures:
 - 1. Form finish:
 - Repair defective concrete. a.
 - Fill depressions deeper than 1/4". b.
 - Fill tie holes. c.
 - Remove fins exceeding 1/8" in height. d.
 - 2. Cementitious finish:
 - Patch all tie holes and defects and remove all fins. a.
 - Within one day of form removal, fill all bug holes, wet the surfaces and rub with b. carborundum brick until a uniform color and texture are produced; or
 - Dampen surfaces, brush apply a grout slurry consisting of 1 part portland cement c. to 1-1/2 parts sand, and rub the surface vigorously with a stone. Remove all excess grout.
 - Provide a two coat cement base waterproofing, sealing finish of Thoroseal and d. Thoroseal Plaster Mix as manufactured by Standard Dry Wall Products, Inc. or an approved equal.
 - Patch all tie holes and defects and removal all fins, and clean surface of 1) all dirt, laitance, grease, form treatments, curing compounds, etc.

- 2) Key coat: Apply key coat of Thoroseal at a rate of two (2) lbs. per sq. yd. by fiber brush. Mix material using one part of Acryl 60 to three parts clean water. Should material start to drag during application, dampen surface with water. During hot weather periods, dampen surfaces with water prior to application of key coat material. Key coat shall be allowed to cure for five (5) days before applying finish coat.
- surface with water. During hot weather periods, dampen surfaces with water prior to application of key coat material. Key coat shall be allowed to cure for five (5) days before applying finish coat.
 3) Apply a finish coat consisting of a four (4) to six (6) lbs. per sq. yd. application of Thoroseal Plaster Mix using steel trowel or spray gun. Color to be selected by the Owner. Mix dry material using one (1) part Acryl 60 to three (3) parts clean water. Firmly press the mix into all voids and level with a steel trowel. When surface is set so that it will not roll or lift, float it uniformly using a sponge float.
- 3. Float finish:
 - a. Begin floating when the water sheen has disappeared and when the surface has stiffened sufficiently to permit the operation.
 - b. Cut down all high spots and fill all low spots and float the slab to a uniform sandy texture.
- 4. Trowel finish:
 - a. Float finish as specified herein.
 - b. Power trowel to a smooth surface free of defects.
 - c. After the surface has hardened sufficiently, hand trowel until a ringing sound is produced as the trowel is moved over the concrete surface.
- 5. Broom finish:
 - a. Float finish as specified herein.
 - b. Provide a scored texture by drawing a broom across the surface.
- 6. Scratch surface:
 - a. Screed the surface to the proper elevations.
 - b. Roughen with rakes or stiff brushes.
- 7. Edge finish: Tool slab edges and joints with a 1/4" radius edging tool.

3.9 SURFACE REPAIR

- A. Patching mortar:
 - 1. Make a patching mortar consisting of 1 part portland cement to 2-1/2 parts sand by damp loose volume.
 - 2. Mix the mortar using one part acrylic bonding admixture to two parts water.
- B. Tie holes: Clean and dampen all tie holes and fill solidly with patching mortar.
- C. Surface defects:
 - 1. Remove all defective concrete down to sound solid concrete.
 - 2. Chip edges perpendicular to the concrete surface or slightly undercut, allowing no feather edges.
 - 3. Dampen surfaces to be patched.
 - 4. Patch defects by filling solidly with repair mortar.
- D. Allow the Engineer to observe the work before placing the patching mortar.
- E. Repair defective areas greater than 1 sq. ft. or deeper than 1-1/2" as directed by the Engineer using materials approved by the Engineer at no additional expense to the Owner.

3.10 JOINTS

- A. Construction joints:
 - 1. Unless otherwise approved by the Engineer, provide construction joints as shown on the drawings.
 - 2. If additional construction joints are found to be required, secure the Engineer's approval of joint design and location prior to start of concrete placement.
 - 3. Continue all reinforcing across construction joints and provide 1-1/2" deep keyways unless indicated otherwise on the drawings.
 - a. Form keyways in place.
 - 4. Provide waterstops in all construction joints of liquid containing structures, structures below grade or other structures as shown on the drawings.
- B. Expansion joints:
 - 1. Provide expansion joints of size, type and locations as shown on the drawings.
 - 2. Do not permit reinforcement or other embedded metal items that are being bonded with concrete (except smooth dowels bonded on only one side of the joints, where indicated on the drawings) to extend continuously through any expansion joint.
 - 3. Provide waterstops where required.
- C. Control or contraction joints:
 - 1. Locate and construct control and contraction joints in accordance with the Drawings.
 - 2. Where no specific joint pattern is indicated in slabs on grade or concrete pavements, submit a proposed joint layout to the Engineer for approval.
 - 3. Where no specific joint details are shown on the drawings, joints may be tooled, preformed or saw-cut.
 - 4. Saw-cut joints as soon as the concrete has hardened sufficiently to prevent aggregates from being dislodged by the saw.

3.11 FIELD QUALITY CONTROL

- A. Concrete cylinder tests:
 - 1. During construction, prepare test cylinders for compressive strength testing, using 6" diameter by 12" long single use molds, complying with ASTM C31.
 - a. Make a set of three test cylinders from each pour of 50 cubic yards or less, plus one additional set of cylinders for each additional 50 cubic yards or fraction thereof.
 - b. Identify each and tag cylinder as to date of pour and location of concrete which it represents.
 - c. Deliver cylinders to testing lab selected by the Owner.
 - d. Cost for preparation and delivery of cylinders shall be borne by the Contractor. Cost for testing cylinders will be borne by the Owner.
 - 2. Should strengths shown by test cylinders fail to meet specified strengths for the concrete represented, then:
 - a. Engineer shall have the right to require changes in the mix proportions as he deems necessary on the remainder of the work.
 - b. Additional curing of those portions of the structure represented by the failed test cylinders shall be accomplished as directed by the Engineer.
 - c. Upon failure of the additional curing to bring the concrete up to specified strength requirements, strengthening or replacement of those portions of the structure shall be as directed by the Engineer.

- d. The Engineer may require additional testing of concrete in question by either non-destructive methods such as the Swiss Hammer, Windsor Probe or Ultrasonics or by coring and testing the concrete in question in accordance with ASTM C42. Such testing shall be performed at no additional cost to the Owner.
- B. Other field concrete tests:
 - 1. Slump tests: Either the Engineer or a testing laboratory representative will make slump tests of concrete as it is discharged from the mixer.
 - a. Slump test may be made on any concrete batch at the discretion of the Engineer.
 - b. Failure to meet specified slump requirements (prior to addition of any superplasticizers) will be cause for rejection of the concrete.
 - 2. Temperature: The concrete temperature may be checked at the discretion of the Engineer.
 - 3. Entrained air: Air content of the concrete will be checked by a representative of the testing laboratory at the discretion of the Engineer.
- C. Coordination of laboratory services: The Contractor shall be responsible for coordination of laboratory services.
 - 1. Maintain a log recording quantities of each type of concrete placed, date and location of pour.
 - 2. Inform the testing laboratory of locations and dates of concrete placement and other information as required to be identified in the laboratory's test reports.
- D. Tests required because of extensive honeycombing, poor consolidation of the concrete or any suspected deficiency in the concrete will be paid for by the Contractor.
- E. Dimensional tolerances:
 - 1. Dimensional tolerances for allowable variations from dimensions or locations of concrete work, including the locations of embedded items shall be as given in ACI 301.
 - 2. Where anchor bolts or other embedded items are required for equipment installation, comply with the manufacturer's tolerances if more stringent than those stated in ACI 301.
- F. Watertight concrete:
 - 1. All liquid containing structures, basements or pits below grade shall be watertight.
 - 2. Any visible leakage or seepage shall be repaired as instructed by the Engineer at no expense to the Owner.
 - 3. Where physical evidence of honeycombing, cold joints or other deficiencies which may impair the watertightness of a structure exists, the Engineer may at his discretion call for leak testing of the structure.
 - a. Fill the structure with water and allow to stand for not less than 48 hours.
 - b. Make repairs on the structure until all visible leaks are sealed and the leakage rate of the water in the structure is less than 0.1% of the volume held in the structure per day.
 - c. The cost of testing and repairs shall be performed at no expense to the Owner.
- G. Concrete which fails to meet strength requirements, dimensional tolerances, watertightness criteria, or is otherwise deficient due to insufficient curing, improper consolidation or physical damage shall be replaced or repaired as instructed by the Engineer at no expense to the Owner.

3.12 MEASUREMENT AND PAYMENT

A. No measurement or direct payment will be made for the work under this Section and all costs for same shall be included in the price bid for the item in which the concrete work is an integral part.

END OF SECTION 033055

SECTION 042000 - UNIT MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Concrete masonry units.
 - 2. Masonry veneer units.
 - 3. Concrete building brick.
 - 4. Face brick.
 - 5. Mortar and grout.
 - 6. Steel reinforcing bars.
 - 7. Masonry joint reinforcement.
 - 8. Ties and anchors.
 - 9. Embedded flashing.
 - 10. Miscellaneous masonry accessories.
- B. Related Sections:
 - 1. Section 047200 "Cast Stone Masonry" for furnishing cast stone trim.
 - 2. Section 072100 "Thermal Insulation" for cavity wall insulation.
 - 3. Section 076200 "Sheet Metal Flashing and Trim" for exposed sheet metal flashing and for furnishing manufactured reglets installed in masonry joints.

1.3 DEFINITIONS

- A. CMU(s): Concrete masonry unit(s).
- B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.4 PERFORMANCE REQUIREMENTS

- A. Provide structural unit masonry that develops indicated net-area compressive strengths at 28 days.
 - 1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For the following:
 - 1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
 - 2. Stone Trim Units: Show sizes, profiles, and locations of each stone trim unit required.
 - 3. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement."
- C. Samples for Initial Selection:
 - 1. Masonry veneer.
 - 2. Face brick.
 - 3. Colored mortar.
 - 4. Weep holes/vents.
- D. Samples for Verification: For each type and color of the following:
 - 1. Masonry veneer.
 - 2. Face brick, in the form of straps of five or more bricks.
 - 3. Pigmented mortar. Make Samples using same sand and mortar ingredients to be used on Project.
 - 4. Weep holes and vents.
 - 5. Accessories embedded in masonry.

1.6 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For each type and size of the following:
 - 1. Masonry units.
 - a. Include data on material properties.
 - b. Manufacturer's certification letter stating that all lightweight aggregates used in the manufacture of CMU concrete masonry units were expanded shale, clay, slate or slag, and that no combustible matter and organic impurities such as coal, coke, cinder/bottom ash or similar type aggregates were used.
 - c. For brick, include size-variation data verifying that actual range of sizes falls within specified tolerances.
 - d. For exposed brick, include test report for efflorescence according to ASTM C 67.
 - e. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.
 - 2. Cementitious materials. Include brand, type, and name of manufacturer.
 - 3. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
 - 4. Grout mixes. Include description of type and proportions of ingredients.
 - 5. Reinforcing bars.
 - 6. Joint reinforcement.
 - 7. Anchors, ties, and metal accessories.

- B. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
 - 1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91 for air content.
 - 2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.
- C. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.
- D. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.7 QUALITY ASSURANCE

- A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.
- B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.
- C. Masonry Standard: Comply with ACI 530.1/ASCE 6/TMS 602 unless modified by requirements in the Contract Documents.
- D. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Build mockup of typical wall area as shown on Drawings.
 - 2. Build mockups for typical exterior wall in sizes approximately 96 inches (2400 mm) long by 72 inches (1800 mm) high by full thickness, including face and backup wythes and accessories.
 - a. Include a sealant-filled joint at least 16 inches (400 mm) long in exterior wall mockup.
 - b. Include through-wall flashing installed for a 24-inch (600-mm) length in corner of exterior wall mockup approximately 16 inches (400 mm) down from top of mockup, with a 12-inch (300-mm) length of flashing left exposed to view (omit masonry above half of flashing).
 - c. Include veneer anchors, flashing, weep holes in exterior masonry-veneer wall mockup.
 - 3. Clean exposed faces of mockups with masonry cleaner as indicated.
 - 4. Protect accepted mockups from the elements with weather-resistant membrane.

- 5. Approval of mockups is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; and aesthetic qualities of workmanship.
 - a. Approval of mockups is also for other material and construction qualities specifically approved by Architect in writing.
 - b. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless such deviations are specifically approved by Architect in writing.
- 6. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination."

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
- B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- D. Deliver preblended, dry mortar mix in moisture-resistant containers designed for use with dispensing silos. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in covered weatherproof dispensing silos.
- E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.9 PROJECT CONDITIONS

- A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
 - 1. Extend cover a minimum of 24 inches (600 mm) down both sides of walls and hold cover securely in place.
 - 2. Where one wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches (600 mm) down face next to unconstructed wythe and hold cover in place.

- B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.
- C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
 - 1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
 - 2. Protect sills, ledges, and projections from mortar droppings.
 - 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
 - 4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
- D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
 - 1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.
- E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

PART 2 - PRODUCTS

2.1 MASONRY UNITS, GENERAL

- A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed Work.
- B. Fire-Resistance Ratings: Where indicated, provide units that comply with requirements for fireresistance ratings indicated as determined by testing according to ASTM E 119, by equivalent masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

2.2 CONCRETE MASONRY UNITS

- A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
 - 1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
 - 2. Provide square-edged units for outside corners unless otherwise indicated.

- B. CMUs: ASTM C 90.
 - 1. Density Classification: Lightweight.
 - 2. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.
- C. Concrete Building Brick: ASTM C 55.
 - 1. Density Classification: Lightweight.
 - 2. Size (Actual Dimensions): 3-5/8 inches (92 mm) wide by 2-1/4 inches (57 mm) high by 7-5/8 inches (194 mm) long.
- D. Masonry Veneer MV-1:
 - 1. Products: Subject to compliance with requirements, provide products as manufactured by Oldcastle Adams Products Company.
 - 2. Size (Actual Dimensions): 3-5/8 inches (92 mm) wide by 7-5/8 inches (92 mm) high by 15-5/8 inches (295 mm) long.
 - 3. Exposed Faces: Polished faces in color matching Architect's sample.

2.3 MASONRY LINTELS

A. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

2.4 BRICK

- A. General: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of adjacent units:
 - 1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
 - 2. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.
- B. Face Brick: Facing brick complying with ASTM C 216.
 - 1. Products: Subject to compliance with requirements, provide the following (or equal approved prior to bidding):

a. <u>Palmetto Brick, Smooth, .75 Graystone (to match adjacent buildings)</u>

- 2. Grade: SW.
- 3. Type: FBS.
- 4. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 3350 psi (23.10 MPa).
- 5. Initial Rate of Absorption: Less than 30 g/30 sq. in. (30 g/194 sq. cm) per minute when tested per ASTM C 67.

- 6. Efflorescence: Provide brick that has been tested according to ASTM C 67 and is rated "not effloresced."
- 7. Size (Actual Dimensions): 3-5/8 inches (92 mm) wide by 2-1/4 inches (57 mm) high by 7-5/8 inches (194 mm) long.
- 8. Application: Use where brick is exposed unless otherwise indicated.

2.5 MORTAR AND GROUT MATERIALS

- A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction.
- B. Masonry Cement: ASTM C 91 (not for Type N Mortar).
- C. Mortar Cement: ASTM C 1329.
 - 1. <u>Products</u>: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. <u>Lafarge North America Inc.</u>; Lafarge Mortar Cement.
- D. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C 979. Use only pigments with a record of satisfactory performance in masonry mortar.
 - 1. <u>Products</u>: Subject to compliance with requirements, provide one of the following:
 - a. <u>Davis Colors</u>; True Tone Mortar Colors.
 - b. <u>Lanxess Corporation</u>; Bayferrox Iron Oxide Pigments.
 - c. <u>Solomon Colors, Inc.</u>; SGS Mortar Colors.
- E. Colored Cement Product: Packaged blend made from mortar cement and mortar pigments, all complying with specified requirements, and containing no other ingredients.
 - 1. Formulate blend as required to produce color indicated or, if not indicated, as selected from manufacturer's standard colors.
 - 2. Pigments shall not exceed 5 percent of mortar cement by weight.
- F. Aggregate for Mortar: ASTM C 144.
 - 1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
 - 2. For joints less than 1/4 inch (6 mm) thick, use aggregate graded with 100 percent passing the No. 16 (1.18-mm) sieve.
 - 3. White-Mortar Aggregates: Natural white sand or crushed white stone.
 - 4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.
- G. Aggregate for Grout: ASTM C 404.

- H. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.
 - 1. <u>Products</u>: Subject to compliance with requirements, provide one of the following:
 - a. <u>Euclid Chemical Company (The)</u>; Accelguard 80.
 - b. <u>Grace Construction Products, W. R. Grace & Co. Conn.</u>; Morset.
 - c. <u>Sonneborn Products, BASF Aktiengesellschaft</u>; Trimix-NCA.
- I. Water: Potable.

2.6 REINFORCEMENT

- A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60 (Grade 420).
- B. Masonry Joint Reinforcement, General: ASTM A 951/A 951M.
 - 1. Interior Walls: Hot-dip galvanized, carbon steel.
 - 2. Exterior Walls: Hot-dip galvanized, carbon steel.
 - 3. Wire Size for Side Rods: 0.148-inch (3.77-mm) diameter.
 - 4. Wire Size for Cross Rods: 0.148-inch (3.77-mm) diameter.
 - 5. Wire Size for Veneer Ties: 0.148-inch (3.77-mm) diameter.
 - 6. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches (407 mm) o.c.
 - 7. Provide in lengths of not less than 10 feet (3 m), with prefabricated corner and tee units.
- C. Masonry Joint Reinforcement for Single-Wythe Masonry: Ladder type with single pair of side rods.
- D. Masonry Joint Reinforcement for Multiwythe Masonry:
 - 1. Adjustable (two-piece) type, either ladder or truss design, with one side rod at each face shell of backing wythe and with separate adjustable ties with pintle-and-eye connections having a maximum adjustment of 1-1/4 inches (32 mm). Size ties to extend at least halfway through facing wythe but with at least 5/8-inch (16-mm) cover on outside face.

2.7 TIES AND ANCHORS

- A. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated.
 - 1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M; with ASTM A 153/A 153M, Class B-2 coating.
 - 2. Steel Sheet, Galvanized after Fabrication: ASTM A 1008/A 1008M, Commercial Steel, with ASTM A 153/A 153M, Class B coating.
 - 3. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

- B. Wire Ties, General: Unless otherwise indicated, size wire ties to extend at least halfway through veneer but with at least 5/8-inch (16-mm) cover on outside face. Outer ends of wires are bent 90 degrees and extend 2 inches (50 mm) parallel to face of veneer.
- C. Individual Wire Ties: Rectangular units with closed ends and not less than 4 inches (100 mm) wide.
 - 1. Z-shaped ties with ends bent 90 degrees to provide hooks not less than 2 inches (50 mm) long may be used for masonry constructed from solid units.
 - 2. Where wythes do not align are of different materials, use adjustable ties with pintle-andeye connections having a maximum adjustment of 1-1/4 inches (32 mm).
 - 3. Wire: Fabricate from 3/16-inch- (4.76-mm-) diameter, hot-dip galvanized steel wire.
- D. Adjustable Anchors for Connecting to Concrete: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
 - 1. Tie Section: Triangular-shaped wire tie, sized to extend within 1 inch (25 mm) of masonry face, made from 0.187-inch- (4.76-mm-) diameter, hot-dip galvanized steel wire.
- E. Partition Top anchors: 0.105-inch- (2.66-mm-) thick metal plate with 3/8-inch- (9.5-mm-) diameter metal rod 6 inches (152 mm) long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from steel, hot-dip galvanized after fabrication.

2.8 MISCELLANEOUS ANCHORS

A. Anchor Bolts: Headed steel bolts complying with ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A 153/A 153M, Class C; of dimensions indicated.

2.9 EMBEDDED FLASHING MATERIALS

- A. Metal Flashing: Provide metal flashing complying with Section 076200 "Sheet Metal Flashing and Trim" and as follows:
 - 1. Fabricate continuous flashings in sections 96 inches (2400 mm) long minimum, but not exceeding 12 feet (3.7 m). Provide splice plates at joints of formed, smooth metal flashing.
 - 2. Fabricate through-wall flashing with snaplock receiver on exterior face where indicated to receive counterflashing.
 - 3. Metal Drip Edge: Fabricate from stainless steel. Extend at least 3 inches (76 mm) into wall and 1/2 inch (13 mm) out from wall, with outer edge bent down 30 degrees and hemmed.
- B. Flexible Flashing: Use the following unless otherwise indicated:

- 1. Copper-Laminated Flashing: 5-oz./sq. ft. (1.5-kg/sq. m) copper sheet bonded between 2 layers of glass-fiber cloth. Use only where flashing is fully concealed in masonry.
 - a. <u>Products</u>: Subject to compliance with requirements, provide one of the following:
 - 1) Advanced Building Products Inc.; Copper Fabric Flashing.
 - 2) <u>Dayton Superior Corporation, Dur-O-Wal Division;</u> Copper Fabric Thru-Wall Flashing.
 - 3) <u>Hohmann & Barnard, Inc.</u>; H & B C-Fab Flashing.
 - 4) <u>Phoenix Building Products;</u> Type FCC-Fabric Covered Copper.
 - 5) <u>Sandell Manufacturing Co.</u>, Inc.; Copper Fabric Flashing.
 - 6) <u>York Manufacturing, Inc.</u>; Multi-Flash 500.
- C. Application: Unless otherwise indicated, use the following:
 - 1. Where flashing is indicated to receive counterflashing, use metal flashing.
 - 2. Where flashing is indicated to be turned down at or beyond the wall face, use metal flashing.
 - 3. Where flashing is partly exposed and is indicated to terminate at the wall face, use metal flashing or flexible flashing with a metal drip edge.
 - 4. Where flashing is fully concealed, use flexible flashing.
- D. Solder and Sealants for Sheet Metal Flashings: As specified in Section 076200 "Sheet Metal Flashing and Trim."
- E. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

2.10 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from urethane.
- B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.
- C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).
- D. Weep/Vent Products: Use the following unless otherwise indicated:
 - 1. Cellular Plastic Weep/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8 inch (3 mm) less than depth of outer wythe, in color selected from manufacturer's standard.
 - a. <u>Products</u>: Subject to compliance with requirements, provide one of the following:
 - 1) <u>Advanced Building Products Inc.</u>; Mortar Maze weep vent.

- 2) <u>Blok-Lok Limited;</u> Cell-Vent.
- 3) <u>Dayton Superior Corporation, Dur-O-Wal Division;</u> Cell Vents.
- 4) <u>Heckmann Building Products Inc.</u>; No. 85 Cell Vent.
- 5) <u>Hohmann & Barnard, Inc.</u>; Quadro-Vent.
- 6) <u>Wire-Bond</u>; Cell Vent.
- E. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and hold reinforcing bars in center of cells. Units are formed from 0.148-inch (3.77-mm) steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.
 - 1. <u>Products</u>: Subject to compliance with requirements, provide one of the following:
 - a. <u>Dayton Superior Corporation</u>, <u>Dur-O-Wal Division</u>; D/A 810, D/A 812 or D/A 817.
 - b. <u>Heckmann Building Products Inc.</u>; No. 376 Rebar Positioner.
 - c. <u>Hohmann & Barnard, Inc.</u>; #RB or #RB-Twin Rebar Positioner.
 - d. <u>Wire-Bond</u>; O-Ring or Double O-Ring Rebar Positioner.

2.11 CAVITY-WALL INSULATION

- A. Extruded-Polystyrene Board Insulation: ASTM C 578, Type X, closed-cell product extruded with an integral skin.
- B. Adhesive: Type recommended by insulation board manufacturer for application indicated.

2.12 MASONRY CLEANERS

- A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.
 - 1. <u>Manufacturers</u>: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. <u>Diedrich Technologies, Inc.</u>
 - b. <u>EaCo Chem, Inc.</u>
 - c. <u>ProSoCo, Inc.</u>

2.13 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.

- 1. Do not use calcium chloride in mortar or grout.
- 2. Use mortar cement mortar unless otherwise indicated.
- 3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.
- B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
- C. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated.
 - 1. For masonry below grade or in contact with earth, use Type S.
 - 2. For reinforced masonry, use Type S.
 - 3. For mortar parge coats, use Type S.
 - 4. For exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type N.
- D. Pigmented Mortar: Use colored cement product or select and proportion pigments with other ingredients to produce color required. Do not add pigments to colored cement products.
 - 1. Pigments shall not exceed 5 percent of mortar cement by weight.
 - 2. Mix to match Architect's samples.
 - 3. Application: Use pigmented mortar for exposed mortar joints with the following units:
 - a. Masonry Veneer
 - b. Face brick.
 - c. Cast stone trim units.
- E. Grout for Unit Masonry: Comply with ASTM C 476.
 - 1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
 - 2. Proportion grout in accordance with ASTM C 476, Table 1 or paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi (14 MPa).
 - 3. Provide grout with a slump of 8 to 11 inches (203 to 279 mm) as measured according to ASTM C 143/C 143M.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
 - 1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
 - 2. Verify that foundations are within tolerances specified.

- 3. Verify that reinforcing dowels are properly placed.
- B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.
- B. Build chases and recesses to accommodate items specified in this and other Sections.
- C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.
- D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
- E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.
 - 1. Mix units from several pallets or cubes as they are placed.
- F. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. (30 g/194 sq. cm) per minute when tested per ASTM C 67. Allow units to absorb water so they are damp but not wet at time of laying.

3.3 TOLERANCES

- A. Dimensions and Locations of Elements:
 - 1. For dimensions in cross section or elevation do not vary by more than plus 1/2 inch (12 mm) or minus 1/4 inch (6 mm).
 - 2. For location of elements in plan do not vary from that indicated by more than plus or minus 1/2 inch (12 mm).
 - 3. For location of elements in elevation do not vary from that indicated by more than plus or minus 1/4 inch (6 mm) in a story height or 1/2 inch (12 mm) total.
- B. Lines and Levels:
 - 1. For bed joints and top surfaces of bearing walls do not vary from level by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2 inch (12 mm) maximum.

- 2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2 inch (12 mm) maximum.
- 3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2 inch (12 mm) maximum.
- 4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2 inch (12 mm) maximum.
- 5. For lines and surfaces do not vary from straight by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2 inch (12 mm) maximum.
- 6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2 inch (12 mm) maximum.
- 7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch (1.5 mm) except due to warpage of masonry units within tolerances specified for warpage of units.
- C. Joints:
 - 1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm), with a maximum thickness limited to 1/2 inch (12 mm).
 - 2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch (3 mm).
 - 3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch (9 mm) or minus 1/4 inch (6 mm).
 - 4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm). Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch (3 mm).
 - 5. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch (1.5 mm) from one masonry unit to the next.

3.4 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less than nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.
- C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4-inches (100-mm). Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.
- D. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

- E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- F. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.
- G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below and rod mortar or grout into core.
- H. Fill cores in hollow CMUs with grout 24 inches (600 mm) under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.
- I. Build non-load-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.
 - 1. Install compressible filler in joint between top of partition and underside of structure above.
 - 2. Wedge non-load-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.
 - 3. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Section 078446 "Fire-Resistive Joint Systems."

3.5 MORTAR BEDDING AND JOINTING

- A. Lay hollow brick and CMUs as follows:
 - 1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
 - 2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.
 - 3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
 - 4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.
- B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.
- C. Set cast-stone trim units in full bed of mortar with full vertical joints. Fill dowel, anchor, and similar holes.
 - 1. Clean soiled surfaces with fiber brush and soap powder and rinse thoroughly with clear water.
 - 2. Allow cleaned surfaces to dry before setting.
 - 3. Wet joint surfaces thoroughly before applying mortar.
- D. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

E. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

3.6 CAVITY WALLS

- A. Bond wythes of cavity walls together using one of the following methods:
 - 1. Masonry Joint Reinforcement: Installed in horizontal mortar joints.
 - a. Where one wythe is of clay masonry and the other of concrete masonry, use adjustable (two-piece) type reinforcement to allow for differential movement regardless of whether bed joints align.
 - 2. Masonry Veneer Anchors: Comply with requirements for anchoring masonry veneers.
- B. Keep cavities clean of mortar droppings and other materials during construction. Bevel beds away from cavity, to minimize mortar protrusions into cavity. Do not attempt to trowel or remove mortar fins protruding into cavity.
- C. Coat cavity face of backup wythe to comply with Section 071113 "Bituminous Dampproofing."
- D. Installing Cavity-Wall Insulation: Place small dabs of adhesive, spaced approximately 12 inches (300 mm) o.c. both ways, on inside face of insulation boards, or attach with plastic fasteners designed for this purpose. Fit courses of insulation between wall ties and other confining obstructions in cavity, with edges butted tightly both ways. Press units firmly against inside wythe of masonry or other construction as shown.
 - 1. Fill cracks and open gaps in insulation with crack sealer compatible with insulation and masonry.

3.7 MASONRY-CELL INSULATION

- A. Pour granular insulation into cavities to fill void spaces. Maintain inspection ports to show presence of insulation at extremities of each pour area. Close the ports after filling has been confirmed. Limit the fall of insulation to 1 story high, but not more than 20 feet (6 m).
- B. Install molded-polystyrene insulation units into masonry unit cells before laying units.

3.8 MASONRY JOINT REINFORCEMENT

- A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch (16 mm) on exterior side of walls, 1/2 inch (13 mm) elsewhere. Lap reinforcement a minimum of 6 inches (150 mm).
 - 1. Space reinforcement not more than 16 inches (406 mm) o.c.
 - 2. Space reinforcement not more than 8 inches (203 mm) o.c. in foundation walls and parapet walls.

- 3. Provide reinforcement not more than 8 inches (203 mm) above and below wall openings and extending 12 inches (305 mm) beyond openings in addition to continuous reinforcement.
- B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.
- C. Provide continuity at wall intersections by using prefabricated T-shaped units.
- D. Provide continuity at corners by using prefabricated L-shaped units.
- E. Cut and bend reinforcing units as directed by manufacturer for continuity at[**corners**,] returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.9 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

- A. Anchor masonry to structural steel and concrete where masonry abuts or faces structural steel or concrete to comply with the following:
 - 1. Provide an open space not less than 1 inch (25 mm) wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
 - 2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
 - 3. Space anchors as indicated, but not more than 24 inches (610 mm) o.c. vertically and 36 inches (915 mm) o.c. horizontally.

3.10 CONTROL AND EXPANSION JOINTS

- A. General: Install control and expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for inplane wall or partition movement.
- B. Form control joints in concrete masonry as follows:1. Install preformed control-joint gaskets designed to fit standard sash block.
- C. Form expansion joints in brick as follows:
 - 1. Form open joint full depth of brick wythe and of width indicated, but not less than 3/8 inch (10 mm) for installation of sealant and backer rod specified in Section 079200 "Joint Sealants."

3.11 LINTELS

- A. Install steel lintels where indicated.
- B. Provide masonry lintels where shown and where openings of more than 12 inches (305 mm) for brick-size units and 24 inches (610 mm) for block-size units are shown without structural steel or other supporting lintels.

C. Provide minimum bearing of 8 inches (200 mm) at each jamb unless otherwise indicated.

3.12 FLASHING, WEEP HOLES, CAVITY DRAINAGE, AND VENTS

- A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.
- B. Install flashing as follows unless otherwise indicated:
 - 1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
 - 2. At multiwythe masonry walls, including cavity walls, extend flashing through outer wythe, turned up a minimum of 8 inches (200 mm), and through inner wythe to within 1/2 inch (13 mm) of the interior face of wall in exposed masonry. Where interior face of wall is to receive furring or framing, carry flashing completely through inner wythe and turn flashing up approximately 2 inches (50 mm) on interior face.
 - 3. At masonry-veneer walls, extend flashing through veneer, across air space behind veneer, and up face of sheathing at least 8 inches (200 mm); with upper edge tucked under building paper or building wrap, lapping at least 4 inches (100 mm).
 - 4. At lintels and shelf angles, extend flashing a minimum of 6 inches (150 mm) into masonry at each end. At heads and sills, extend flashing 6 inches (150 mm) at ends and turn up not less than 2 inches (50 mm) to form end dams.
 - 5. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch (13 mm) back from outside face of wall and adhere flexible flashing to top of metal drip edge.
 - 6. Cut flexible flashing off flush with face of wall after masonry wall construction is completed.
- C. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.
- D. Install weep holes in head joints in exterior wythes of first course of masonry immediately above embedded flashing and as follows:
 - 1. Use specified weep/vent products to form weep holes.
 - 2. Use wicking material to form weep holes above flashing under brick sills. Turn wicking down at lip of sill to be as inconspicuous as possible.
 - 3. Space weep holes 24 inches (600 mm) o.c. unless otherwise indicated.
 - 4. Trim wicking material flush with outside face of wall after mortar has set.

3.13 REINFORCED UNIT MASONRY INSTALLATION

A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.

- 1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
- 2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other loads that may be placed on them during construction.
- B. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.
- C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
 - 1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
 - 2. Limit height of vertical grout pours to not more than 60 inches (1520 mm).

3.14 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.
- B. Inspections: Level 1 special inspections according to the "International Building Code."
 - 1. Begin masonry construction only after inspectors have verified proportions of siteprepared mortar.
 - 2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
 - 3. Place grout only after inspectors have verified proportions of site-prepared grout.
- C. Testing Prior to Construction: One set of tests.
- D. Testing Frequency: One set of tests for each 5000 sq. ft. (464 sq. m) of wall area or portion thereof.
- E. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C 140 for compressive strength.
- F. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.

3.15 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.
- C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
 - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
 - 2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
 - 3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
 - 4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
 - 5. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.
 - 6. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.

3.16 MASONRY WASTE DISPOSAL

- A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.
- B. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 042000
SECTION 047200 - CAST STONE MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Cast stone trim.
 - a. Window sills.
 - b. Wall caps.
- B. Related Sections:
 - 1. Section 042000 "Unit Masonry" for installing cast stone units in unit masonry.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. For cast stone units, include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: Show fabrication and installation details for cast stone units. Include dimensions, details of reinforcement and anchorages if any, and indication of finished faces.
 - 1. Include building elevations showing layout of units and locations of joints and anchors.
- C. Samples for Initial Selection: For colored mortar.
- D. Samples for Verification:
 - 1. For each color and texture of cast stone required, 10 inches (250 mm) square in size.
- E. Full-Size Samples: For each color texture and shape of cast stone unit required.
 - 1. Make available for Architect's review at Project site.
 - 2. Approved Samples may be installed in the Work.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer.
 - 1. Include copies of material test reports for completed projects, indicating compliance of cast stone with ASTM C 1364.
- B. Material Test Reports: For each mix required to produce cast stone, based on testing according to ASTM C 1364, including test for resistance to freezing and thawing.
 - 1. Provide test reports based on testing within previous two years.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer of cast stone units similar to those indicated for this Project, that has sufficient production capacity to manufacture required units, and is a plant certified by the Cast Stone Institute, the Architectural Precast Association or the Precast/Prestressed Concrete Institute for Group A, Category AT.
- B. Source Limitations for Cast Stone: Obtain cast stone units through single source from single manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Coordinate delivery of cast stone with unit masonry work to avoid delaying the Work.
- B. Pack, handle, and ship cast stone units in suitable packs or pallets.
 - 1. Lift with wide-belt slings; do not use wire rope or ropes that might cause staining. Move cast stone units, if required, using dollies with wood supports.
 - 2. Store cast stone units on wood skids or pallets with nonstaining, waterproof covers, securely tied. Arrange to distribute weight evenly and to prevent damage to units. Ventilate under covers to prevent condensation.

1.7 PROJECT CONDITIONS

- A. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Comply with cold-weather construction requirements in ACI 530.1/ASCE 6/TMS 602.
 - 1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and above and will remain so until cast stone has dried, but no fewer than seven days after completing cleaning.
- B. Hot-Weather Requirements: Comply with hot-weather construction requirements in ACI 530.1/ASCE 6/TMS 602.

PART 2 - PRODUCTS

2.1 CAST STONE MATERIALS

- A. General: Comply with ASTM C 1364 and the following:
- B. Portland Cement: ASTM C 150, Type I or Type III, containing not more than 0.60 percent total alkali when tested according to ASTM C 114. Provide natural color or white cement as required to produce cast stone color indicated.
- C. Coarse Aggregates: Granite, quartz, or limestone complying with ASTM C 33; gradation and colors as needed to produce required cast stone textures and colors.
- D. Fine Aggregates: Natural sand or crushed stone complying with ASTM C 33, gradation and colors as needed to produce required cast stone textures and colors.
- E. Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.
- F. Admixtures: Use only admixtures specified or approved in writing by Architect.
 - 1. Do not use admixtures that contain more than 0.1 percent water-soluble chloride ions by mass of cementitious materials. Do not use admixtures containing calcium chloride.
 - 2. Use only admixtures that are certified by manufacturer to be compatible with cement and other admixtures used.
 - 3. Air-Entraining Admixture: ASTM C 260.
 - 4. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
 - 5. Water-Reducing, Retarding Admixture: ASTM C 494/C 494M, Type D.
 - 6. Water-Reducing, Accelerating Admixture: ASTM C 494/C 494M, Type E.
- G. Reinforcement: Deformed steel bars complying with ASTM A 615/A 615M, Grade 60 (Grade 420). Use galvanized or epoxy-coated reinforcement when covered with less than 1-1/2 inches (38 mm) of cast stone material.
 - 1. Epoxy Coating: ASTM A 775/A 775M.
 - 2. Galvanized Coating: ASTM A 767/A 767M.
- H. Embedded Anchors and Other Inserts: Fabricated from stainless steel complying with ASTM A 240/A 240M, ASTM A 276, or ASTM A 666, Type 304.

2.2 CAST STONE UNITS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. ACCI-Tannerstone, Palmetto, GA
 - 2. Architectural Ornamental Castings Inc. Valdosta, GA
 - 3. Carolina Cast Stone Co., Inc. Greensboro, NC

- 4. Cast Stone Systems Inc., Warrenton, NC
- 5. ConArt PreCast LLC, Cobb, GA
- 6. Lucas Concrete Products, Inc. Charlotte, NC
- B. Provide cast stone units complying with ASTM C 1364 using either the vibrant dry tamp or wet-cast method.
 - 1. Provide units that are resistant to freezing and thawing as determined by laboratory testing according to ASTM C 666/C 666M, Procedure A, as modified by ASTM C 1364.
- C. Fabricate units with sharp arris and accurately reproduced details, with indicated texture on all exposed surfaces unless otherwise indicated.
 - 1. Slope exposed horizontal surfaces 1:12 to drain unless otherwise indicated.
 - 2. Provide raised fillets at backs of sills and at ends indicated to be built into jambs.
 - 3. Provide drips on projecting elements unless otherwise indicated.
- D. Fabrication Tolerances:
 - 1. Variation in Cross Section: Do not vary from indicated dimensions by more than 1/8 inch (3 mm).
 - 2. Variation in Length: Do not vary from indicated dimensions by more than 1/360 of the length of unit or 1/8 inch (3 mm), whichever is greater, but in no case by more than 1/4 inch (6 mm).
 - 3. Warp, Bow, and Twist: Not to exceed 1/360 of the length of unit or 1/8 inch (3 mm), whichever is greater.
 - 4. Location of Grooves, False Joints, Holes, Anchorages, and Similar Features: Do not vary from indicated position by more than 1/8 inch (3 mm) on formed surfaces of units and 3/8 inch (10 mm) on unformed surfaces.
- E. Cure units as follows:
 - 1. Cure units in enclosed moist curing room at 95 to 100 percent relative humidity and temperature of 100 deg F (38 deg C) for 12 hours or 70 deg F (21 deg C) for 16 hours.
 - 2. Keep units damp and continue curing to comply with one of the following:
 - a. No fewer than five days at mean daily temperature of 70 deg F (21 deg C) or above.
 - b. No fewer than six days at mean daily temperature of 60 deg F (16 deg C) or above.
 - c. No fewer than seven days at mean daily temperature of 50 deg F (10 deg C) or above.
 - d. No fewer than eight days at mean daily temperature of 45 deg F (7 deg C) or above.
- F. Acid etch units after curing to remove cement film from surfaces to be exposed to view.
- G. Colors and Textures: Match Architect's samples.

2.3 MORTAR MATERIALS

A. Provide mortar materials that comply with Section 042000 "Unit Masonry."

2.4 ACCESSORIES

- A. Anchors: Type and size indicated, fabricated from Type 304 stainless steel complying with ASTM A 240/A 240M, ASTM A 276, or ASTM A 666.
- B. Dowels: 1/2-inch- (12-mm-) diameter, round bars, fabricated from Type 304 stainless steel complying with ASTM A 240/A 240M, ASTM A 276, or ASTM A 666.

2.5 MORTAR MIXES

A. Comply with requirements in Section 042000 "Unit Masonry" for mortar mixes.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SETTING CAST STONE IN MORTAR

- A. Install cast stone units to comply with requirements in Section 042000 "Unit Masonry."
- B. Set cast stone as indicated on Drawings. Set units accurately in locations indicated with edges and faces aligned according to established relationships and indicated tolerances.
 - 1. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure units in place.
 - 2. Coordinate installation of cast stone with installation of flashing specified in other Sections.
- C. Wet joint surfaces thoroughly before applying mortar or setting in mortar.
- D. Set units in full bed of mortar with full head joints unless otherwise indicated.
 - 1. Set units with joints 1/4 to 3/8 inch (6 to 10 mm) wide unless otherwise indicated.
 - 2. Build anchors and ties into mortar joints as units are set.
 - 3. Fill dowel holes and anchor slots with mortar.
 - 4. Fill collar joints solid as units are set.
 - 5. Build concealed flashing into mortar joints as units are set.

- 6. Keep head joints in coping and other units with exposed horizontal surfaces open to receive sealant.
- 7. Keep joints at shelf angles open to receive sealant.
- E. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
- F. Provide sealant joints at copings and other horizontal surfaces, at expansion, control, and pressure-relieving joints, and at locations indicated.
 - 1. Keep joints free of mortar and other rigid materials.
 - 2. Build in compressible foam-plastic joint fillers where indicated.
 - 3. Form joint of width indicated, but not less than 3/8 inch (10 mm).
 - 4. Prime cast stone surfaces to receive sealant and install compressible backer rod in joints before applying sealant unless otherwise indicated.
 - 5. Prepare and apply sealant of type and at locations indicated to comply with applicable requirements in Section 079200 "Joint Sealants."

3.3 INSTALLATION TOLERANCES

- A. Variation from Plumb: Do not exceed 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2 inch (12 mm) maximum.
- B. Variation from Level: Do not exceed 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2 inch (12 mm) maximum.
- C. Variation in Joint Width: Do not vary joint thickness more than 1/8 inch in 36 inches (3 mm in 900 mm) or one-fourth of nominal joint width, whichever is less.
- D. Variation in Plane between Adjacent Surfaces (Lipping): Do not vary from flush alignment with adjacent units or adjacent surfaces indicated to be flush with units by more than 1/16 inch (1.5 mm), except where variation is due to warpage of units within tolerances specified.

3.4 ADJUSTING AND CLEANING

- A. Remove and replace stained and otherwise damaged units and units not matching approved Samples. Cast stone may be repaired if methods and results are approved by Architect.
- B. Replace units in a manner that results in cast stone matching approved Samples, complying with other requirements, and showing no evidence of replacement.
- C. In-Progress Cleaning: Clean cast stone as work progresses.
 - 1. Remove mortar fins and smears before tooling joints.
 - 2. Remove excess sealant immediately, including spills, smears, and spatter.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed cast stone as follows:

- 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
- 2. Test cleaning methods on sample; leave one sample uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of cast stone.
- 3. Protect adjacent surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
- 4. Wet surfaces with water before applying cleaners; remove cleaners promptly by rinsing thoroughly with clear water.
- 5. Clean cast stone with proprietary acidic cleaner applied according to manufacturer's written instructions.

END OF SECTION 047200

SECTION 051200 STRUCTURAL STEEL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes fabrication and erection of structural steel work, as shown on drawings including schedules, notes, and details showing size and location of members, typical connections, and types of steel required.
 - 1. Structural steel is that work defined in American Institute of Steel Construction (AISC) "Code of Standard Practice" and as otherwise shown on drawings.
 - 2. Miscellaneous Metal Fabrications are specified elsewhere in Division 5.
 - 3. Refer to Division 3 for anchor bolt installation in concrete, Division 4 for anchor bolt installation in masonry.

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Product data or manufacturer's specifications and installation instructions for following products. Include laboratory test reports and other data to show compliance with specifications (including specified standards).
 - 1. Structural steel (each type); for information only; including certified copies of mill reports covering chemical and physical properties.
 - 2. High-strength bolts (each type), including nuts and washers; for information only.
 - 3. Structural steel primer paint.
 - 4. Shrinkage-resistant grout.
- C. Shop drawings prepared under supervision of a licensed Structural Engineer, including complete details and schedules for fabrication and assembly of structural steel members, procedures, and diagrams.
 - 1. Include details of cuts, connections, camber, holes, and other pertinent data. Indicate welds by standard AWS symbols and show size, length, and type of each weld.
 - 2. Provide setting drawings, templates, and directions for installation of anchor bolts and other anchorages to be installed as work of other sections.

- 3. Column and beam details shall be submitted simultaneously for each area. Index sheets updated for each submission shall be provided concurrently with the shop drawings they represent.
- 4. Submit shop drawings in complete packages. A complete package shall consist of erection drawings, beams, girders, trusses, columns, bracing, and detail materials such that each connection can be reviewed with all the connected members at once. Erection drawings shall show only the mark numbers submitted with that package.
- 5. Drawings which require resubmittal shall have revisions clearly delineated by enclosing only the revised areas within a free-hand drawn "CLOUD."
- 6. Processing Time: The Contractor shall allow up to 15 business days between the time shop drawings are received by the Engineer of Record and the time they are returned to the Contractor.
- 7. Contract Documents shall not be incorporated into shop drawings.
- 8. Substitutions: Substitutions of shapes, sections, products, modifications of details, and deviations from the Design Drawings, including the reasons for these substitutions shall be submitted prior to shop drawing submission for approval and shall be specifically called to the attention of the Engineer of Record. Contractor shall incorporate all approved substitutions in the work at no additional cost to the Owner. Cost of reviews by the Engineer of Record shall be paid by the Contractor.
- 9. Reviewed Drawings: Review of shop drawings by the Engineer will be for general conformance with Contract Documents only and will not relieve Contractor from:
 - a. Responsibility for providing work in strict conformance with Contract requirements;
 - b. Properly furnishing material, workmanship and maintaining specified fabrication and erection tolerances;
 - c. For fit and erectability of the structure required by Contract Drawings and Specification.
 - d. The Engineer of Record is not responsible for reviewing these aspects nor is the Engineer of Record responsible for reviewing means and methods of construction and related job safety issues.
- 10. The shop drawings are interpretations of and are supplemental to the Contract Drawings and Specifications. Their intent is to demonstrate to the Architect/Engineer that the Contractor has understood the design concept, and to provide detailed information necessary for fabrication, assembly and installation of products and materials specified. Neither shop drawings nor comments placed on them by the Architect/Engineer shall be construed as being change orders. If deviations, discrepancies and conflicts between shop drawings, Contract Drawings and Specifications are discovered, both prior to and after shop drawings have been reviewed, Contract Drawings and Specifications shall control and shall be followed. Promptly notify Architect/Engineer whenever design of members and connections for any portion of structure are not clearly indicated.

D. Test reports conducted on shop- and field-bolted and welded connections. Include data on type(s) of tests conducted and test results.

1.4 QUALITY ASSURANCE

- A. Codes and Standards: Comply with provisions of following, except as otherwise indicated:
 - 1. American Institute of Steel Construction (AISC) "Code of Standard Practice for Steel Buildings and Bridges."
 - a. Modification to AISC "Code of Standard Practice."
 - 1) Section 1.2 Definitions:
 - a) Architect/Engineer The Owner's designated representative responsible for the preparation of plans and specifications.
 - b) General Contractor The Owner's designated representative for construction of the structure.
 - 2) Section 3.1:

The first sentence shall be modified as follows:

"In order to insure adequate and complete bids, the Contract Documents provide structural steel plans shown in sufficient detail the work to be performed..."

3) Para. 3.3 - Discrepancies. The section shall be replaced with the following language:

"In case of discrepancies in plans and specifications for buildings, the more restrictive requirement shall govern unless otherwise agreed to by the Engineer. In case of discrepancies between scale dimensions on the plans and figures written on them, the figures shall govern."

- 2. AISC "Specifications for Structural Steel Buildings," including "Commentary."
- 3. "Specifications for Structural Joints using ASTM A 325 or A 490 Bolts" approved by the Research Council on Structural Connections.
- 4. American Welding Society (AWS) D1.1 "Structural Welding Code Steel."
- 5. ASTM A 6 "General Requirements for Delivery of Rolled Steel Plates, Shapes, Sheet Piling and Bars for Structural Use."
- 6. Steel Structures Painting Manual Volume 1, "Good Painting Practice" and Steel Structures Painting Manual Volume 2, "Systems and Specifications."
- 7. OSHA Safety and Health Standards (29 CFR 1926/1910) Revised 1987, as amended to date.

- 8. All pertinent Federal, State and Local Codes.
- 9. American Society for Testing and Materials ASTM Standards.
- B. Fabricator Qualifications: Engage a firm with minimum of 5 years of experience in fabricating structural steel similar to the project and with a record of successful in-service performance. Fabricator must meet the following requirement:
 - 1. A qualified fabricator who is currently certified by AISC Quality Certification Program for Structural Steel Fabricators and is designated as AISC Certified Fabricator, Standard for Steel Building Structures.
- C. Structural Steel Erector- Not less than 5 years of experience in the erection of structural steel buildings.
- D. Qualifications for Welding Work: Qualify welding procedures and welding operators in accordance with AWS "Qualification" requirements.
 - 1. Provide certification that welders to be employed in work have satisfactorily passed AWS qualification tests.
 - 2. If recertification of welders is required, retesting will be Contractor's responsibility.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to site at such intervals to ensure uninterrupted progress of work.
- B. Deliver anchor bolts and anchorage devices, which are to be embedded in cast-in-place concrete or masonry, in ample time to not to delay work.
- C. Store materials to permit easy access for inspection and identification. Keep steel members off ground by using pallets, platforms, or other supports. Protect steel members and packaged materials from erosion and deterioration. If bolts and nuts become dry or rusty, clean and relubricate before use.
 - 1. Do not store materials on structure in a manner that might cause distortion or damage to members or supporting structures. Repair or replace damaged materials or structures as directed.

PART 2 - PRODUCTS

- 2.1 MATERIALS
 - A. Metal Surfaces, General: For fabrication of work that will be exposed to view, use only materials that are smooth and free of surface blemishes including pitting, rust and scale seam marks, roller marks, rolled trade names, and roughness. Remove such blemishes by grinding, or by welding and grinding, prior to cleaning, treating, and applying surface finishes.
 - B. Structural Steel W and C Shapes: ASTM A992 (50 ksi).

- C. Structural Steel Angles, Plates, and Bars: ASTM A36.
- D. Cold-Formed Steel Tubing: ASTM A 500, Grade B.
- E. Steel Pipe: ASTM A 53, Type E or S, Grade B; or ASTM A 501.
- F. Anchor Bolts: ASTM A 36, nonheaded type unless otherwise indicated, with heavy hex head nuts.
- G. Unfinished Threaded Fasteners: ASTM A 307, Grade A, regular low-carbon steel bolts and nuts.
 - 1. Provide hexagonal heads and nuts for all connections.
 - 2. Provide either hexagonal or square heads and nuts, except use only hexagonal units for exposed connections.
- H. High-Strength Threaded Fasteners: Heavy hexagon structural bolts, heavy hexagon nuts, and hardened washers, as follows:
 - 1. Quenched and tempered medium-carbon steel bolts, nuts, and washers, complying with ASTM A 325.
 - a. Where indicated as galvanized, provide units that are zinc coated, either mechanically deposited complying with ASTM B 695, Class 50, or hot-dip galvanized complying with ASTM A 153.
- I. Electrodes for Welding: Comply with AWS Code and ASTM A232, E70XX Electrodes, Low Hydrogen.
- J. Structural Steel Primer Paint: SSPC Paint 25; Red Iron Oxide, Zinc Oxide, Raw Linseed Oil and Alkyd primer (without lead or chromate pigments).
- K. Structural Steel Galvanizing: ASTM A123.
- L. Nonmetallic Shrinkage-Resistant Grout: Premixed, nonmetallic, noncorrosive, nonstaining product containing selected silica sands, Portland cement, shrinkage compensating agents, plasticizing and water-reducing agents, complying with CE-CRD-C621. Minimum compressive strength at fluid consistency shall be 6,000 psi at 7 days and 7,000 psi at 28 days in accordance with ASTM.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to, the following:
 - a. Euco N.S.; Euclid Chemical Co.
 - b. Masterflow 928; Master Builders.
 - c. Sealtight 588 Grout; W. R. Meadows.
 - d. Set Non-Shrink; Set Products, Inc.
 - e. Five Star Grout; U.S. Grout Corp.

2.2 FABRICATION

- A. Shop Fabrication and Assembly: Fabricate and assemble structural assemblies in shop to greatest extent possible. Fabricate items of structural steel in accordance with AISC Specifications and as indicated on final shop drawings. Provide camber in structural members where indicated.
 - 1. Properly mark and match-mark materials for field assembly. Fabricate for delivery sequence that will expedite erection and minimize field handling of materials.
 - 2. Where finishing is required, complete assembly, including welding of units, before start of finishing operations. Provide finish surfaces of members exposed in final structure free of markings, burrs, and other defects.
- B. Connections: Weld or bolt shop connections, as indicated.
- C. Bolt field connections, except where welded connections or other connections are indicated.
 - 1. Provide high-strength threaded fasteners for all bolted connections.
- D. High-Strength Bolted Construction: Install high-strength threaded fasteners in accordance with AISC "Specifications for Structural Joints using ASTM A 325 or A 490 Bolts."
- E. Welded Construction: Comply with AWS Code for procedures, appearance and quality of welds, and methods used in correcting welding work.
- F. Assemble and weld built-up sections by methods that will produce true alignment of axes without warp.
- G. Holes for Other Work: Provide holes required for securing other work to structural steel framing and for passage of other work through steel framing members, as shown on final shop drawings.
- H. Provide threaded nuts welded to framing and other specialty items as indicated to receive other work.
- I. Cut, drill, or punch holes perpendicular to metal surfaces. Do not flame-cut holes or enlarge holes by burning. Drill holes in bearing plates.

2.3 SHOP PAINTING

- A. General: Shop-paint structural steel, except those members or portions of members to be embedded in concrete or mortar. Paint embedded steel that is partially exposed on exposed portions and initial 2 inches of embedded areas only.
 - 1. Do not paint surfaces to be welded or high-strength bolted with slip critical-type connections.
 - 2. Do not paint surfaces scheduled to receive sprayed-on fireproofing.
 - 3. Apply 2 coats of paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

- B. Surface Preparation: After inspection and before shipping, clean steelwork to be painted. Remove loose rust, loose mill scale, and spatter, slag, or flux deposits. Clean steel in accordance with Steel Structures Painting Council (SSPC) as follows:
 - 1. Exterior Steel Exposed to View: SSPC-SP6 "Commercial Blast Cleaning."
 - 2. Other Steel: SSPC-SP1 "Solvent Cleaning," followed by SSPC SP2 "Hand Tool Cleaning."

2.4 SOURCE QUALITY CONTROL

- A. General: Materials and fabrication procedures are subject to inspection and tests in mill, shop, and field, conducted by a qualified inspection agency. Such inspections and tests will not relieve Contractor of responsibility for providing materials and fabrication procedures in compliance with specified requirements.
 - 1. Promptly remove and replace materials or fabricated components that do not comply.
- B. Design of Members and Connections: Details shown are typical; similar details apply to similar conditions, unless otherwise indicated. Verify dimensions at site whenever possible without causing delay in the work.
 - 1. Promptly notify Engineer whenever design of members and connections for any portion of structure are not clearly indicated.

PART 3 - EXECUTION

3.1 ERECTION

- A. Temporary Shoring and Bracing: Provide temporary shoring and bracing members with connections of sufficient strength to bear imposed loads. Remove temporary members and connections when permanent members are in place and final connections are made. Provide temporary guy lines to achieve proper alignment of structures as erection proceeds.
- B. Temporary Planking: Provide temporary planking and working platforms as necessary to effectively complete work.
- C. Setting Bases and Bearing Plates: Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen to improve bond to surfaces. Clean bottom surface of base and bearing plates.
 - 1. Set loose and attached base plates and bearing plates for structural members on wedges or other adjusting devices.
 - 2. Tighten anchor bolts after supported members have been positioned and plumbed. Do not remove wedges or shims, but if protruding, cut off flush with edge of base or bearing plate prior to packing with grout.
 - 3. Pack grout solidly between bearing surfaces and bases or plates to ensure that no voids remain. Finish exposed surfaces, protect installed materials, and allow to cure.
 - 4. For proprietary grout materials, comply with manufacturer's instructions.

- D. Field Assembly: Set structural frames accurately to lines and elevations indicated. Align and adjust various members forming part of complete frame or structure before permanently fastening. Clean bearing surfaces and other surfaces that will be in permanent contact before assembly. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
- E. Level and plumb individual members of structure within specified AISC tolerances.
- F. Establish required leveling and plumbing measurements on mean operating temperature of structure. Make allowances for difference between temperature at time of erection and mean temperature at which structure will be when completed and in service.
- G. Erection Bolts: On exposed welded construction, remove erection bolts, fill holes with plug welds, and grind smooth at exposed surfaces.
 - 1. Comply with AISC Specifications for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.
 - 2. Do not enlarge unfair holes in members by burning or by using drift pins. Ream holes that must be enlarged to admit bolts to the next larger size and install the next larger size bolt.
- H. Gas Cutting: Do not use gas cutting torches in field for correcting fabrication errors.
- I. Touch-Up Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint. Apply paint to exposed areas using same material as used for shop painting.
 - 1. Apply by brush or spray to provide minimum dry film thickness of 1.5 mils.
- J. Protect other work from staining due to corrosion of steel during construction.
- K. Provide drain holes as required to prevent accumulation of water.
- L. Steel buried in soil shall be painted with a coal tar epoxy-Polyamide paint. This paint shall conform to the Steel Structures Painting Council Paint Specification No. 16 (SSPC-Paint 16). Provide a minimum dry film thickness of 16 mils.

3.2 QUALITY CONTROL

- A. Owner will engage an independent testing and inspection agency to inspect high-strength bolted connections and welded connections and to perform tests and prepare test reports.
 - 1. The Owner's Testing and Inspection Agency shall be provided with the following by the contractor:
 - a. Information as to the time and place of starting fabrication in shop and erection in the field.
 - b. A complete set of approved shop and erection drawings including any subsequent revisions, clarifications and field required fixes.
 - c. Cutting lists, order sheets, material bills and shipping bills.

- d. Representative sample pieces requested by the Inspection Agency, for testing, if necessary.
- e. Full and ample means of assistance for testing inspection of material.
- f. Proper facilities, including scaffolding and temporary work platforms, for inspection of the work in shop and field.
- g. Contractor shall submit records of qualification of welders, welding operators, and tackers; and, records of qualification of welding procedures to the Owner's Testing and Inspection Agency.
- 2. The Owner's general review during construction and inspection and testing Independent Inspection and Testing Agencies are both undertaken to inform the Owner of performance by the Contractor and shall not relieve the Contractor of his responsibility to perform the work and provide the materials required nor replace the Contractor's quality control.
- B. Testing agency shall conduct and interpret tests, state in each report whether test specimens comply with requirements, and specifically state any deviations therefrom.
- C. Provide access for testing agency to places where structural steel work is being fabricated or produced so that required inspection and testing can be accomplished.
- D. Testing agency may inspect structural steel at plant before shipment.
- E. Correct deficiencies in structural steel work that inspections and laboratory test reports have indicated to be not in compliance with requirements. Perform additional tests, at Contractor's expense, as necessary to reconfirm any noncompliance of original work and to show compliance of corrected work.
- F. Field-Bolted Connections: Inspect in accordance with AISC specifications.
- G. Field Welding: Inspect and test during erection of structural steel as follows:
 - 1. Certify welders and conduct inspections and tests as required. Record types and locations of defects found in work. Record work required and performed to correct deficiencies.
 - 2. Perform visual inspection of all welds.

END OF SECTION

SECTION 053100 STEEL DECK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

1.2 SUMMARY

A. This Section includes steel deck units for floor and roof applications.

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
 - 1. Product data including manufacturer's specifications and installation instructions for each type of decking and accessories.
 - a. Provide test data for mechanical fasteners used in lieu of welding for fastening deck to supporting structures.
 - 2. Shop drawings showing layout and types of deck units, anchorage details, and conditions requiring closure strips, supplementary framing, sump pans, cant strips, cut openings, special jointing, and other accessories.

1.4 QUALITY ASSURANCE

- A. Codes and Standards: Comply with provisions of the following codes and standards, except as otherwise indicated:
 - 1. American Iron and Steel Institute (AISI), "Specification for the Design of Cold-Formed Steel Structural Members."
 - 2. American Welding Society (AWS), D1.3 "Structural Welding Code Sheet Steel."
 - 3. Steel Deck Institute (SDI), "Design Manual for Composite Decks, Form Decks and Roof Decks."
- B. Qualification of Field Welding: Use qualified welding processes and welding operators in accordance with "Welder Qualification" procedures of AWS.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include but are not limited to the following:
- B. Manufacturers: Subject to compliance with requirements, provide products of one of the following:
 - 1. Bowman Metal Deck Div., Cyclops Corp.
 - 2. H. H. Robertson Co.
 - 3. United Steel Deck, Inc.
 - 4. Vulcraft Div., Nucor Corp.
 - 5. Wheeling Corrugating Co.

2.2 MATERIALS

- A. Steel for Galvanized Metal Deck Units: ASTM A 653, grade as required to comply with SDI specifications.
- B. Miscellaneous Steel Shapes: ASTM A 36.
- C. Sheet Metal Accessories: ASTM A 526, commercial quality, galvanized.
- D. Galvanizing: ASTM A 924, G60.
- E. Galvanizing Repair: Where galvanized surfaces are damaged, prepare surfaces and repair in accordance with procedures specified in ASTM A 780.
- F. Flexible Closure Strips: Manufacturer's standard vulcanized, closed-cell, synthetic rubber.

2.3 FABRICATION

- A. General: Form deck units in lengths to span three or more supports, with flush, telescoped, or nested 2-inch laps at ends and interlocking or nested side laps, of metal thickness, depth, and width as indicated.
- B. Roof Deck Units: Provide deck configurations that comply with SDI "Specifications and Commentary for Steel Roof Deck."
- C. Non-Composite Steel Form Deck: Provide fluted sections of metal deck as permanent forms for reinforced concrete slabs.
- D. Composite Steel Floor Deck: Fabricate deck units with integral embossing or raised pattern to furnish mechanical bond with concrete slabs. Fabricate open-beam deck units with fluted section having interlocking side laps.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install deck units and accessories in accordance with manufacturer's recommendations, shop drawings, and as specified herein.
- B. Place deck units on supporting steel framework and adjust to final position with ends accurately aligned and bearing on supporting members before being permanently fastened. Do not stretch or contract side lap interlocks.
- C. Align deck units for entire length of run of cells and with close alignment between cells at ends of abutting units.
- D. Place deck units flat and square, secured to adjacent framing without warp or deflection.
- E. Coordinate and cooperate with structural steel erector in locating decking bundles to prevent overloading of structural members.
- F. Roof deck shall not be used to suspend piping, ducts, conduit, ceilings or any other item.
- G. Do not use floor deck units for storage or working platforms until permanently secured.
- H. Fastening Deck Units:
 - 1. Fasten floor deck units to steel supporting members by nominal 5/8- inch puddle welds or elongated welds of equal strength, spaced not more than 12 inches o.c. with a minimum of two welds per unit at each support.
 - 2. Tack weld or use self-tapping No. 8 or larger machine screws at 4 feet o.c. for fastening end closures.
 - 3. Fasten roof deck units to steel supporting members by not less than 1/2-inch-diameter puddle welds or elongated welds of equal strength, spaced not more than 12 inches at every support, and at closer spacing where indicated. In addition, secure deck to each supporting member in ribs where side laps occur.
 - 4. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work.
 - a. Use welding washers where recommended by deck manufacturer.
 - 5. Mechanical fasteners, either powder-actuated or pneumatically driven, may be used in lieu of welding. Locate mechanical fasteners and install in accordance with deck manufacturer's instructions.
 - 6. Mechanically fasten side laps of adjacent deck units between supports, at intervals as indicated in structure ntoes.
 - 7. Uplift Loading: Install and anchor roof deck units to resist gross uplift loading of 45 lbs. psf at eave overhang and 30 lbs. psf for other roof areas.

STEEL DECK

- I. Cutting and Fitting: Cut and neatly fit deck units and accessories around other work projecting through or adjacent to the decking, as shown.
- J. Reinforcement at Openings: Provide additional metal reinforcement and closure pieces as required for strength, continuity of decking, and support of other work shown.
- K. Joint Covers: Provide metal joint covers at abutting ends and changes in direction of floor deck units, except where taped joints are required.
- L. Roof Sump Pans: Place over openings provided in roof decking and weld to top decking surface. Space welds not more than 12 inches o.c. with at least one weld at each corner.
- M. Closure Strips: Provide metal closure strips at open uncovered ends and edges of roof decking and in voids between decking and other construction. Weld into position to provide a complete decking installation.
 - 1. Provide flexible closure strips instead of metal closures, at Contractor's option, wherever their use will ensure complete closure. Install with adhesive in accordance with manufacturer's instructions.

END OF SECTION

SECTION 054000 COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

1.2 SUMMARY

- A. Types of cold-formed metal framing units include the following:
 - 1. Load-bearing punched channel studs.
 - 2. C-shaped load-bearing steel studs.
 - 3. C-shaped steel joists.

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
 - 1. Product data and installation instructions for each item of cold-formed metal framing and accessories.
 - 2. Shop drawings for special components and installations not fully dimensioned or detailed in manufacturer's product data.
 - a. Include placing drawings for framing members showing size and gage designations, number, type, location, and spacing. Indicate supplemental strapping, bracing, splices, bridging, accessories, and details required for proper installation.

1.4 QUALITY ASSURANCE

A. Component Design: Calculate structural properties of studs and joists in accordance with American Iron and Steel Institute (AISI) "Specification for Design of Cold-Formed Steel Structural Members."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products of one of the following:
 - 1. Dale Industries, Inc.
 - 2. Dietrich Industries, Inc.
 - 3. Superior Steel Studs, Inc.
 - 4. USG Industries
 - 5. United States Steel

COLD-FORMED METAL FRAMING

2.2 METAL FRAMING

- A. System Components: Manufacturer's standard non load-bearing steel studs of type, size, shape, and gage as indicated. With each type of metal framing required, provide manufacturer's standard, steel runners (tracks), blocking, lintels, clip angles, shoes, reinforcements, fasteners, and accessories for applications indicated, as needed to provide a complete metal framing system.
- B. Materials and Finishes:
 - 1. For 16-gage and heavier units, fabricate metal framing components of structural quality steel sheet with a minimum yield point of 50,000 psi; ASTM A 653.
 - 2. For 18-gage and lighter units, fabricate metal framing components of commercial quality steel sheet with a minimum yield point of 33,000 psi; ASTM A 653.
 - 3. Provide galvanized finish to metal framing components complying with ASTM A 633 for minimum G 60 coating.
 - a. Finish of installation accessories to match that of main framing components, unless otherwise indicated.
 - 4. Fasteners: Provide nuts, bolts, washers, screws, and other fasteners with corrosion-resistant plated finish.

2.3 FABRICATION

- A. General: Framing components may be prefabricated into assemblies before erection. Fabricate panels plumb, square, true to line, and braced against racking with joints welded. Perform lifting of prefabricated units to prevent damage or distortion.
- B. Fabricate units in jig templates to hold members in proper alignment and position and to assure consistent component placement.
- C. Fastenings: Attach similar components by bolting, or screw fasteners, as standard with manufacturer.
- D. Wire tying of framing components is not permitted.
- E. Fabrication Tolerances: Fabricate units to a maximum allowable tolerance variation from plumb, level, and true to line of 1/8 inch in 10 feet.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install metal framing systems in accordance with manufacturer's printed or written instructions and recommendations.
- B. Runner Tracks: Install continuous tracks sized to match studs. Align tracks accurately to layout at base and tops of studs. Secure tracks as recommended by stud manufacturer for type of construction

COLD-FORMED METAL FRAMING

involved, except do not exceed 24 inches o.c. spacing for nail or power-driven fasteners or 16 inches o.c. for other types of attachment. Provide fasteners at corners and ends of tracks.

- C. Installation of Wall Studs: Secure studs to top and bottom runner tracks by either welding or screw fastening at both inside and outside flanges.
- D. Set studs plumb.
- E. Where stud system abuts structural columns or walls, including masonry walls, anchor ends of stiffeners to supporting structure.
- F. Install supplementary framing, blocking, and bracing in metal framing system wherever walls or partitions are indicated to support fixtures, equipment, services, casework, heavy trim and furnishings, and similar work requiring attachment to the wall or partition. Where type of supplementary support is not otherwise indicated, comply with stud manufacturer's recommendations and industry standards in each case, considering weight or loading resulting from item supported.
- G. Frame wall openings larger than 2 feet square with double stud at each jamb of frame except where more than two are either shown or indicated in manufacturer's instructions. Install runner tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with stud shoes or by welding, and space jack studs same as full-height studs of wall. Secure stud system wall opening frame in manner indicated.
- H. Install horizontal stiffeners in stud system, spaced (vertical distance) at not more than 54 inches o.c.
- I. Erection Tolerances: Bolt or weld wall panels (at both horizontal and vertical junctures) to produce flush, even, true-to-line joints.
- J. Field Painting: Touch-up damaged shop-applied protective coatings. Use compatible primer for prime-coated surfaces; use galvanizing repair system for galvanized surfaces.

END OF SECTION

SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Steel framing and supports for overhead doors.
 - 2. Steel framing and supports for countertops.
 - 3. Steel framing and supports for applications where framing and supports are not specified in other Sections.
 - 4. Elevator machine beams, hoist beams,.
 - 5. Steel shapes for supporting elevator door sills.
 - 6. Shelf angles.
 - 7. Metal ladders.
 - 8. Metal downspout boots.
 - 9. Loose bearing and leveling plates for applications where they are not specified in other Sections.
- B. Products furnished, but not installed, under this Section:
 - 1. Loose steel lintels.
 - 2. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
 - 3. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.
- C. Related Sections:
 - 1. Section 033000 "Cast-in-Place Concrete" for installing anchor bolts, steel pipe sleeves, slotted-channel inserts, wedge-type inserts, and other items cast into concrete.
 - 2. Section 042000 "Unit Masonry" for installing loose lintels, anchor bolts, and other items built into unit masonry.
 - 3. Section 055100 "Metal Stairs."
 - 4. Section 055213 "Pipe and Tube Railings."

1.3 PERFORMANCE REQUIREMENTS

- A. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
 - 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

1.4 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Nonslip aggregates and nonslip-aggregate surface finishes.
 - 2. Paint products.
 - 3. Grout.
- B. Shop Drawings: Show fabrication and installation details for metal fabrications.
 - 1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.

1.5 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code Steel."
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code Steel."
 - 2. AWS D1.2/D1.2M, "Structural Welding Code Aluminum."

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

1.8 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages and steel weld plates and angles for casting into concrete. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

2.2 FERROUS METALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Stainless-Steel Sheet, Strip, and Plate: ASTM A 240/A 240M or ASTM A 666, Type 304.
- C. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.
- D. Steel Tubing: ASTM A 500, cold-formed steel tubing.
- E. Steel Pipe: ASTM A 53/A 53M, standard weight (Schedule 40) unless otherwise indicated.
- F. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.
 - 1. Size of Channels: 1-5/8 by 1-5/8 inches (41 by 41 mm).
 - 2. Material: Cold-rolled steel, ASTM A 1008/A 1008M, [commercial steel, Type B] structural steel, Grade 33 (Grade 230); 0.0677-inch (1.7-mm) minimum thickness; hot-dip galvanized after fabrication.

2.3 FASTENERS

- A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
 - 1. Provide stainless-steel fasteners for fastening aluminum.

- 2. Provide stainless-steel fasteners for fastening stainless steel.
- 3. Provide stainless-steel fasteners for fastening nickel silver.
- 4. Provide bronze fasteners for fastening bronze.
- B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with hex nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.
- C. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563; and, where indicated, flat washers.
 - 1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.
- D. Eyebolts: ASTM A 489.
- E. Machine Screws: ASME B18.6.3 (ASME B18.6.7M).
- F. Lag Screws: ASME B18.2.1 (ASME B18.2.3.8M).
- G. Wood Screws: Flat head, ASME B18.6.1.
- H. Plain Washers: Round, ASME B18.22.1 (ASME B18.22M).
- I. Lock Washers: Helical, spring type, ASME B18.21.1 (ASME B18.21.2M).
- J. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.
- K. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.
 - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.
- L. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches (41 by 22 mm) by length indicated with anchor straps or studs not less than 3 inches (75 mm) long at not more than 8 inches (200 mm) o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B 633, Class Fe/Zn 5, as needed for fastening to inserts.

2.4 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

- B. Shop Primers: Provide primers that comply with Section 099113 "Exterior Painting," Section 099123 Interior Painting," and Section 099600 "High-Performance Coatings."
- C. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.
- E. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- F. Concrete: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normalweight, air-entrained, concrete with a minimum 28-day compressive strength of 3000 psi (20 MPa).

2.5 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work with accurate angles and surfaces and straight edges.
- E. Weld corners and seams continuously to comply with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
- G. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

- H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
 - 1. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches (3.2 by 38 mm), with a minimum 6-inch (150-mm) embedment and 2-inch (50-mm) hook, not less than 8 inches (200 mm) from ends and corners of units and 24 inches (600 mm) o.c., unless otherwise indicated.

2.6 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
 - 1. Fabricate units from slotted channel framing where indicated.
 - 2. Furnish inserts for units installed after concrete is placed.
- C. Galvanize miscellaneous framing and supports where indicated.
- D. Prime miscellaneous framing and supports with primer specified in Section 099600 "High-Performance Coatings" where indicated.

2.7 METAL LADDERS

- A. General:
 - 1. Comply with ANSI A14.3 unless otherwise indicated.
 - 2. For elevator pit ladders, comply with ASME A17.1.
- B. Steel Ladders:
 - 1. Space siderails of elevator pit ladders 12 inches (300 mm) apart.
 - 2. Siderails: Continuous, 3/8-by-2-1/2-inch (9.5-by-64-mm) steel flat bars, with eased edges.
 - 3. Rungs: 3/4-inch- (19-mm-) diameter steel bars.
 - 4. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
 - 5. Provide nonslip surfaces on top of each rung by coating with abrasive material metallically bonded to rung.
 - a. <u>Products</u>: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- 1) <u>IKG Industries, a division of Harsco Corporation; Mebac</u>.
- 2) <u>SlipNOT Metal Safety Flooring, a W. S. Molnar company; SlipNOT</u>.
- 6. Support each ladder at top and bottom and not more than 60 inches (1500 mm) o.c. with welded or bolted steel brackets.
- 7. Primeladders, including brackets and fasteners, with primer specified in Section 099123 "Interior Painting."

2.8 METAL DOWNSPOUT BOOTS

- A. Provide downspout boots made from stainless steel in heights indicated with inlets of size and shape to suit downspouts. Provide units with flanges and holes for countersunk anchor bolts.
 - 1. Outlet: Horizontal, to discharge into pipe. 4" PVC adapter
- B. Pre-finished powder coat silver to match downspout 304 stainless steel.
- C. Removable stainless steel grate with cleanout flap door.
- D. Piedmont Pipe Downspout Adapter or approved equal.

2.9 LOOSE BEARING AND LEVELING PLATES

- A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.
- B. Galvanize plates.
- C. Prime plates with zinc-rich primer.

2.10 LOOSE STEEL LINTELS

- A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.
- B. Galvanize loose steel lintels located in exterior walls.

2.11 STEEL WELD PLATES AND ANGLES

A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.12 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish metal fabrications after assembly.
- C. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.13 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.
 - 1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
- B. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
 - 1. Shop prime with primers specified in Section 099113 "Exterior Painting," Section 099123 "Interior Painting" or Section 099600 "High-Performance Coatings" where indicated.
- C. Preparation for Shop Priming: Prepare surfaces to comply with requirements indicated below:
 - 1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 3. Items Indicated to Receive Primers Specified in Section 099600 "High-Performance Coatings": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 4. Other Items: SSPC-SP 3, "Power Tool Cleaning."
- D. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
 - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

2.14 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. As-Fabricated Finish: AA-M10 (Mechanical Finish: as fabricated, unspecified).

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- F. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:
 - 1. Cast Aluminum: Heavy coat of bituminous paint.
 - 2. Extruded Aluminum: Two coats of clear lacquer.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

3.3 INSTALLING BEARING AND LEVELING PLATES

A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.

- B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.
 - 1. Use nonshrink grout, nonmetallic grout in exposed locations unless otherwise indicated.
 - 2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.4 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 055000
SECTION 055100 - METAL STAIRS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Preassembled steel stairs with concrete-filled treads.
 - 2. Steel tube railings attached to metal stairs.
 - 3. Steel tube handrails attached to walls adjacent to metal stairs.
- B. Related Sections:
 - 1. Section 033000 "Cast-in-Place Concrete" for concrete fill for stair treads and platforms.
 - 2. Section 055213 "Pipe and Tube Railings" for pipe and tube railings not attached to metal stairs or to walls adjacent to metal stairs.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design metal stairs, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance of Stairs: Metal stairs shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.
 - 1. Uniform Load: 100 lbf/sq. ft. (4.79 kN/sq. m).
 - 2. Concentrated Load: 300 lbf (1.33 kN) applied on an area of 4 sq. in. (2580 sq. mm).
 - 3. Uniform and concentrated loads need not be assumed to act concurrently.
 - 4. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
 - 5. Limit deflection of treads, platforms, and framing members to L/360 or 1/4 inch (6.4 mm), whichever is less.
 - 6. Refer to structural drawings for additional information.
- C. Structural Performance of Railings: Railings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.
 - 1. Handrails and Top Rails of Guards:
 - a. Uniform load of 50 lbf/ ft. (0.73 kN/m) applied in any direction.

- b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
- c. Uniform and concentrated loads need not be assumed to act concurrently.
- 2. Infill of Guards:
 - a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
 - b. Infill load and other loads need not be assumed to act concurrently.

1.4 ACTION SUBMITTALS

- A. Product Data: For metal stairs and the following:
 - 1. Prefilled metal-pan stair treads.
 - 2. Paint products.
 - 3. Grout.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- C. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified professional engineer.
- B. Welding certificates.
- C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of products.
- B. NAAMM Stair Standard: Comply with "Recommended Voluntary Minimum Standards for Fixed Metal Stairs" in NAAMM AMP 510, "Metal Stairs Manual," for class of stair designated, unless more stringent requirements are indicated.
 - 1. Preassembled Stairs: Commercial class.
- C. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code Steel."
 - 2. AWS D1.3, "Structural Welding Code Sheet Steel."

1.7 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for metal stairs. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- C. Coordinate locations of hanger rods and struts with other work so that they will not encroach on required stair width and will be within the fire-resistance-rated stair enclosure.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

2.2 FERROUS METALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Steel Tubing: ASTM A 500 (cold formed) or ASTM A 513.
- C. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.
- D. Uncoated, Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, structural steel, Grade 25 (Grade 170), unless another grade is required by design loads; exposed.

2.3 FASTENERS

- A. General: Provide zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 12 for exterior use, and Class Fe/Zn 5 where built into exterior walls. Select fasteners for type, grade, and class required.
- B. Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with hex nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.
- C. Plain Washers: Round, ASME B18.22.1 (ASME B18.22M).

2.4 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Shop Primers: Provide primers that comply with Section 099113 "Exterior Painting," Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings."
- C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.
- D. Concrete Materials and Properties: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with a minimum 28-day compressive strength of 3000 psi (20 MPa) unless otherwise indicated.

2.5 FABRICATION, GENERAL

- A. Provide complete stair assemblies, including metal framing, hangers, struts, railings, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.
 - 1. Join components by welding unless otherwise indicated.
 - 2. Use connections that maintain structural value of joined pieces.
 - 3. Fabricate treads and platforms of exterior stairs so finished walking surfaces slope to drain.
- B. Preassembled Stairs: Assemble stairs in shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- E. Form exposed work with accurate angles and surfaces and straight edges.
- F. Weld connections to comply with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Weld exposed corners and seams continuously unless otherwise indicated.
 - 5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 2 welds: completely sanded joint, some undercutting and pinholes okay .

- G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated. Locate joints where least conspicuous.
- H. Fabricate joints that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

2.6 STEEL-FRAMED STAIRS

- A. Stair Framing:
 - 1. Fabricate stringers of steel channels with minimum 3-inch wide flange.
 - a. Provide closures for exposed ends of channel stringers.
 - 2. Construct platforms of steel plate or channel headers and miscellaneous framing members as needed to comply with performance requirements.
 - 3. Weld stringers to headers; weld framing members to stringers and headers.
 - 4. Where masonry walls support metal stairs, provide temporary supporting struts designed for erecting steel stair components before installing masonry.
- B. Metal-Pan Stairs: Form risers, subtread pans, and subplatforms to configurations shown from steel sheet of thickness needed to comply with performance requirements but not less than 0.067 inch (1.7 mm).
 - 1. Steel Sheet: Uncoated cold-rolled steel sheet.
 - 2. Directly weld metal pans to stringers; locate welds on top of subtreads where they will be concealed by concrete fill. Do not weld risers to stringers.
 - 3. Shape metal pans to include nosing integral with riser.
 - 4. Provide subplatforms of configuration indicated or, if not indicated, the same as subtreads. Weld subplatforms to platform framing.

2.7 STAIR RAILINGS

- A. Steel Tube Railings: Fabricate railings to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of tube, post spacings, and anchorage, but not less than that needed to withstand indicated loads.
 - 1. Rails and Posts: 1-5/8-inch- (41-mm-) diameter top and bottom rails and 1-1/2-inch- (38-mm-) square posts.
 - 2. Picket Infill: 1/2-inch- (13-mm-) square pickets spaced less than 4 inches (100 mm) clear.
- B. Welded Connections: Fabricate railings with welded connections. Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

- 1. Finish welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 3 welds: partially dressed weld with spatter removed.
- C. Form changes in direction of railings as follows:
 - 1. As detailed.
 - 2. By bending.
 - 3. By flush bends.
 - 4. By radius bends of radius indicated.
- D. Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- E. Close exposed ends of railing members with prefabricated end fittings.
- F. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch (6 mm) or less.
- G. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnecting components and for attaching to other work. Furnish inserts and other anchorage devices for connecting to concrete or masonry work.
 - 1. Connect posts to stair framing by direct welding unless otherwise indicated.
 - 2. For nongalvanized railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves, except galvanize anchors embedded in exterior masonry and concrete construction.

2.8 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish metal stairs after assembly.
- C. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed products:
 - 1. Exterior Stairs: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 2. Interior Stairs: SSPC-SP 3, "Power Tool Cleaning."
- D. Apply shop primer to uncoated surfaces of metal stair components, except those with galvanized finishes and those to be embedded in concrete or masonry unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
 - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.
- C. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete unless otherwise indicated.
- D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- E. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- F. Field Welding: Comply with requirements for welding in "Fabrication, General" Article.
- G. Place and finish concrete fill for treads and platforms to comply with Section 033000 "Cast-in-Place Concrete."

3.2 INSTALLING RAILINGS

- A. Adjust railing systems before anchoring to ensure matching alignment at abutting joints. Space posts at spacing indicated or, if not indicated, as required by design loads. Plumb posts in each direction. Secure posts and rail ends to building construction as follows:
 - 1. Anchor posts to steel by welding directly to steel supporting members.
 - 2. Anchor handrail ends to concrete and masonry with steel round flanges welded to rail ends and anchored with postinstalled anchors and bolts.
- B. Attach handrails to wall with wall brackets. Use type of bracket with predrilled hole for exposed bolt anchorage. Provide bracket with 1-1/2-inch (38-mm) clearance from inside face of handrail and finished wall surface. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads. Secure wall brackets to building construction as required to comply with performance requirements. And as follows:
 - 1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.

3.3 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 055100

SECTION 055213 - PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Steel pipe railings.
 - 2. Aluminum pipe railings.
- B. Related Sections:
 - 1. Section 055100 "Metal Stairs" for steel tube railings associated with metal stairs.
 - 2. Section 057300 "Decorative Metal Railings" for ornamental railings fabricated from pipes and tubes.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design railings, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:
 - 1. Steel: 72 percent of minimum yield strength.
 - 2. Aluminum: The lesser of minimum yield strength divided by 1.65 or minimum ultimate tensile strength divided by 1.95.
 - 3. Stainless Steel: 60 percent of minimum yield strength.
- C. Structural Performance: Railings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - 1. Handrails and Top Rails of Guards:
 - a. Uniform load of 50 lbf/ ft. (0.73 kN/m) applied in any direction.
 - b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.
 - 2. Infill of Guards:

- a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
- b. Infill load and other loads need not be assumed to act concurrently.
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
 - 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
- E. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.4 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Manufacturer's product lines of mechanically connected railings.
 - 2. Railing brackets.
 - 3. Grout, anchoring cement, and paint products.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- C. Samples for Initial Selection: For products involving selection of color, texture, or design.
- D. Samples for Verification: For each type of exposed finish required.
 - 1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters.
 - 2. Fittings and brackets.
 - 3. Assembled Sample of railing system, made from full-size components, including top rail, post, handrail, and infill. Sample need not be full height.
 - a. Show method of finishing connecting members at intersections.
- E. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified professional engineer.
- B. Welding certificates.
- C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of railing from single source from single manufacturer.
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code Steel."
- C. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code Steel."
 - 2. AWS D1.2/D1.2M, "Structural Welding Code Aluminum."

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

1.8 COORDINATION AND SCHEDULING

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- C. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
- B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.

2.2 STEEL AND IRON

- A. Tubing: ASTM A 500 (cold formed) or ASTM A 513.
- B. Pipe: ASTM A 53/A 53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.
 - 1. Provide galvanized finish for exterior installations and where indicated.
- C. Plates, Shapes, and Bars: ASTM A 36/A 36M.
- D. Woven-Wire Mesh: Intermediate-crimp, square pattern, 2-inch (50-mm) woven-wire mesh, made from 0.135-inch (3.5-mm) nominal diameter wire complying with ASTM A 510 (ASTM A 510M).

2.3 ALUMINUM

- A. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of alloy and temper designated below for each aluminum form required.
- B. Extruded Bars and Tubing: ASTM B 221 (ASTM B 221M), Alloy 6063-T5/T52.
- C. Extruded Structural Pipe and Round Tubing: ASTM B 429/B 429M, Alloy 6063-T6.
 - 1. Provide Standard Weight (Schedule 40) pipe, unless otherwise indicated.
- D. Drawn Seamless Tubing: ASTM B 210 (ASTM B 210M), Alloy 6063-T832.
- E. Plate and Sheet: ASTM B 209 (ASTM B 209M), Alloy 6061-T6.
- F. Die and Hand Forgings: ASTM B 247 (ASTM B 247M), Alloy 6061-T6.
- G. Castings: ASTM B 26/B 26M, Alloy A356.0-T6.

2.4 FASTENERS

- A. General: Provide the following:
 - 1. Ungalvanized-Steel Railings: Plated steel fasteners complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5 for zinc coating.
 - 2. Hot-Dip Galvanized Railings: Type 304 stainless-steel or hot-dip zinc-coated steel fasteners complying with ASTM A 153/A 153M or ASTM F 2329 for zinc coating.
 - 3. Aluminum Railings: Type 304 stainless-steel fasteners.
- B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.

- C. Fasteners for Interconnecting Railing Components:
 - 1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless exposed fasteners are unavoidable or are the standard fastening method for railings indicated.

2.5 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
 - 1. For aluminum railings, provide type and alloy as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.
- B. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- C. Shop Primers: Provide primers that comply with Section 099600 "High-Performance Coatings."
- D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.
- E. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- F. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.
 - 1. Water-Resistant Product: At exterior locations (with occupied space below) provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

2.6 FABRICATION

- A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.
- B. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

- D. Form work true to line and level with accurate angles and surfaces.
- E. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- G. Connections: Fabricate railings with welded connections unless otherwise indicated.
- H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove flux immediately.
 - 4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.
- I. Welded Connections for Aluminum Pipe: Fabricate railings to interconnect members with concealed internal welds that eliminate surface grinding, using manufacturer's standard system of sleeve and socket fittings.
- J. Nonwelded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
- K. Form changes in direction as follows:
 - 1. As detailed.
 - 2. By bending.
- L. Bend members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- M. Close exposed ends of railing members with prefabricated end fittings.
- N. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch (6 mm) or less.
- O. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.
- P. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.
- Q. Woven-Wire Mesh Infill Panels: Fabricate infill panels from woven-wire mesh crimped into 1by-1/2-by-1/8-inch (25-by-13-by-3-mm) metal channel frames. Make wire mesh and frames from same metal as railings in which they are installed.

1. Orient wire mesh with wires horizontal and vertical.

2.7 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

2.8 STEEL AND IRON FINISHES

- A. Galvanized Railings:
 - 1. Hot-dip galvanize exterior steel and iron railings, including hardware, after fabrication.
 - 2. Comply with ASTM A 123/A 123M for hot-dip galvanized railings.
 - 3. Comply with ASTM A 153/A 153M for hot-dip galvanized hardware.
 - 4. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
 - 5. Fill vent and drain holes that will be exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.
- B. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.
- C. Preparing Galvanized Railings for Shop Priming: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner.
- D. For nongalvanized steel railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves, except galvanize anchors to be embedded in exterior concrete or masonry.
- E. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with requirements indicated below:
 - 1. Exterior Railings: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 2. Railings Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 3. Railings Indicated to Receive Primers Specified in Section 099600 "High-Performance Coatings": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
- F. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.

2.9 ALUMINUM FINISHES

- Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 - 1. Minimum hardness measured in accordance with ASTM D3363: 2H.
 - 2. Direct impact resistance tested in accordance with ASTM D2794: Withstand 160 inchpounds.
 - 3. Salt spray resistance tested in accordance with ASTM B117: No undercutting, rusting, or blistering after 500 hours in 5 percent salt spray at 95 degrees F and 95 percent relative humidity and after 1000 hours less than 3/16 inch (5 mm) undercutting.
 - 4. Weatherability tested in accordance with ASTM D822: No film failure and 88 percent gloss retention after 1 year exposure in South Florida with test panels tilted at 45 degrees.
 - 5. Prior to powder-coat finish application, prepare surfaces as required for smooth finish. Remove all rough areas and runs in galvanizing. Apply galvanized primer at all weld joints to fill in all pits and voids.
 - 6. Color and Gloss: Match Architect's sample (Garnet to match college color). Semi-Gloss

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Fit exposed connections together to form tight, hairline joints.
- B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
 - 1. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
 - 2. Set posts plumb within a tolerance of 1/16 inch in 3 feet (2 mm in 1 m).
 - 3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet (5 mm in 3 m).
- C. Corrosion Protection: Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- D. Adjust railings before anchoring to ensure matching alignment at abutting joints.
- E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.2 RAILING CONNECTIONS

- A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of railings.
- B. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.
- C. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches (50 mm) beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6 inches (150 mm) of post.

3.3 ANCHORING POSTS

- A. Form or core-drill holes not less than 5 inches (125 mm) deep and 3/4 inch (20 mm) larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.
- B. Leave anchorage joint exposed with anchoring material flush with adjacent surface.
- C. Anchor posts to metal surfaces with oval flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:
 - 1. For aluminum pipe railings, attach posts using fittings designed and engineered for this purpose.
 - 2. For steel pipe railings, weld flanges to post and bolt to metal supporting surfaces.
- D. Install removable railing sections, where indicated, in slip-fit metal sockets cast in concrete.

3.4 ADJUSTING AND CLEANING

- A. Clean aluminum by washing thoroughly with clean water and soap and rinsing with clean water.
- B. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.
- C. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099600 "High-Performance Coatings."

D. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

3.5 **PROTECTION**

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

END OF SECTION 055213

SECTION 057000 - DECORATIVE METAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:1. Mesh Frame System at stair enclosures.
- B. Related Sections:
 - 1. Section 055000 "Metal Fabrications" for non-decorative metal fabrications.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated, including finishing materials.
- B. Shop Drawings: Show fabrication and installation details for decorative metal.
 - 1. Include plans, elevations, component details, and attachments to other work. Include detailed elevations for maximum panel sizes based on structural steel dimensions.
 - 2. Indicate materials and profiles of each decorative metal member, fittings, joinery, finishes, fasteners, anchorages, and accessory items.
- C. Samples for Initial Selection: For products involving selection of color, texture, or design.
- D. Samples for Verification: For each type of exposed finish required.
 - 1. Assembled Samples of systems, made from full-size components, including spacer, frame and infill. Show method of finishing members at intersections. Samples need not be full height.

1.4 INFORMATIONAL SUBMITTALS

- A. Mill Certificates: Signed by manufacturers of stainless-steel certifying that products furnished comply with requirements.
- B. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: A firm experienced in producing decorative metal similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- B. Installer Qualifications: Fabricator of products.
- C. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code Steel."
 - 2. AWS D1.2/D1.2M, "Structural Welding Code Aluminum."
 - 3. AWS D1.3, "Structural Welding Code Sheet Steel."
 - 4. AWS D1.6, "Structural Welding Code Stainless Steel."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store decorative metal in a well-ventilated area, away from uncured concrete and masonry, and protected from weather, moisture, soiling, abrasion, extreme temperatures, and humidity.
- B. Deliver and store cast-metal products in wooden crates surrounded by sufficient packing material to ensure that products will not be cracked or otherwise damaged.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with decorative metal by field measurements before fabrication and indicate measurements on Shop Drawings.

1.8 COORDINATION

A. Coordinate installation of anchorages for decorative metal items. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. Provide materials without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

2.2 ALUMINUM

- A. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with strength and durability properties for each aluminum form required not less than that of alloy and temper designated below.
- B. Extruded Bars and Shapes: ASTM B 221 (ASTM B 221M), Alloy 6063-T5/T52.
- C. Plate and Sheet: ASTM B 209 (ASTM B 209M), Alloy 3003-H14.
- D. Woven-Wire Mesh: McNichols Quality Techna 3155 Decorative Mesh, (Aluminum to match Architect's sample) (1/8" wire)

2.3 STAINLESS STEEL

- A. Sheet, Strip, Plate, and Flat Bar: ASTM A 666, Type 304.
- B. Bars and Shapes: ASTM A 276, Type 304.

2.4 FASTENERS

- A. Fastener Materials: Unless otherwise indicated, provide the following:
 - 1. Aluminum Items: Type 304 stainless-steel fasteners.
 - 2. Stainless-Steel Items: Type 304 stainless-steel fasteners.
 - 3. Dissimilar Metals: Type 304 stainless-steel fasteners.
- B. Fasteners for Anchoring to Other Construction: Unless otherwise indicated, select fasteners of type, grade, and class required to produce connections suitable for anchoring indicated items to other types of construction indicated.
- C. Provide concealed fasteners for interconnecting components and for attaching decorative metal items to other work unless otherwise indicated.
 - 1. Provide Phillips flat-head machine screws for exposed fasteners unless otherwise indicated.
- D. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

2.5 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

- 1. For aluminum, provide type and alloy as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.
- B. Brazing Rods: For copper alloys, provide type and alloy as recommended by producer of metal to be brazed and as required for color match, strength, and compatibility in fabricated items.
- C. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- D. Shop Primers: Provide primers that comply with Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
- E. Universal Shop Primer for Ferrous Metal: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
 - 1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- F. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.

2.6 FABRICATION, GENERAL

- A. Assemble items in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- B. Form decorative metal to required shapes and sizes, true to line and level with true curves and accurate angles and surfaces. Finish exposed surfaces to smooth, sharp, well-defined lines and arris.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing the Work.
- D. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- E. Mill joints to a tight, hairline fit. Cope or miter corner joints. Fabricate connections that will be exposed to weather in a manner to exclude water.
- F. Provide weep holes where water may accumulate. Locate weep holes in inconspicuous locations.
- G. Provide necessary rebates, lugs, and brackets to assemble units and to attach to other work. Cut, reinforce, drill, and tap as needed to receive finish hardware, screws, and similar items unless otherwise indicated.

- H. Comply with AWS for recommended practices in shop welding and brazing. Weld and braze behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed joints of flux, and dress exposed and contact surfaces.
 - 1. Where welding and brazing cannot be concealed behind finished surfaces, finish joints to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 1 Welds: no evidence of a welded joint.

2.7 MESH FRAME SYSTEM

- A. Fabricate infill panels from woven-wire mesh crimped and spot welded in aluminum channel or angle frames. Frame to be 1"x1/2"x1/8".
- B. Orient wire mesh with wires horizontal and vertical.
- C. Fabricate spacers to provide 1" gap between structural steel and infill panel frame.
- D. General: Fabricate decorative window grilles to designs indicated from steel bars and shapes of sizes and profiles indicated. Form steel bars by bending, forging, coping, mitering, and welding.
- E. Welding: Interconnect grille members with full-length, full-penetration welds unless otherwise indicated. Use welding method that is appropriate for metal and finish indicated and that develops full strength of members joined. Finish exposed welds and surfaces smooth, flush, and blended to match adjoining surfaces.
- F. Brackets, Fittings, and Anchors: Provide brackets, fittings, and anchors to connect frame system to structural steel.
 - 1. Coordinate anchorage devices with supporting structure.
 - 2. Fabricate anchorage devices that are capable of withstanding loads indicated.

2.8 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

2.9 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

2.10 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize products made from rolled, pressed, and forged steel shapes, castings, plates, bars, and strips indicated to be galvanized to comply with ASTM A 123/A 123M.
 - 1. Hot-dip galvanize steel and iron hardware indicated to be galvanized to comply with ASTM A 153/A 153M.
 - 2. Do not quench or apply post-galvanizing treatments that might interfere with paint adhesion.
 - 3. Fill vent and drain holes that will be exposed in finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.
- B. Preparing Galvanized Items for Shop Priming: After galvanizing, thoroughly clean decorative metal of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of decorative metal.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Provide anchorage devices and fasteners where needed to secure decorative metal to in-place construction.
- B. Install concealed gaskets, joint fillers, insulation, and flashings as work progresses.
- C. Corrosion Protection: Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

3.3 INSTALLING METAL MESH FRAME SYSTEM

- A. Mount frames to structural steel tubes.
 - 1. Secure to framing with specified fasteners.

3.4 CLEANING AND PROTECTION

A. Unless otherwise indicated, clean metals by washing thoroughly with clean water and soap, rinsing with clean water, and drying with soft cloths.

- B. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.
- C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.
- D. Protect finishes of decorative metal from damage during construction period with temporary protective coverings approved by decorative metal fabricator. Remove protective covering at time of Substantial Completion.
- E. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION 057000

SECTION 061053 - MISCELLANEOUS ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Wood blocking and nailers.
 - 2. Wood sleepers.
 - 3. Plywood backing panels.
- B. Related Requirements:
 - 1. Section 061600 "Sheathing."

1.3 DEFINITIONS

- A. Dimension Lumber: Lumber of 2 inches nominal (38 mm actual) or greater but less than 5 inches nominal (114 mm actual) in least dimension.
- B. Lumber grading agencies, and the abbreviations used to reference them, include the following:
 - 1. NeLMA: Northeastern Lumber Manufacturers' Association.
 - 2. NHLA: National Hardwood Lumber Association.
 - 3. SPIB: The Southern Pine Inspection Bureau.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
 - 1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
 - 2. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
 - 3. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

1.5 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: For the following, from ICC-ES:
 - 1. Preservative-treated wood.
 - 2. Power-driven fasteners.
 - 3. Powder-actuated fasteners.
 - 4. Expansion anchors.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber flat with spacers beneath and between each bundle to provide air circulation. Protect lumber from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
 - 1. Factory mark each piece of lumber with grade stamp of grading agency.
 - 2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
- B. Maximum Moisture Content of Lumber: 19 percent unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

- A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with the ground, Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground.
 - 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.
- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
- D. Application: Treat items indicated on Drawings, and the following:

MISCELLANEOUS ROUGH CARPENTRY

- 1. Wood nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
- 2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.

2.3 DIMENSION LUMBER FRAMING

- A. Other Framing: No. 2 grade and the following species:
 - 1. Hem-fir (north); NLGA.
 - 2. Mixed southern pine; SPIB.
 - 3. Spruce-pine-fir; NLGA.
 - 4. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.

2.4 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
 - 1. Blocking.
 - 2. Nailers.
- B. For items of dimension lumber size, provide Construction or No. 2 grade lumber and the following species:
 - 1. Hem-fir (north); NLGA.
 - 2. Mixed southern pine; SPIB.
 - 3. Spruce-pine-fir; NLGA.
 - 4. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
- C. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.
- D. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

2.5 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: DOC PS 1, Exterior, AC, in thickness indicated or, if not indicated, not less than 3/4-inch (19-mm) nominal thickness.

2.6 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

- 1. Where carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners of Type 304 stainless steel.
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: NES NER-272.
- D. Wood Screws: ASME B18.6.1.
- E. Screws for Fastening to Metal Framing: ASTM C 1002, length as recommended by screw manufacturer for material being fastened.
- F. Lag Bolts: ASME B18.2.1 (ASME B18.2.3.8M).
- G. Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers.
- H. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.
 - 1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.
 - 2. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2 (ASTM F 738M and ASTM F 836M, Grade A1 or A4).

2.7 MISCELLANEOUS MATERIALS

A. Adhesives for Gluing Furring and Sleepers to Concrete or Masonry: Formulation complying with ASTM D 3498 that is approved for use indicated by adhesive manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, and similar supports to comply with requirements for attaching other construction.
- B. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

- C. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- D. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels.
- E. Metal Framing Anchors: Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.
- F. Do not splice structural members between supports unless otherwise indicated.
- G. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
 - 1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches (406 mm) o.c.
- H. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- I. Securely attach carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 - 1. NES NER-272 for power-driven fasteners.
 - 2. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.
- J. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

3.2 WOOD SLEEPER, BLOCKING, AND NAILER INSTALLATION

- A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

END OF SECTION 061053

SECTION 061600 - SHEATHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Wall sheathing.
 - 2. Roof sheathing.
 - 3. Subflooring.
 - 4. Underlayment.
 - 5. Sheathing joint and penetration treatment.
- B. Related Requirements:
 - 1. Section 061053 "Miscellaneous Rough Carpentry" for plywood backing panels.
 - 2. Section 072500 "Weather Barriers" for water-resistive barrier applied over wall sheathing.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
 - 1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Indicate type of preservative used and net amount of preservative retained.
 - 2. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
 - 3. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

1.4 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: For following products, from ICC-ES:
 - 1. Preservative-treated plywood.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PANEL PRODUCTS

- A. Plywood: Either DOC PS 1 or DOC PS 2 unless otherwise indicated.
- B. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.
- C. Factory mark panels to indicate compliance with applicable standard.

2.2 PRESERVATIVE-TREATED PLYWOOD

- A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with the ground, Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground.
 - 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
- B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.
- C. Application: Treat items indicated on Drawings and plywood in contact with masonry or concrete or used with roofing, flashing, vapor barriers, and waterproofing.

2.3 WALL SHEATHING

- A. Glass-Mat Gypsum Wall Sheathing: ASTM C 1177/1177M.
 - 1. <u>Products</u>: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. <u>CertainTeed Corporation; GlasRoc</u>.
 - b. <u>G-P Gypsum Corporation; Dens-Glass Gold</u>.
 - c. <u>National Gypsum Company; Gold Bond e(2)XP</u>.
 - d. <u>Temple-Inland Inc.; GreenGlass</u>
 - e. <u>United States Gypsum Co.; Securock</u>.
 - 2. Type and Thickness: Regular, 1/2 inch (13 mm) thick.
 - 3. Size: 48 by 96 inches (1219 by 2438 mm) for vertical installation.

SHEATHING

2.4 WALL SHEATHING

- A. Glass-Mat Gypsum Wall Sheathing: ASTM C 1177/1177M.
 - 1. <u>Products</u>: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. <u>CertainTeed Corporation; GlasRoc</u>.
 - b. <u>G-P Gypsum Corporation; Dens-Glass Gold</u>.
 - c. <u>National Gypsum Company; Gold Bond e(2)XP</u>.
 - d. <u>Temple-Inland Inc.; GreenGlass</u>
 - e. <u>United States Gypsum Co.; Securock</u>.
 - 2. Type and Thickness: Regular, 1/2 inch (13 mm) thick.
 - 3. Size: 48 by 96 inches (1219 by 2438 mm) for vertical installation.

2.5 ROOF SHEATHING

- A. Glass-Mat Gypsum Wall Sheathing: ASTM C 1177/1177M.
 - <u>Products</u>: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

 <u>G-P Gypsum Corporation; Dens-Deck.</u>
 - 2. Type and Thickness: Regular, 1/2 inch (13 mm) thick.

2.6 SUBFLOORING AND UNDERLAYMENT

- A. Plywood Combination Subfloor-Underlayment: DOC PS 1, Exposure 1, Underlayment singlefloor panels.
 - 1. Span Rating: Not less than 16 o.c.
 - 2. Nominal Thickness: Not less than 23/32 inch (18.3 mm).
 - 3. Edge Detail: Square.
- B. Plywood Subflooring: Exposure 1 single-floor panels or sheathing.
 - 1. Span Rating: Not less than 16 o.c..
 - 2. Nominal Thickness: Not less than 23/32 inch (18.3 mm).
- C. Underlayment, General: Provide underlayment in nominal thicknesses indicated or, if not indicated, not less than 1/4 inch (6.4 mm) over smooth subfloors and not less than 3/8 inch (9.5 mm) over board or uneven subfloors.
- D. Plywood Underlayment for Carpet: DOC PS 1, Interior, Underlayment.

2.7 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
 - 1. For roof and wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: NES NER-272.
- D. Wood Screws: ASME B18.6.1.
- E. Screws for Fastening Wood Structural Panels to Cold-Formed Metal Framing: ASTM C 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.
 - 1. For wall and roof sheathing panels, provide screws with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.
- F. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing to be attached, with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.
 - 1. For steel framing less than 0.0329 inch (0.835 mm) thick, use screws that comply with ASTM C 1002.
 - 2. For steel framing from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick, use screws that comply with ASTM C 954.

2.8 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS

- A. Sealant for Glass-Mat Gypsum Sheathing: Silicone emulsion sealant complying with ASTM C 834, compatible with sheathing tape and sheathing and recommended by tape and sheathing manufacturers for use with glass-fiber sheathing tape and for covering exposed fasteners.
 - 1. Sheathing Tape: Self-adhering glass-fiber tape, minimum 2 inches (50 mm) wide, 10 by 10 or 10 by 20 threads/inch (390 by 390 or 390 by 780 threads/m), of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing and with a history of successful in-service use.
PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.
- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.
- C. Securely attach to substrate by fastening as indicated, complying with the following:
 - 1. NES NER-272 for power-driven fasteners.
 - 2. Table 2304.9.1, "Fastening Schedule," in ICC's "International Building Code."
- D. Coordinate wall and roof sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.
- E. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.
- F. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.2 WOOD STRUCTURAL PANEL INSTALLATION

- A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.
- B. Fastening Methods: Fasten panels as indicated below:
 - 1. Combination Subfloor-Underlayment:
 - a. Glue and nail to wood framing.
 - b. Space panels 1/8 inch (3 mm) apart at edges and ends.
 - 2. Wall and Roof Sheathing:
 - a. Screw to cold-formed metal framing.
 - b. Space panels 1/8 inch (3 mm) apart at edges and ends.

3.3 GYPSUM SHEATHING INSTALLATION

- A. Comply with GA-253 and with manufacturer's written instructions.
 - 1. Fasten gypsum sheathing to cold-formed metal framing with screws.

- 2. Install boards with a 3/8-inch (9.5-mm) gap where non-load-bearing construction abuts structural elements.
- 3. Install boards with a 1/4-inch (6.4-mm) gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.
- B. Apply fasteners so heads bear tightly against face of sheathing, but do not cut into facing.
- C. Vertical Installation: Install board vertical edges centered over studs. Abut ends and edges of each board with those of adjacent boards. Attach boards at perimeter and within field of board to each stud.
 - 1. Space fasteners approximately 8 inches (200 mm) o.c. and set back a minimum of 3/8 inch (9.5 mm) from edges and ends of boards.

END OF SECTION 061600

SECTION 064113 - WOOD-VENEER-FACED ARCHITECTURAL CABINETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Architectural wood cabinets.
 - 2. Wood furring, blocking, shims, and hanging strips for installing architectural wood cabinets unless concealed within other construction before cabinet installation.
 - 3. Shop finishing of architectural wood cabinets.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product, including panel products cabinet hardware and accessories and finishing materials and processes.
 - 1. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.
- B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
 - 1. Show details full size.
 - 2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
 - 3. Show locations and sizes of cutouts and holes for electrical switches and outlets and other items installed in architectural wood cabinets.
 - 4. Show veneer leaves with dimensions, grain direction, exposed face, and identification numbers indicating the flitch and sequence within the flitch for each leaf.
- C. Samples for Initial Selection:
 - 1. Shop-applied transparent finishes.
 - 2. Shop-applied opaque finishes.
 - 3. PVC edge material.
 - 4. Thermoset decorative panels.
- D. Samples for Verification:

- 1. Lumber for transparent finish, not less than 5 inches (125 mm) wide by 12 inches (300 mm) long, for each species and cut, finished on one side and one edge.
- 2. Veneer leaves representative of and selected from flitches to be used for transparent-finished cabinets.
- 3. Thermoset decorative panels, 8 by 10 inches (200 by 250 mm), for each color, pattern, and surface finish.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For fabricator.
- B. Product Certificates: For each type of product.
 - 1. Thermoset decorative panels.
 - 2. Adhesives.
- C. Evaluation Reports: For fire-retardant-treated materials, from ICC-ES.

1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful inservice performance. Shop is a certified participant in AWI's Quality Certification Program.
- B. Testing Agency Qualifications: For testing agency providing classification marking for fireretardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver cabinets until painting and similar operations that could damage woodwork have been completed in installation areas. If cabinets must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install cabinets until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
- B. Environmental Limitations: Do not deliver or install cabinets until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F (16 and 32 deg C) and relative humidity between 25 and 55 percent during the remainder of the construction period.

- C. Field Measurements: Where cabinets are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - 1. Locate concealed framing, blocking, and reinforcements that support cabinets by field measurements before being enclosed, and indicate measurements on Shop Drawings.
- D. Established Dimensions: Where cabinets are indicated to fit to other construction, establish dimensions for areas where cabinets are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.8 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that wood-veneer-faced architectural cabinets can be supported and installed as indicated.

PART 2 - PRODUCTS

2.1 ARCHITECTURAL CABINET FABRICATORS

A. Source Limitations: Engage a qualified woodworking firm to assume undivided responsibility for production of architectural wood cabinets with sequence-matched wood veneers wood paneling, wood doors with face veneers that are sequence matched with woodwork and transparent-finished wood doors that are required to be of same species as woodwork.

2.2 ARCHITECTURAL WOOD CABINETS, GENERAL

- A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of architectural wood cabinets indicated for construction, finishes, installation, and other requirements.
 - 1. The Contract Documents contain selections chosen from options in the quality standard and additional requirements beyond those of the quality standard. Comply with those selections and requirements in addition to the quality standard.

2.3 WOOD CABINETS FOR TRANSPARENT FINISH

- A. Grade: Premium.
- B. Type of Construction: Frameless.
- C. Cabinet and Door and Drawer Front Interface Style: Flush overlay.
- D. Wood for Exposed Surfaces:

- 1. Species: White Maple
- 2. Cut: Plain sliced/plain sawn.
- 3. Grain Direction: Vertically for drawer fronts, doors, and fixed panels.
- 4. Matching of Veneer Leaves: Slip match.
- 5. Veneer Matching within Panel Face: Balance match.
- 6. Veneer Matching within Room: Provide cabinet veneers in each room or other space from a single flitch with doors, drawer fronts, and other surfaces matched in a sequenced set with continuous match where veneers are interrupted perpendicular to the grain.
- 7. Comply with veneer and other matching requirements indicated for blueprint-matched paneling.
- E. Semiexposed Surfaces: Provide surface materials indicated below:
 - 1. Surfaces Other Than Drawer Bodies: Thermoset decorative panels.
 - a. Edges of Thermoset Decorative Panel Shelves: PVC or polyester edge banding.
 - 2. Drawer Subfronts, Backs, and Sides: Solid-hardwood lumber, same species indicated for exposed surfaces.
 - 3. Drawer Bottoms: Thermoset decorative panels.
- F. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.
 - 1. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners or glued dovetail joints.
- G. Brackets:
 - 1. Fold down arm bracket for counter: Hafele Hebgo Folding Table Bracket or equal 1100lbs per bracket (Hafele 287.43.400)
 - 2. Counter bracket (3rd level): Hebgo Bracket minimum 1000 lbs per pair (287.45.459)
 - 3. Counter bracket lower level Hebgo Bracket minimum 330 lbs per pair. (287.44.416)

2.4 WOOD MATERIALS

- A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.
 - 1. Do not use plain-sawn softwood lumber with exposed, flat surfaces more than 3 inches (75 mm) wide.
 - 2. Wood Moisture Content: 5 to 10 percent.
 - 3. Softwood Plywood: DOC PS 1, medium-density overlay.
 - 4. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1.
 - 5. Thermoset Decorative Panels: Particleboard or medium-density fiberboard finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMA LD 3, Grade VGL, for test methods 3.3, 3.4, 3.6, 3.8, and 3.10.

2.5 CABINET HARDWARE AND ACCESSORIES

- A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets except for items specified in Section 087111 "Door Hardware (Descriptive Specification)."
- B. Butt Hinges: 2-3/4-inch (70-mm), five-knuckle steel hinges made from 0.095-inch- (2.4-mm-) thick metal, and as follows:
 - 1. Semiconcealed Hinges for Flush Doors: BHMA A156.9, B01361.
 - 2. Semiconcealed Hinges for Overlay Doors: BHMA A156.9, B01521.
- C. Back-Mounted Pulls: BHMA A156.9, B02011.
- D. Wire Pulls: Back mounted, solid metal, 4 inches (100 mm) long, 5/16 inch (8 mm) in diameter.
- E. Catches: Magnetic catches, BHMA A156.9, B03141 Push-in magnetic catches, BHMA A156.9, B03131.
- F. Shelf Rests: BHMA A156.9, B04013; metal.
- G. Drawer Slides: BHMA A156.9.
 - 1. Grade 1HD-100 and Grade 1HD-200: Side mounted; full-extension full-overtravelextension type; zinc-plated-steel ball-bearing slides.
 - 2. For drawers more than 3 inches (75 mm) high but not more than 6 inches (150 mm) high and not more than 24 inches (600 mm) wide, provide Grade 1HD-100.
 - 3. For drawers more than 6 inches (150 mm) high or more than 24 inches (600 mm) wide, provide Grade 1HD-100.
 - 4. For trash bins not more than 20 inches (500 mm) high and 16 inches (400 mm) wide, provide Grade 1HD-100.
- H. Door Locks: BHMA A156.11, E07121.
- I. Drawer Locks: BHMA A156.11, E07041.
- J. Door and Drawer Silencers: BHMA A156.16, L03011.
- K. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.
 - 1. Satin Brass, Blackened, Bright Relieved, Clear Coated: BHMA 610 for brass base; BHMA 636 for steel base.
 - 2. Satin Chromium Plated: BHMA 626 for brass or bronze base; BHMA 652 for steel base.
 - 3. Bright Chromium Plated: BHMA 625 for brass or bronze base; BHMA 651 for steel base.
 - 4. Satin Stainless Steel: BHMA 630.
- L. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

2.6 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content.
- B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrousmetal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

2.7 FABRICATION

- A. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.
- B. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:
 - 1. Corners of Cabinets: 1/16 inch (1.5 mm) unless otherwise indicated.
- C. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
 - 1. Notify Architect seven days in advance of the dates and times woodwork fabrication will be complete.
 - 2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements before disassembling for shipment.
- D. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

2.8 SHOP FINISHING

- A. General: Finish architectural wood cabinets at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.
- B. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing architectural wood cabinets, as applicable to each unit of work.
 - 1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of cabinets.

- C. Transparent Finish:
 - 1. Grade: Premium.
 - 2. Finish: System 3, postcatalyzed lacquer.
 - 3. Wash Coat for Closed-Grain Woods: Apply wash-coat sealer to cabinets made from closed-grain wood before staining and finishing.
 - 4. Staining: Match Architect's sample.
 - 5. Sheen: Satin, 31-45 gloss units measured on 60-degree gloss meter per ASTM D 523.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Before installation, condition cabinets to average prevailing humidity conditions in installation areas.
- B. Before installing cabinets, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

3.2 INSTALLATION

- A. Grade: Install cabinets to comply with same grade as item to be installed.
- B. Assemble cabinets and complete fabrication at Project site to the extent that it was not completed in the shop.
- C. Install cabinets level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm).
- D. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- E. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork.
 - 1. For shop finished items use filler matching finish of items being installed.
- F. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
 - 1. Install cabinets with no more than 1/8 inch in 96-inch (3 mm in 2400-mm) sag, bow, or other variation from a straight line.
 - 2. Maintain veneer sequence matching of cabinets with transparent finish.

- 3. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches (400 mm) o.c. with No. 10 wafer-head screws sized for not less than 1-1/2-inch (38-mm) penetration into wood framing, blocking, or hanging strips.
- G. Touch up finishing work specified in this Section after installation of woodwork. Fill nail holes with matching filler where exposed.
 - 1. Apply specified finish coats, including stains and paste fillers if any, to exposed surfaces where only sealer/prime coats are applied in shop.

3.3 ADJUSTING AND CLEANING

- A. Repair damaged and defective cabinets, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.
- B. Clean, lubricate, and adjust hardware.
- C. Clean cabinets on exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION 064113

SECTION 071113 - BITUMINOUS DAMPPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:1. Cold-applied, emulsified-asphalt dampproofing.
- B. Related Requirements:
 - 1. Section 033000 "Cast-in-Place Concrete" for bituminous vapor retarders.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 FIELD CONDITIONS

- A. Weather Limitations: Proceed with application only when existing and forecasted weather conditions permit dampproofing to be performed according to manufacturers' written instructions.
- B. Ventilation: Provide adequate ventilation during application of dampproofing in enclosed spaces. Maintain ventilation until dampproofing has cured.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Source Limitations: Obtain primary dampproofing materials and primers from single source from single manufacturer. Provideauxiliary materials recommended in writing by manufacturer of primary materials.

2.2 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

- A. <u>Manufacturers</u>: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. BASF Construction Chemicals Building Systems; Sonneborn Brand Products.
 - 2. <u>ChemMasters, Inc</u>.
 - 3. <u>Euclid Chemical Company (The)</u>; an RPM company.
 - 4. <u>Meadows, W. R., Inc</u>.
- B. Fibered Brush and Spray Coats: ASTM D 1227, Type II, Class 1.

2.3 AUXILIARY MATERIALS

- A. General: Furnish auxiliary materials recommended in writing by dampproofing manufacturer for intended use and compatible with bituminous dampproofing.
- B. Emulsified-Asphalt Primer: ASTM D 1227, Type III, Class 1, except diluted with water as recommended in writing by manufacturer.
- C. Asphalt-Coated Glass Fabric: ASTM D 1668, Type I.
- D. Patching Compound: Asbestos-free fibered mastic of type recommended in writing by dampproofing manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions with Applicator present, for compliance with requirements for surface smoothness, surface moisture, and other conditions affecting performance of bituminous dampproofing work.
- B. Proceed with application only after substrate construction and penetrating work have been completed and unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Mask or otherwise protect adjoining exposed surfaces from being stained, spotted, or coated with dampproofing. Prevent dampproofing materials from entering and clogging weep holes and drains.
- B. Clean substrates of projections and substances detrimental to the dampproofing work; fill voids, seal joints, and remove bond breakers if any, as recommended in writing by prime material manufacturer.
- C. Apply patching compound to patch and fill tie holes, honeycombs, reveals, and other imperfections; cover with asphalt-coated glass fabric.

3.3 APPLICATION, GENERAL

- A. Comply with manufacturer's written instructions for dampproofing application, cure time between coats, and drying time before backfilling unless more stringent requirements are indicated.
 - 1. Apply dampproofing to provide continuous plane of protection.
 - 2. Apply additional coats if recommended in writing by manufacturer or to achieve a smooth surface and uninterrupted coverage.
- B. Where dampproofing footings and foundation walls, apply from finished-grade line to top of footing; extend over top of footing and down a minimum of 6 inches (150 mm) over outside face of footing.
 - 1. Extend dampproofing 12 inches (300 mm) onto intersecting walls and footings, but do not extend onto surfaces exposed to view when Project is completed.
 - 2. Install flashings and corner protection stripping at internal and external corners, changes in plane, construction joints, cracks, and where shown as "reinforced," by embedding an 8-inch- (200-mm-) wide strip of asphalt-coated glass fabric in a heavy coat of dampproofing. Dampproofing coat for embedding fabric is in addition to other coats required.
- C. Where dampproofing exterior face of inner wythe of exterior masonry cavity walls, lap dampproofing at least 1/4 inch (6 mm) onto flashing, masonry reinforcement, veneer ties, and other items that penetrate inner wythe.
 - 1. Extend dampproofing over outer face of structural members and concrete slabs that interrupt inner wythe.
 - 2. Lap dampproofing at least 1/4 inch (6 mm) onto shelf angles supporting veneer.

3.4 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

A. Exterior Face of Inner Wythe of Cavity Walls: Apply primer and one brush or spray coat at not less than 1 gal./100 sq. ft. (0.4 L/sq. m).

3.5 CLEANING

A. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

END OF SECTION 071113

SECTION 071326 - SELF-ADHERING SHEET WATERPROOFING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Modified bituminous sheet waterproofing.
- B. Related Requirements:
 - 1. Section 033000, CAST-IN-PLACE CONCRETE.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review waterproofing requirements including surface preparation, substrate condition and pretreatment, minimum curing period, forecasted weather conditions, special details and sheet flashings, installation procedures, testing and inspection procedures, and protection and repairs.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, and tested physical and performance properties of waterproofing.
 - 2. Include manufacturer's written instructions for evaluating, preparing, and treating substrate.
- B. Shop Drawings: Show locations and extent of waterproofing and details of substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.
 - 1. Include setting drawings showing layout, sizes, sections, profiles, and joint details of pedestal-supported concrete pavers.
- C. Samples: For the following products:
 - 1. 8-by-8-inch (200-by-200-mm) square of waterproofing and flashing sheet.
 - 2. 4-by-4-inch (100-by-100-mm) square of drainage panel.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Field quality-control reports.

- C. Sample Warranties: For special warranties.
- 1.5 QUALITY ASSURANCE
 - A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by waterproofing manufacturer.
- 1.6 FIELD CONDITIONS
 - A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate.
 - 1. Do not apply waterproofing in snow, rain, fog, or mist.
 - B. Maintain adequate ventilation during preparation and application of waterproofing materials.

1.7 WARRANTY

- A. Manufacturer's Warranty: Manufacturer's standard materials-only warranty in which manufacturer agrees to furnish replacement waterproofing material for waterproofing that does not comply with requirements or that fails to remain watertight within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Source Limitations for Waterproofing System: Obtain waterproofing materials and protection course from single source from single manufacturer.

2.2 MODIFIED BITUMINOUS SHEET WATERPROOFING

- A. Modified Bituminous Sheet: Minimum 60-mil (1.5-mm) nominal thickness, self-adhering sheet consisting of 56 mils (1.4 mm) of rubberized asphalt laminated on one side to a 4-mil- (0.10-mm-) thick, polyethylene-film reinforcement, and with release liner on adhesive side; formulated for application with primer or surface conditioner that complies with VOC limits of authorities having jurisdiction.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Carlisle Coatings & Waterproofing Inc.; CCW MiraDRI 860/861.
 - b. Grace, W. R., & Co. Conn.; Bituthene 3000/Low Temperature or Bituthene 4000.
 - c. Henry Company; Blueskin WP 100/200.
 - 2. Physical Properties:

- a. Tensile Strength, Membrane: 250 psi (1.7 MPa) minimum; ASTM D 412, Die C, modified.
- b. Ultimate Elongation: 300 percent minimum; ASTM D 412, Die C, modified.
- c. Low-Temperature Flexibility: Pass at minus 20 deg F (minus 29 deg C); ASTM D 1970.
- d. Crack Cycling: Unaffected after 100 cycles of 1/8-inch (3-mm) movement; ASTM C 836.
- e. Puncture Resistance: 40 lbf (180 N) minimum; ASTM E 154.
- f. Water Absorption: 0.2 percent weight-gain maximum after 48-hour immersion at 70 deg F (21 deg C); ASTM D 570.
- g. Water Vapor Permeance: 0.05 perms (2.9 ng/Pa x s x sq. m) maximum; ASTM E 96/E 96M, Water Method.
- h. Hydrostatic-Head Resistance: 200 feet (60 m minimum; ASTM D 5385.
- 3. Sheet Strips: Self-adhering, rubberized-asphalt strips of same material and thickness as sheet waterproofing.

2.3 AUXILIARY MATERIALS

- A. General: Furnish auxiliary materials recommended by waterproofing manufacturer for intended use and compatible with sheet waterproofing.
 - 1. Furnish liquid-type auxiliary materials that comply with VOC limits of authorities having jurisdiction.
- B. Primer: Liquid waterborne or solvent-borne primer recommended for substrate by sheet-waterproofing material manufacturer.
- C. Surface Conditioner: Liquid, waterborne surface conditioner recommended for substrate by sheet-waterproofing material manufacturer.
- D. Liquid Membrane: Elastomeric, two-component liquid, cold fluid applied, of trowel grade or low viscosity.
- E. Substrate Patching Membrane: Low-viscosity, two-component, modified asphalt coating.
- F. Metal Termination Bars: Aluminum bars, approximately 1 by 1/8 inch (25 by 3 mm) thick, predrilled at 9-inch (229-mm) centers.
- G. Protection Course: ASTM D 6506, semirigid sheets of fiberglass or mineral-reinforcedasphaltic core, pressure laminated between two asphalt-saturated fibrous liners and as follows:
 - 1. Thickness: 1/4 inch (6 mm), nominal.
 - 2. Adhesive: Rubber-based solvent type recommended by waterproofing manufacturer for protection course type.

2.4 MOLDED-SHEET DRAINAGE PANELS

A. Molded-Sheet Drainage Panel: Composite subsurface drainage panel consisting of a studded, nonbiodegradable, molded-plastic-sheet drainage core; with a geotextile facing.

- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. American Hydrotech, Inc.; Hydrodrain 700.
 - b. Carlisle Coatings & Waterproofing Inc.; CCW MiraDRAIN 9000.
 - c. Grace, W. R., & Co. Conn.; Hydroduct 660.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the waterproofing.
 - 1. Verify that concrete has cured and aged for minimum time period recommended in writing by waterproofing manufacturer.
 - 2. Verify that substrate is visibly dry and within the moisture limits recommended in writing by manufacturer. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

- A. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for waterproofing application.
- B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.
- C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
- D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids.
- E. Prepare, fill, prime, and treat joints and cracks in substrates. Remove dust and dirt from joints and cracks according to ASTM D 4258.
 - 1. Install sheet strips of width according to manufacturer's written instructions and center over treated construction and contraction joints and cracks exceeding a width of 1/16 inch.
- F. Bridge and cover isolation joints, expansion joints and discontinuous deck-to-wall and deck-todeck joints with overlapping sheet strips of widths according to manufacturer's written instructions.
 - 1. Invert and loosely lay first sheet strip over center of joint. Firmly adhere second sheet strip to first and overlap to substrate.
- G. Corners: Prepare, prime, and treat inside and outside corners according to ASTM D 6135.

- 1. Install membrane strips centered over vertical inside corners. Install 3/4-inch (19-mm) fillets of liquid membrane on horizontal inside corners and as follows:
 - a. At footing-to-wall intersections, extend liquid membrane in each direction from corner or install membrane strip centered over corner.
 - b. At plaza-deck-to-wall intersections, extend liquid membrane or sheet strips onto deck waterproofing and to finished height of sheet flashing.
- H. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through waterproofing and at drains and protrusions according to ASTM D 6135.

3.3 MODIFIED BITUMINOUS SHEET-WATERPROOFING APPLICATION

- A. Install modified bituminous sheets according to waterproofing manufacturer's written instructions and recommendations in ASTM D 6135.
- B. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by sheet waterproofing in same day. Reprime areas exposed for more than 24 hours.
- C. Apply and firmly adhere sheets over area to receive waterproofing. Accurately align sheets and maintain uniform 2-1/2-inch- (64-mm-) minimum lap widths and end laps. Overlap and seal seams, and stagger end laps to ensure watertight installation.
 - 1. When ambient and substrate temperatures range between 25 and 40 deg F (minus 4 and plus 5 deg C), install self-adhering, modified bituminous sheets produced for low-temperature application. Do not use low-temperature sheets if ambient or substrate temperature is higher than 60 deg F (16 deg C).
- D. Horizontal Application: Apply sheets from low to high points of decks to ensure that laps shed water.
- E. Apply continuous sheets over already-installed sheet strips, bridging substrate cracks, construction, and contraction joints.
- F. Seal edges of sheet-waterproofing terminations with mastic.
- G. Repair tears, voids, and lapped seams in waterproofing not complying with requirements. Slit and flatten fishmouths and blisters. Patch with sheet waterproofing extending 6 inches (150 mm) beyond repaired areas in all directions.
- H. Immediately install protection course with butted joints over waterproofing membrane.

3.4 MOLDED-SHEET DRAINAGE-PANEL INSTALLATION

A. Place and secure molded-sheet drainage panels, with geotextile facing away from deck substrate, according to manufacturer's written instructions. Use adhesives or other methods that do not penetrate waterproofing. Lap edges and ends of geotextile to maintain continuity. Protect installed molded-sheet drainage panels during subsequent construction.

3.5 PROTECTION, REPAIR, AND CLEANING

- A. Do not permit foot or vehicular traffic on unprotected membrane.
- B. Protect waterproofing from damage and wear during remainder of construction period.
- C. Correct deficiencies in or remove waterproofing that does not comply with requirements; repair substrates, reapply waterproofing, and repair sheet flashings.
- D. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION

SECTION 071326.1 - SELF-ADHERING SHEET WATERPROOFING (WALLS)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Modified bituminous sheet waterproofing.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, and tested physical and performance properties of waterproofing.
 - 2. Include manufacturer's written instructions for evaluating, preparing, and treating substrate.
- B. Samples: For each exposed product and for each color and texture specified, including the following products:
 - 1. 8-by-8-inch (200-by-200-mm) square of waterproofing and flashing sheet.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Field quality-control reports.
- C. Sample Warranties: For special warranties.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by waterproofing manufacturer.

1.6 FIELD CONDITIONS

- A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate.
 - 1. Do not apply waterproofing in snow, rain, fog, or mist.
- B. Maintain adequate ventilation during preparation and application of waterproofing materials.

1.7 WARRANTY

- A. Manufacturer's Warranty: Manufacturer's standard materials-only warranty in which manufacturer agrees to furnish replacement waterproofing material for waterproofing that does not comply with requirements or that fails to remain watertight within specified warranty period.
 - 1. Warranty Period: Three years from date of Substantial Completion.
- B. Installer's Special Warranty: Specified form, signed by Installer, covering Work of this Section, for warranty period of two years.
 - 1. Warranty includes removing and reinstalling protection board, drainage panels, insulation, pedestals, and pavers on plaza decks.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Source Limitations for Waterproofing System: Obtain waterproofing materials, protection course, and molded-sheet drainage panels from single source from single manufacturer.

2.2 MODIFIED BITUMINOUS SHEET WATERPROOFING

- A. Modified Bituminous Sheet: Minimum 60-mil (1.5-mm) nominal thickness, self-adhering sheet consisting of 56 mils (1.4 mm) of rubberized asphalt laminated on one side to a 4-mil- (0.10-mm-) thick, polyethylene-film reinforcement, and with release liner on adhesive side; formulated for application with primer or surface conditioner that complies with VOC limits of authorities having jurisdiction.
 - 1. <u>Products</u>: Subject to compliance with requirements, provide one of the following:
 - a. <u>American Hydrotech, Inc</u>; VM75.
 - b. <u>Carlisle Coatings & Waterproofing Inc;</u> CCW MiraDRI 860/861.
 - c. <u>Grace Construction Products; W.R. Grace & Co. -- Conn</u>; Bituthene 4000.
 - d. <u>Meadows, W.R.,Inc</u>; SealTight Mel-Rol.
 - e. <u>Polyguard Products, Inc</u>; Polyguard 650.

- 2. Physical Properties:
 - a. Tensile Strength, Membrane: 250 psi (1.7 MPa) minimum; ASTM D 412, Die C, modified.
 - b. Ultimate Elongation: 300 percent minimum; ASTM D 412, Die C, modified.
 - c. Low-Temperature Flexibility: Pass at minus 20 deg F (minus 29 deg C); ASTM D 1970.
 - d. Crack Cycling: Unaffected after 100 cycles of 1/8-inch (3-mm) movement; ASTM C 836.
 - e. Puncture Resistance: 40 lbf (180 N) minimum; ASTM E 154.
 - f. Water Absorption: 0.2 percent weight-gain maximum after 48-hour immersion at 70 deg F (21 deg C); ASTM D 570.
 - g. Water Vapor Permeance: 0.05 perms (2.9 ng/Pa x s x sq. m) maximum; ASTM E 96/E 96M, Water Method.
- 3. Sheet Strips: Self-adhering, rubberized-asphalt strips of same material and thickness as sheet waterproofing.

2.3 AUXILIARY MATERIALS

- A. General: Furnish auxiliary materials recommended by waterproofing manufacturer for intended use and compatible with sheet waterproofing.
- B. Primer: Liquid waterborne primer recommended for substrate by sheet-waterproofing material manufacturer.
- C. Surface Conditioner: Liquid, waterborne surface conditioner recommended for substrate by sheet-waterproofing material manufacturer.
- D. Liquid Membrane: Elastomeric, two-component liquid, cold fluid applied, of trowel grade or low viscosity.
- E. Substrate Patching Membrane: Low-viscosity, two-component, modified asphalt coating.
- F. Metal Termination Bars: Aluminum bars, approximately 1 by 1/8 inch (25 by 3 mm) thick, predrilled at 9-inch (229-mm) centers.
- G. Protection Course: ASTM D 6506, semirigid sheets of fiberglass or mineral-reinforcedasphaltic core, pressure laminated between two asphalt-saturated fibrous liners and as follows:
 - 1. Thickness: 1/8 inch (3 mm), nominal, for vertical applications; 1/4 inch (6 mm), nominal, elsewhere.
 - 2. Adhesive: Rubber-based solvent type recommended by waterproofing manufacturer for protection course type.

2.4 MOLDED-SHEET DRAINAGE PANELS (AT WALLS TALLER THAN 6 FEET)

A. High-Capacity, Molded-Sheet Collector-Panel System: Composite subsurface collector-panel system by same manufacturer as primary molded-sheet drainage panels; consisting of a high-

profile, studded, nonbiodegradable, molded-plastic-sheet drainage core; with a wovengeotextile facing with an apparent opening size not exceeding No. 40 (0.425-mm) sieve laminated to one side of the core and a polymeric film bonded to the other side; and with a vertical flow rate of 9 to 15 gpm per ft. (112 to 188 L/min. per m) and a horizontal flow rate. Provide system with manufacturer's outlets, connectors, tapes, and other accessories to connect primary molded-sheet drainage panels with piped subdrainage system specified in Section 334600 "Subdrainage."

- 1. <u>Products</u>: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. <u>Carlisle Coatings & Waterproofing Inc;</u> CCW QuickDRAIN.
 - b. <u>Grace Construction Products; W.R. Grace & Co. -- Conn</u>; Hydroduct Coil 600.

2.5 INSULATION

- A. Board Insulation: Extruded-polystyrene board insulation complying with ASTM C 578, square edged.
 - 1. <u>Manufacturers</u>: Subject to compliance with requirements, provide products by one of the following:
 - a. <u>Dow Chemical Company (The)</u>; STYROFOAM Brand Square Edge Insulation.
 - b. <u>Owens Corning Insulating Systems LLC</u>.
 - 2. Type VI, 40-psi (276-kPa) minimum compressive strength.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the waterproofing.
 - 1. Verify that concrete has cured and aged for minimum time period recommended in writing by waterproofing manufacturer.
 - 2. Verify that substrate is visibly dry and within the moisture limits recommended in writing by manufacturer. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

A. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for waterproofing application.

- B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.
- C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
- D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids.
- E. Prepare, fill, prime, and treat joints and cracks in substrates. Remove dust and dirt from joints and cracks according to ASTM D 4258.
- F. Bridge and cover isolation joints, expansion joints and discontinuous deck-to-wall and deck-todeck joints with overlapping sheet strips of widths according to manufacturer's written instructions.
 - 1. Invert and loosely lay first sheet strip over center of joint. Firmly adhere second sheet strip to first and overlap to substrate.
- G. Corners: Prepare, prime, and treat inside and outside corners according to ASTM D 6135.
 - 1. Install membrane strips centered over vertical inside corners. Install 3/4-inch (19-mm) fillets of liquid membrane on horizontal inside corners and as follows:
 - a. At footing-to-wall intersections, extend liquid membrane in each direction from corner or install membrane strip centered over corner.
- H. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through waterproofing and at drains and protrusions according to ASTM D 6135.

3.3 MODIFIED BITUMINOUS SHEET-WATERPROOFING APPLICATION

- A. Install modified bituminous sheets according to waterproofing manufacturer's written instructions and recommendations in ASTM D 6135.
- B. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by sheet waterproofing in same day. Reprime areas exposed for more than 24 hours.
- C. Apply and firmly adhere sheets over area to receive waterproofing. Accurately align sheets and maintain uniform 2-1/2-inch- (64-mm-) minimum lap widths and end laps. Overlap and seal seams, and stagger end laps to ensure watertight installation.
 - 1. When ambient and substrate temperatures range between 25 and 40 deg F (minus 4 and plus 5 deg C), install self-adhering, modified bituminous sheets produced for low-temperature application. Do not use low-temperature sheets if ambient or substrate temperature is higher than 60 deg F (16 deg C).
- D. Apply continuous sheets over already-installed sheet strips, bridging substrate cracks, construction, and contraction joints.

- E. Seal edges of sheet-waterproofing terminations with mastic.
- F. Install sheet-waterproofing and auxiliary materials to tie into adjacent waterproofing.
- G. Repair tears, voids, and lapped seams in waterproofing not complying with requirements. Slit and flatten fishmouths and blisters. Patch with sheet waterproofing extending 6 inches (150 mm) beyond repaired areas in all directions.
- H. Immediately install protection course with butted joints over waterproofing membrane.
 - 1. Molded-sheet drainage panels Insulation drainage panels or Board insulation may be used in place of a separate protection course to vertical applications when approved by waterproofing manufacturer and installed immediately.

3.4 MOLDED-SHEET DRAINAGE-PANEL INSTALLATION

- A. Place and secure molded-sheet drainage panels, with geotextile facing away from wall or deck substrate, according to manufacturer's written instructions. Use adhesives or other methods that do not penetrate waterproofing. Lap edges and ends of geotextile to maintain continuity. Protect installed molded-sheet drainage panels during subsequent construction.
 - 1. For vertical applications, install board insulation before installing drainage panels.

3.5 INSULATION INSTALLATION

- A. Install one or more layers of board insulation to achieve required thickness over waterproofed surfaces. Cut and fit to within 3/4 inch (19 mm) of projections and penetrations.
- B. On vertical surfaces, set insulation units in adhesive or tape applied according to manufacturer's written instructions.

3.6 PROTECTION, REPAIR, AND CLEANING

- A. Do not permit foot or vehicular traffic on unprotected membrane.
- B. Protect waterproofing from damage and wear during remainder of construction period.
- C. Protect installed board insulation and insulation drainage panels from damage due to UV light, harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.
- D. Correct deficiencies in or remove waterproofing that does not comply with requirements; repair substrates, reapply waterproofing, and repair sheet flashings.
- E. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 071326

SECTION 072100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Foam-plastic board insulation.
 - 2. Glass-fiber blanket insulation.
 - 3. Mineral-wool blanket insulation.
 - 4. Spray polyurethane foam insulation.
- B. Related Sections:
 - 1. Section 042000 "Unit Masonry" for insulation installed in cavity walls and masonry cells.
 - 2. Section 071326 "Self-Adhering Sheet Waterproofing" for insulated drainage panels installed with waterproofing.
 - 3. Section 075216 "Styrene-Butadiene-Styrene (SBS) Modified Bituminous Membrane Roofing" and Section 075419 Polyvinyl-Chloride (PVC) Roofing" for insulation specified as part of roofing construction.
 - 4. Section 078446 "Fire-Resistive Joint Systems" for insulation installed as part of a perimeter fire-resistive joint system.
 - 5. Section 092116.23 "Gypsum Board Shaft Wall Assemblies" for installation in metalframed assemblies of insulation specified by referencing this Section.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each product.
- B. Research/Evaluation Reports: For foam-plastic insulation, from ICC-ES.

1.5 QUALITY ASSURANCE

A. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.
- B. Protect foam-plastic board insulation as follows:
 - 1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
 - 2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site before installation time.
 - 3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 - PRODUCTS

2.1 FOAM-PLASTIC BOARD INSULATION

- A. Extruded-Polystyrene Board Insulation: ASTM C 578, of type and minimum compressive strength indicated below, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.
- B. Basis-of-Design Product: Subject to compliance with requirements, provide **Dow Chemical Company "Cavitymate Ultra"** or comparable product by one of the following:
 - 1. DiversiFoam Products.
 - 2. Owens Corning.
 - 3. Pactiv Building Products.
 - 4. Type IV, 25 psi (173 kPa).
- C. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

2.2 GLASS-FIBER BLANKET INSULATION

- A. <u>Manufacturers</u>: Subject to compliance with requirements, provide products by one of the following:
 - 1. <u>CertainTeed Corporation</u>.

- 2. <u>Guardian Building Products, Inc</u>.
- 3. Johns Manville.
- 4. <u>Knauf Insulation</u>.
- 5. <u>Owens Corning</u>.
- B. Unfaced, Glass-Fiber Blanket Insulation: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

2.3 MINERAL-WOOL BLANKET INSULATION

- A. <u>Manufacturers</u>: Subject to compliance with requirements, provide products by one of the following:
 - 1. <u>Fibrex Insulations Inc</u>.
 - 2. <u>Owens Corning</u>.
 - 3. Roxul Inc.
 - 4. <u>Thermafiber</u>.
- B. Unfaced, Mineral-Wool Blanket Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

2.4 SPRAY POLYURETHANE FOAM INSULATION

- A. Closed-Cell Polyurethane Foam Insulation: ASTM C 1029, Type II, with maximum flamespread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.
 - 1. <u>Manufacturers</u>: Subject to compliance with requirements, provide products by one of the following:
 - a. <u>BASF Corporation</u>.
 - b. <u>BaySystems NorthAmerica, LLC</u>.
 - c. <u>Dow Chemical Company (The)</u>.
 - d. <u>ERSystems, Inc</u>.
 - e. <u>Gaco Western Inc</u>.
 - f. <u>Henry Company</u>.
 - g. <u>NCFI; Division of Barnhardt Mfg. Co</u>.
 - h. <u>SWD Urethane Company</u>.
 - i. <u>Volatile Free, Inc</u>.
 - 2. Minimum density of 1.5 lb/cu. ft. (24 kg/cu. m), thermal resistivity of 6.2 deg F x h x sq. ft./Btu x in. at 75 deg F (43 K x m/W at 24 deg C).

2.5 INSULATION FASTENERS

- A. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position indicated with self-locking washer in place.
 - 1. Plate: Perforated, galvanized carbon-steel sheet, 0.030 inch (0.762 mm) thick by 2 inches (50 mm) square.
 - 2. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inch (2.67 mm) in diameter; length to suit depth of insulation indicated.
- B. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates indicated without damaging insulation, fasteners, and substrates.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of substances that are harmful to insulation or that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications indicated.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. Extend insulation to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.3 INSTALLATION OF CAVITY-WALL INSULATION

- A. Foam-Plastic Board Insulation: Install pads of adhesive spaced approximately 24 inches (610 mm) o.c. both ways on inside face, and as recommended by manufacturer. Fit courses of insulation between wall ties and other obstructions, with edges butted tightly in both directions. Press units firmly against inside substrates.
 - 1. Supplement adhesive attachment of insulation by securing boards with two-piece wall ties designed for this purpose and specified in Section 042000 "Unit Masonry."

3.4 INSTALLATION OF INSULATION FOR FRAMED CONSTRUCTION

- A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.
- B. Foam-Plastic Board Insulation: Seal joints between units by applying adhesive, mastic, or sealant to edges of each unit to form a tight seal as units are shoved into place. Fill voids in completed installation with adhesive, mastic, or sealant as recommended by insulation manufacturer.
- C. Glass-Fiber or Mineral-Wool Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
 - 1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
 - 2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
 - 3. Maintain 3-inch (76-mm) clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
 - 4. For metal-framed wall cavities where cavity heights exceed 96 inches (2438 mm), support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.
- D. Spray-Applied Insulation: Apply spray-applied insulation according to manufacturer's written instructions. Do not apply insulation until installation of pipes, ducts, conduits, wiring, and electrical outlets in walls is completed and windows, electrical boxes, and other items not indicated to receive insulation are masked. After insulation is applied, make flush with face of studs by using method recommended by insulation manufacturer.
- E. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:
 - 1. Loose-Fill Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft. (40 kg/cu. m).
 - 2. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.

3.5 INSTALLATION OF INSULATION IN CEILINGS FOR SOUND ATTENUATION

Where glass-fiber blankets are indicated for sound attenuation above ceilings, install blanket insulation over entire ceiling area in thicknesses indicated. Extend insulation 48 inches (1219 mm) up either side of partitions.

3.6 INSTALLATION OF INSULATION FOR CONCRETE SUBSTRATES

A. Install board insulation on concrete substrates by adhesively attached, spindle-type insulation anchors as follows:

- 1. Fasten insulation anchors to concrete substrates with insulation anchor adhesive according to anchor manufacturer's written instructions. Space anchors according to insulation manufacturer's written instructions for insulation type, thickness, and application indicated.
- 2. Apply insulation standoffs to each spindle to create cavity width indicated between concrete substrate and insulation.
- 3. After adhesive has dried, install board insulation by pressing insulation into position over spindles and securing it tightly in place with insulation-retaining washers, taking care not to compress insulation below indicated thickness.
- 4. Where insulation will not be covered by other building materials, apply capped washers to tips of spindles.

3.7 **PROTECTION**

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

3.8 INSULATION SCHEDULE

- A. Insulation Type I-2 Unfaced, glass-fiber blanket insulation.
- B. Insulation Type I-3 Unfaced, mineral-wool blanket insulation.
- C. Insulation Type I-4 Polyurethane spray foam insulation.

END OF SECTION 072100

SECTION 071900 – CONCRETE SEALERS AND WATER REPELLENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes penetrating concrete sealer and water-repellent treatments for the following vertical and horizontal surfaces:
 - 1. Cast-in-place concrete.
- B. Related Sections:
 - 1. Section 033000, CAST-IN-PLACE CONCRETE.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. Include manufacturer's printed statement of VOC content.
 - 2. Include manufacturer's recommended number of coats for each type of substrate and spreading rate for each separate coat.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Applicator.
- B. Product Certificates: For each type of sealer and water repellent, from manufacturer.
- C. Field quality-control reports.
- D. Warranty: Special warranty specified in this Section.
- 1.4 QUALITY ASSURANCE
 - A. Applicator Qualifications: An employer of workers trained and approved by manufacturer.

1.5 PROJECT CONDITIONS

- A. Limitations: Proceed with application only when the following existing and forecasted weather and substrate conditions permit water repellents to be applied according to manufacturers' written instructions and warranty requirements:
 - 1. Concrete surfaces have cured for not less than 28 days.
 - 2. Ambient temperature is above 40 deg F (4.4 deg C) and below 100 deg F (37.8 deg C) and will remain so for 24 hours.
 - 3. Substrate is not frozen and substrate-surface temperature is above 40 deg F (4.4 deg C) and below 100 deg F (37.8 deg C).
 - 4. Rain or snow is not predicted within 24 hours.

5. Not less than 24 hours have passed since surfaces were last wet.

PART 2 - PRODUCTS

2.1 PENETRATING CONCRETE SEALER/HARDENER

- A. Provide one of the following, or approved equal:
 - 1. The Ashford Formular; Curecrete Distribution Inc.
 - 2. Chemisil Plus; ChemMasters.
 - 3. ChemTec One; ChemTec Int'l.

2.2 PENETRATING WATER REPELLENTS

- A. Silicone Rubber Water Repellent: Clear, single component water repellant; and with 100 g/L or less of VOCs.
 - 1. Products: Subject to compliance with requirements, provide the following:
 - a. Tnemec Co., Inc.; Series V626 Dur A Pell.
 - b. Euclid Chemical Company (The), an RPM company; Approved equal.
 - c. PROSOCO, Inc.; Approved equal.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements and conditions affecting performance of the Work.
 - 1. Verify that surfaces are clean and dry according to concrete sealer and water-repellent manufacturer's requirements. Check moisture content in three representative locations by method recommended by manufacturer.
 - 2. Inspect for previously applied treatments that may inhibit penetration or performance of sealers and water repellents.
 - 3. Verify that there is no efflorescence or other removable residues that would be trapped beneath the application of sealer and water repellent.
 - 4. Verify that required repairs are complete, cured, and dry before applying water repellent.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Cleaning: Before application of sealers and water repellent, clean substrate of substances that could impair penetration or performance of product according to manufacturer's written instructions and as follows:
 - 1. Concrete: Remove oil, curing compounds, laitance, and other substances that inhibit penetration or performance of sealers and water repellents.

- B. Protect adjoining work, including mortar and sealant bond surfaces, from spillage or blow-over of sealers and water repellent. Cover adjoining and nearby surfaces of aluminum and glass if there is the possibility of sealer and water repellent being deposited on surfaces. Cover live vegetation.
- C. Coordination with Sealant Joints: Do not apply sealers or water repellent until sealants for joints adjacent to surfaces receiving water-repellent treatment have been installed and cured.
 - 1. Water-repellent work may precede sealant application only if sealant adhesion and compatibility have been tested and verified using substrate, water repellent, and sealant materials identical to those required.

3.3 FIRST COAT, SEALER APPLICATION

- A. Comply with manufacturer's recommendations and printed instructions.
- B. Apply a heavy-saturation coating sealer on surfaces indicated for treatment, using **spray**, **roller or brush** to the point of saturation. Allow material to dwell for period of time as recommended by manufacturer. Comply with manufacturer's written instructions for application procedure unless otherwise indicated.
- C. Remove excess sealer material that has not penetrated as recommended by manufacturer.

3.4 SECOND COAT, WATER REPELLANT APPLICATION

A. Apply a heavy-saturation coating of water repellent, on surfaces indicated for treatment, using low pressure **spray** to the point of saturation. Apply coating in dual passes of uniform, overlapping strokes. Remove excess material; do not allow material to puddle beyond saturation. Comply with manufacturer's written instructions for application procedure unless otherwise indicated.

3.5 FIELD QUALITY CONTROL

- A. Coverage Test: In the presence of Architect, hose down a dry, repellent-treated surface to verify complete and uniform product application. A change in surface color will indicate incomplete application.
 - 1. Notify Architect seven days in advance of the dates and times when surfaces will be tested.
 - 2. Reapply water repellent until coverage test indicates complete coverage.

3.6 CLEANING

- A. Immediately clean sealer and water repellent from adjoining surfaces and surfaces soiled or damaged by water-repellent application as work progresses. Correct damage to work of other trades caused by sealer and water-repellent application, as approved by Architect.
- B. Comply with manufacturer's written cleaning instructions.

University of South Carolina Softball Stadium Construction BID SET

END OF SECTION

Architect's Project No. 11.122.00 State Project No. H27-6088-MJ 03/16/12
SECTION 07 24 13 - POLYMER-BASED EXTERIOR FINISH SYSTEM (DEFS)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Direct applied Exterior Finish System (DEFS) applied over Glass-Mat Gypsum sheathing substrate.
- B. Related Sections:
 - 1. Division 06 Section "Sheathing" for Glass-Mat Gypsum sheathing.
 - 2. Division 07 Section "Joint Sealants" for sealing joints in DEFS with elastomeric joint sealants.

1.3 SYSTEM DESCRIPTION

A. Direct Applied Exterior Finish System (DEFS): A non-load-bearing, exterior cladding system that consists of a exterior sheathing substrate; an integrally reinforced base coat; and a textured protective finish coat.

1.4 PERFORMANCE REQUIREMENTS

- A. DEFS Performance: Comply with the following:
 - 1. Bond Integrity: Free from bond failure within DEFS components or between system and supporting construction assemblies, resulting from exposure to fire, wind loads, weather, or other in-service conditions.
 - 2. Weathertightness: Resistant to water penetration from exterior into DEFS and assemblies behind it or through them into interior of building that results in deterioration of DEFS and assemblies behind it, including substrates, supporting wall construction, and interior finish.

1.5 SUBMITTALS

A. Product Data: For each type and component of DEFS and trim accessories indicated.

- B. Shop Drawings: For DEFS. Include plans, elevations, sections, details of components, details of penetration and termination, flashing details, joint locations and configurations, fastening and anchorage details including mechanical fasteners, and connections and attachments to other work.
- C. Samples for Initial Selection: For each type of finish-coat color and texture indicated.
 - 1. Include similar Samples of joint sealants and exposed accessories involving color selection.
- D. Qualification Data: For Installer.
- E. Manufacturer Certificates: Signed by manufacturers certifying that DEFS and joint sealants comply with requirements.
- F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each reinforcing mesh, joint sealant, and coating.
- G. Compatibility and Adhesion Test Reports: For joint sealants from sealant manufacturer indicating the following:
 - 1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
 - 2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.
- H. Field quality-control reports and special inspection reports.
- I. Maintenance Data: For DEFS to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An installer who is certified in writing by DEFS manufacturer as qualified to install manufacturer's system using trained workers.
- B. Source Limitations: Obtain DEFS from single source from single DEFS manufacturer and from sources approved by DEFS manufacturer as compatible with system components.
- C. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution and set quality standards for fabrication and installation.
 - 1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- D. Preinstallation Conference: Conduct conference at Project site.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original, unopened packages with manufacturers' labels intact and clearly identifying products.
- B. Store materials inside and under cover; keep them dry and protected from weather, direct sunlight, surface contamination, aging, corrosion, damaging temperatures, construction traffic, and other causes.

1.8 PROJECT CONDITIONS

- A. Weather Limitations: Maintain ambient temperatures above 40 deg F (4.4 deg C) for a minimum of 24 hours before, during, and after adhesives or coatings are applied. Do not apply DEFS adhesives or coatings during rainfall. Proceed with installation only when existing and forecasted weather conditions and ambient outdoor air, humidity, and substrate temperatures permit DEFS to be applied, dried, and cured according to manufacturers' written instructions and warranty requirements.
- B. Field Measurements: Verify actual dimensions required for prefabricated panels by field measurements before fabrication.

1.9 COORDINATION

A. Coordinate installation of DEFS with related Work specified in other Sections to ensure that wall assemblies, including sheathing, flashing, trim, joint sealants, windows, and doors, are protected against damage from the effects of weather, age, corrosion, moisture, and other causes. Do not allow water to penetrate behind flashing and barrier coating of DEFS.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Dryvit Systems, Inc.
 - 2. Parex, Inc.; a brand of ParexLahabra, Inc.
 - 3. Sto Corp.

2.2 MATERIALS

A. Compatibility: Provide adhesive, fasteners, board insulation, reinforcing meshes, base- and finish-coat systems, sealants, and accessories that are compatible with one another and with substrates and approved for use by DEFS manufacturer for Project.

- B. Primer/Sealer: DEFS manufacturer's standard substrate conditioner designed to seal substrates from moisture penetration and to improve the bond between substrate of type indicated and adhesive used for application of insulation.
- C. Reinforcing Mesh: Balanced, alkali-resistant, open-weave, glass-fiber mesh treated for compatibility with other DEFS materials, made from continuous multiend strands with retained mesh tensile strength of not less than 120 lbf/in. (21 dN/cm) per ASTM E 2098; complying with ASTM D 578 and the following:
 - 1. Intermediate-Impact Reinforcing Mesh: Not less than 10 oz./sq. yd. (339 g/sq. m).
 - 2. Detail Reinforcing Mesh: Not less than 4.0 oz./sq. yd. (136 g/sq. m).
 - 3. Corner Reinforcing Mesh: Not less than 7.2 oz./sq. yd. (244 g/sq. m).
- D. Base-Coat Materials: DEFS manufacturer's standard mixture complying with the following:
 - 1. Factory-blended dry formulation of portland cement, dry polymer admixture, and inert fillers to which only water is added at Project site.
- E. Waterproof Adhesive/Base-Coat Materials: DEFS manufacturer's standard waterproof formulation complying with the following:
 - 1. Job-combined formulation of manufacturer's standard polymer-emulsion adhesive and manufacturer's standard dry mix containing portland cement.
- F. Primer: DEFS manufacturer's standard factory-mixed, elastomeric-polymer primer for preparing base-coat surface for application of finish coat.
- G. Finish-Coat Materials: DEFS manufacturer's standard acrylic-based coating complying with the following:
 - 1. Factory-mixed formulation of polymer-emulsion binder, colorfast mineral pigments, sound stone particles, and fillers.
 - 2. Sealer: Manufacturer's waterproof, clear acrylic-based sealer for protecting finish coat.
 - 3. Colors: As selected by Architect from manufacturer's full range.
- H. Water: Potable.
- I. Trim Accessories: Type as designated or required to suit conditions indicated and to comply with DEFS manufacturer's written instructions; manufactured from extruded aluminum alloy 6063 T5, with clear anodized finish.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide products designated below as manufactured by **Fry Reglet Corporation**, or comparable products by other manufacturers submitted for acceptance within the bidding period and approved in accordance with Division 00 Section 00900 "Submittal of Substitutions":
 - a. "J" Molding: JDM-50
 - b. Soffit Vent: DRM-50-V-300.

2.3 ELASTOMERIC SEALANTS

- A. Elastomeric Sealant Products: Provide DEFS manufacturer's listed and recommended chemically curing, elastomeric sealant that is compatible with joint fillers, joint substrates, and other related materials, and complies with requirements for products and testing indicated in ASTM C 1481 and with requirements in Division 07 Section "Joint Sealants" for products corresponding to description indicated below:
 - 1. Single-component, nonsag, neutral-curing silicone sealant.
- B. Sealant Color: As selected by Architect from manufacturer's full range.

2.4 MIXING

A. General: Comply with DEFS manufacturer's requirements for combining and mixing materials. Do not introduce admixtures, water, or other materials except as recommended by DEFS manufacturer. Mix materials in clean containers. Use materials within time period specified by DEFS manufacturer or discard.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of DEFS.
- B. Examine roof edges, wall framing, flashings, openings, substrates, and junctures at other construction for suitable conditions where DEFS will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.
 - 1. Begin coating application only after surfaces are dry.
 - 2. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Protect contiguous work from moisture deterioration and soiling caused by application of DEFS. Provide temporary covering and other protection needed to prevent spattering of exterior finish coats on other work.
- B. Protect DEFS, substrates, and wall construction behind them from inclement weather during installation. Prevent penetration of moisture behind DEFS and deterioration of substrates.
- C. Prepare and clean substrates to comply with DEFS manufacturer's written instructions to obtain optimum bond between substrate and adhesive for insulation.

3.3 DEFS INSTALLATION, GENERAL

A. Comply with ASTM C 1397 and DEFS manufacturer's written instructions for installation of DEFS as applicable to each type of substrate indicated.

3.4 SUBSTRATE PROTECTION APPLICATION

A. Primer/Sealer: Apply over glass-mat gypsum sheathing substrates to protect substrates from degradation and where required by DEFS manufacturer.

3.5 TRIM INSTALLATION

- A. Trim: Apply trim accessories at perimeter of DEFS, at control joints, and elsewhere as indicated, according to DEFS manufacturer's written instructions. Coordinate with installation of insulation.
 - 1. Casing Bead: Use at sheathing perimeter and to form control joints.
 - 2. Soffit Vent: Use where indicated on Drawings.

3.6 BASE-COAT INSTALLATION

- A. Base Coat: Apply to exposed surfaces in minimum thickness recommended in writing by DEFS manufacturer, but not less than 1/16-inch (1.6-mm) dry-coat thickness.
- B. Reinforcing Mesh: Embed type indicated below in wet base coat to produce wrinkle-free installation with mesh continuous at corners and overlapped not less than 2-1/2 inches (64 mm) or otherwise treated at joints to comply with ASTM C 1397 and DEFS manufacturer's written instructions. Do not lap reinforcing mesh within 8 inches (204 mm) of corners. Completely embed mesh, applying additional base-coat material if necessary, so reinforcing-mesh color and pattern are not visible.
 - 1. Intermediate-impact reinforcing mesh.
- C. Additional Reinforcing Mesh: Apply strip reinforcing mesh around openings extending 4 inches (100 mm) beyond perimeter. Apply additional 9-by-12-inch (230-by-300-mm) strip reinforcing mesh diagonally at corners of openings (re-entrant corners). Apply 8-inch- (200-mm-) wide strip reinforcing mesh at both inside and outside corners unless base layer of mesh is lapped not less than 4 inches (100 mm) on each side of corners.
 - 1. At trim accessories, apply strip reinforcing mesh not less than 8 inches (200 mm) wide.
 - 2. Embed strip reinforcing mesh in base coat before applying first layer of reinforcing mesh.

3.7 FINISH-COAT INSTALLATION

A. Primer: Apply over dry base coat according to DEFS manufacturer's written instructions.

- B. Finish Coat: Apply over dry primed base coat, maintaining a wet edge at all times for uniform appearance, in thickness required by DEFS manufacturer to produce a uniform finish of color and texture matching approved sample and free of cold joints, shadow lines, and texture variations.
 - 1. Texture: As selected by Architect from manufacturer's full range.
- C. Sealer Coat: Apply over dry finish coat, in number of coats and thickness required by DEFS manufacturer.

3.8 INSTALLATION OF JOINT SEALANTS

- A. Prepare joints and apply sealants, of type and at locations indicated, to comply with applicable requirements in Division 07 Section "Joint Sealants" and in ASTM C 1481.
 - 1. Apply joint sealants after base coat has cured but before applying finish coat.
 - 2. Clean surfaces to receive sealants to comply with indicated requirements and DEFS manufacturer's written instructions.
 - 3. Apply primer recommended in writing by sealant manufacturer for surfaces to be sealed.
 - 4. Install sealant backing to control depth and configuration of sealant joint and to prevent sealant from adhering to back of joint.
 - 5. Apply masking tape to protect areas adjacent to sealant joints. Remove tape immediately after tooling joints, without disturbing joint seal.

3.9 CLEANING AND PROTECTION

A. Remove temporary covering and protection of other work. Promptly remove coating materials from adjacent surfaces outside areas indicated to receive DEFS coatings.

END OF SECTION 07 24 13

SECTION 072500 - WEATHER BARRIERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

1.2 SUMMARY

- A. Section Includes:
 - 1. Underlayment materials.
 - 2. Building wrap.
 - 3. Flexible flashing.
- B. Related Requirements:
 - 1. Section 061600 "Sheathing" for sheathing joint and penetration treatment.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. For building wrap, include data on air and water-vapor permeance based on testing according to referenced standards.

1.4 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For water-resistive barrier and flexible flashing, from ICC-ES.

PART 2 - PRODUCTS

2.1 UNDERLAYMENT MATERIALS

- A. Self-Adhering, High-Temperature Sheet: 30 to 40 mils (0.76 to 1.0 mm) thick minimum, consisting of slip-resisting, polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.
 - 1. Thermal Stability: Stable after testing at 240 deg F (116 deg C); ASTM D 1970.
 - 2. Low-Temperature Flexibility: Passes after testing at minus 20 deg F (29 deg C); ASTM D 1970.
 - 3. <u>Products:</u> Subject to compliance with requirements, provide one of the following:

- a. <u>Carlisle Coatings & Waterproofing Inc.</u>, Div. of Carlisle Companies Inc.; CCW WIP 300HT.
- b. <u>Grace Construction Products; a unit of Grace, W. R. & Co.; Ultra.</u>
- c. <u>Henry Company</u>; Blueskin PE200 HT.
- d. <u>Metal-Fab Manufacturing, LLC</u>; MetShield.
- e. <u>Owens Corning</u>; WeatherLock Metal High Temperature Underlayment.

2.2 WATER-RESISTIVE BARRIER

- A. Building Wrap: ASTM E 1677, Type I air barrier; with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, when tested according to ASTM E 84; UV stabilized; and acceptable to authorities having jurisdiction.
 - 1. <u>Products</u>: Subject to compliance with requirements, provide one of the following:
 - a. <u>DuPont (E. I. du Pont de Nemours and Company)</u>; Tyvek CommercialWrap.
 - b. <u>Pactiv, Inc</u>.; GreenGuard Ultra Wrap.
 - c. <u>Raven Industries Inc</u>.; Fortress Pro Weather Protective Barrier.
 - 2. Water-Vapor Permeance: Not less than 50 g through 1 sq. m of surface in 24 hours per ASTM E 96/E 96M, Desiccant Method (Procedure A).
 - 3. Allowable UV Exposure Time: Not less than three months.
- B. Building-Wrap Tape: Pressure-sensitive plastic tape recommended by building-wrap manufacturer for sealing joints and penetrations in building wrap.

2.3 MISCELLANEOUS MATERIALS

- A. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, rubberized-asphalt compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.040 inch (1.0 mm), 12-inch wide roll.
 - 1. <u>Products</u>: Subject to compliance with requirements, provide one of the following:
 - a. <u>Carlisle Coatings & Waterproofing</u>; CCW-705-TWF Thru-Wall Flashing.
 - b. <u>Fortifiber Building Systems Group</u>; Fortiflash 40.
 - c. <u>Grace Construction Products, a unit of W. R. Grace & Co. Conn.</u>; Vycor V40 Self-Adhered Flashing.
- B. Primer for Flexible Flashing: Product recommended by manufacturer of flexible flashing for substrate.

PART 3 - EXECUTION

3.1 UNDERLAYMENT INSTALLATION

- A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply at locations indicated below, wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches (150 mm) staggered 24 inches (600 mm) between courses. Overlap side edges not less than 3-1/2 inches (90 mm). Roll laps with roller. Cover underlayment within 14 days.
 - 1. Apply where indicated over exterior sheathing.
- B. Install flashings to cover underlayment to comply with requirements specified in Section 076200 "Sheet Metal Flashing and Trim."

3.2 WATER-RESISTIVE BARRIER INSTALLATION

- A. Cover exposed exterior surface of sheathing with water-resistive barrier securely fastened to framing immediately after sheathing is installed.
- B. Cover sheathing with water-resistive barrier as follows:
 - 1. Cut back barrier 1/2 inch (13 mm) on each side of the break in supporting members at expansion- or control-joint locations.
 - 2. Apply barrier to cover vertical flashing with a minimum 4-inch (100-mm) overlap unless otherwise indicated.
- C. Building Wrap: Comply with manufacturer's written instructions.
 - 1. Seal seams, edges, fasteners, and penetrations with tape.
 - 2. Extend into jambs of openings and seal corners with tape.

3.3 FLEXIBLE FLASHING INSTALLATION

- A. Apply flexible flashing where indicated to comply with manufacturer's written instructions.
 - 1. Prime substrates as recommended by flashing manufacturer.
 - 2. Lap seams and junctures with other materials at least 4 inches (100 mm) except that at flashing flanges of other construction, laps need not exceed flange width.
 - 3. Lap flashing over water-resistive barrier at bottom and sides of openings.
 - 4. Lap water-resistive barrier over flashing at heads of openings.
 - 5. After flashing has been applied, roll surfaces with a hard rubber or metal roller to ensure that flashing is completely adhered to substrates.

END OF SECTION 072500

SECTION 072600 – UNDER SLAB VAPOR BARRIER

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Products furnished under this section, and installed in coordination with related sections include the following:
 - 1. Vapor barrier, seam tape, vapor proofing mastic, pipe boots, detail strip for installation under concrete slabs.
- B. Related Sections:
 - 1. Division 03 Section "Cast-In-Place Concrete" for concrete floor slabs.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Material Certificates: For each product, signed by manufacturers.
- C. Samples for verification: (2) 6" x 6" samples of plastic vapor barrier, seamed together along one side using manufacturer's seam tape, to form a single 6" x 12" sample.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain primary materials and accessories through one source from a single manufacturer.

1.5 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit vapor retarder to be installed according to manufacturers' written instructions.

PART 2 - PRODUCTS

2.1 PLASTIC VAPOR BARRIER

- A. Vapor barrier membrane that meets or exceeds the following properties:
 - 1. Permeance rating: ASTM E 96 or ASTM F 1249, meets permeance requirements for both new material, and after ASTM E-1745 mandatory conditioning tests (ASTM E 154; Sections 8, 11, 12, 13):
 - a. New material: Less than 0.01 perms.
 - b. After conditioning: Less than 0.01 perms.
 - 2. Water Vapor Retarder: ASTM E 1745, Class A
 - 3. Minimum thickness : 15 mils, ACI 302.1R-06.
 - 4. Manufactured from prime virgin resins.
 - 5. Woven materials are not acceptable.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. StegoWrap, Stego Industries LLC.
 - 2. VaporBlock VB15, Raven Industries.
 - 3. Viper VaporCheck II, Insulation Solutions, Inc.

2.2 MISCELLANEOUS MATERIALS

- A. Seam Tape: ASTM E 96, Water Vapor Transmission Rate 0.3 perms or lower.
- B. Vapor Proofing mastic: ASTM E 96, Water Vapor Transmission Rate 0.3 perms or lower.
- C. Pipe boots: Construct pipe boots from vapor retarder material, pressure sensitive tape and/or mastic per manufacturer's instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine slab base course, with Installer present, for compliance with requirements for surface stability and other conditions affecting performance of work.
 - 1. Proceed with vapor barrier installation only after base course construction and penetrating work have been completed and unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Coordinate installation of the under slab vapor barrier in conjunction with the drawings and with the work specified in Division 3, Section 03 30 00 "Cast-In-Place Concrete".
- B. Comply with manufacturer's written recommendations and ASTM E 1643-98 (2005), unless more stringent requirements are indicated or required by Project conditions to ensure satisfactory performance of vapor barrier.
 - 1. Unroll vapor barrier with the longest dimension parallel in the direction of the concrete pour.
 - 2. Lap vapor barrier over footings or seal to foundation walls.
 - 3. Overlap joints 6 inches and seal with manufacturer's tape.
 - 4. Seal all penetrations (including pipes) per manufacturer's instructions.
 - 5. Do not penetrate the vapor barrier except where necessary for reinforcing steel and permanent utilities.
 - 6. Repair damaged areas by cutting patches of vapor barrier, overlapping damaged area 6 inches and taping all four sides with seam tape.

END OF SECTION 072600

SECTION 074113.16 - STANDING-SEAM METAL ROOF PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes standing-seam metal roof panels.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Meet with Owner, Architect, Owner's insurer if applicable, metal panel Installer, metal panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects metal panels, including installers of roof accessories and roof-mounted equipment.
 - 2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 3. Review methods and procedures related to metal panel installation, including manufacturer's written instructions.
 - 4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
 - 5. Review structural loading limitations of deck purlins and rafters during and after roofing.
 - 6. Review flashings, special details, drainage, penetrations, equipment curbs, and condition of other construction that affect metal panels.
 - 7. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
 - 8. Review temporary protection requirements for metal panel systems during and after installation.
 - 9. Review procedures for repair of metal panels damaged after installation.
 - 10. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.

- B. Shop Drawings:
 - 1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
 - 2. Accessories: Include details of the flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches (1:10).
- C. Samples for Initial Selection: For each type of metal panel indicated with factory-applied color finishes.
 - 1. Include similar Samples of trim and accessories involving color selection.
- D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.
 - 1. Metal Panels: 12 inches (305 mm) long by actual panel width. Include clips, fasteners, closures, and other metal panel accessories.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For each product, for tests performed by a qualified testing agency.
- C. Field quality-control reports.
- D. Sample Warranties: For special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal panels to include in maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. UL-Certified, Portable Roll-Forming Equipment: UL-certified, portable roll-forming equipment capable of producing metal panels warranted by manufacturer to be the same as factory-formed products. Maintain UL certification of portable roll-forming equipment for duration of work.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.

- B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.
- D. Retain strippable protective covering on metal panels during installation.

1.9 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

1.10 COORDINATION

- A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.
- B. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.11 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including rupturing, cracking, or puncturing.
 - b. Deterioration of metals and other materials beyond normal weathering.
 - 2. Warranty Period: Two years from date of Substantial Completion.
- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Finish Warranty Period: 20 years from date of Substantial Completion.

- C. Special Weathertightness Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that fail to remain weathertight, including leaks, within specified warranty period.
 - 1. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 1592:
 - 1. Wind Loads: As indicated on Drawings.
 - 2. Other Design Loads: As indicated on Drawings.
 - 3. Deflection Limits: For wind loads, no greater than 1/180 of the span.
- B. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. (0.3 L/s per sq. m) when tested according to ASTM E 1680 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 6.24 lbf/sq. ft. (300 Pa).
- C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 1646 or ASTM E 331 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 6.24 lbf/sq. ft. (300 Pa).
- D. Hydrostatic-Head Resistance: No water penetration when tested according to ASTM E 2140.
- E. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.
 - 1. Uplift Rating: UL 90.
- F. FM Global Listing: Provide metal roof panels and component materials that comply with requirements in FM Global 4471 as part of a panel roofing system and that are listed in FM Global's "Approval Guide" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Global markings.
 - 1. Fire/Windstorm Classification: Class 1A- 90.
 - 2. Hail Resistance: SH.
- G. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 STANDING-SEAM METAL ROOF PANELS

- A. General: Provide factory-formed metal roof panels designed to be installed by lapping and interconnecting raised side edges of adjacent panels with joint type indicated and mechanically attaching panels to supports using concealed clips in side laps. Include clips, cleats, pressure plates, and accessories required for weathertight installation.
 - 1. Steel Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E 1514.
 - 2. Aluminum Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E 1637.
- B. Vertical-Rib, Seamed-Joint, Standing-Seam Metal Roof Panels: Formed with vertical ribs at panel edges and intermediate stiffening ribs symmetrically spaced between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels, engaging opposite edge of adjacent panels, and mechanically seaming panels together.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. <u>ATAS International, Inc</u>.
 - b. <u>Berridge Manufacturing Company</u>.
 - c. <u>CENTRIA Architectural Systems</u>.
 - d. <u>Dimensional Metals, Inc</u>.
 - e. <u>Fabral</u>.
 - f. <u>Firestone Metal Products, LLC</u>.
 - g. <u>IMETCO</u>.
 - h. <u>McElroy Metal, Inc</u>.
 - i. <u>Merchant & Evans</u>.
 - j. <u>Metal-Fab Manufacturing, LLC</u>.
 - k. Morin; a Kingspan Group company.
 - 1. <u>Petersen Aluminum Corporation</u>.
 - 2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, G90 (Z275) coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, Class AZ50 (Class AZM150) coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 - a. Nominal Thickness: 0.028 inch (0.71 mm).
 - b. Exterior Finish: Mica fluoropolymer.
 - c. Color: Match Architect's samples.
 - 3. Clips: Two-piece floating to accommodate thermal movement.

- a. Material: 0.064-inch- (1.63-mm-) nominal thickness, zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet.
- 4. Joint Type: Double folded.
- 5. Panel Coverage: 16 inches (406 mm).
- 6. Panel Height: 2.0 inches (51 mm).

2.3 UNDERLAYMENT MATERIALS

- A. Self-Adhering, High-Temperature Underlayment: Provide self-adhering, cold-applied, sheet underlayment, a minimum of 30 mils (0.76 mm) thick, consisting of slip-resistant, polyethylene-film top surface laminated to a layer of butyl or SBS-modified asphalt adhesive, with release-paper backing. Provide primer when recommended by underlayment manufacturer.
 - 1. Thermal Stability: Stable after testing at 240 deg F (116 deg C); ASTM D 1970.
 - 2. Low-Temperature Flexibility: Passes after testing at minus 20 deg F (29 deg C); ASTM D 1970.
 - 3. <u>Products</u>: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Carlisle Residential, a division of Carlisle Construction Materials; WIP 300HT.
 - b. <u>Grace Construction Products, a unit of W. R. Grace & Co.</u>; Grace Ice and Water Shield HT Ultra.
 - c. <u>Henry Company</u>; Blueskin PE200 HT.
 - d. <u>Kirsch Building Products, LLC</u>; Sharkskin Ultra SA.
 - e. <u>Metal-Fab Manufacturing, LLC</u>; MetShield.
 - f. <u>Owens Corning</u>; WeatherLock Metal High Temperature Underlayment.
- B. Slip Sheet: Manufacturer's recommended slip sheet, of type required for application.

2.4 MISCELLANEOUS MATERIALS

- A. Miscellaneous Metal Subframing and Furring: ASTM C 645; cold-formed, metallic-coated steel sheet, ASTM A 653/A 653M, G90 (Z275 hot-dip galvanized) coating designation or ASTM A 792/A 792M, Class AZ50 (Class AZM150) coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.
- B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
 - 1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal panels.
 - 2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
 - 3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- (25-mm-) thick, flexible closure

strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

- C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.
- D. Gutters: Formed from same material as roof panels, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 96-inch- (2400-mm-) long sections, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual." Furnish gutter supports spaced a maximum of 36 inches (914 mm) o.c., fabricated from same metal as gutters. Provide wire ball strainers of compatible metal at outlets. Finish gutters to match metal roof panels.
- E. Downspouts: Formed from same material as roof panels. Fabricate in 10-foot- (3-m-) long sections, complete with formed elbows and offsets, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual." Finish downspouts to match Architect's sample.
- F. Panel Fasteners: Self-tapping screws designed to withstand design loads.
- G. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.
 - 1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.
 - 2. Joint Sealant: ASTM C 920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.
 - 3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.

2.5 FABRICATION

- A. General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.
- C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

- D. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.
- E. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.
 - 1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
 - 2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
 - 3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flatlock seams. Tin edges to be seamed, form seams, and solder.
 - 4. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
 - 5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
 - 6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.
 - a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal panel manufacturer for application, but not less than thickness of metal being secured.

2.6 FINISHES

- A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are unacceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Steel Panels and Accessories:
 - 1. Mica Fluoropolymer: AAMA 621. Two-coat fluoropolymer finish with suspended mica flakes containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 2. Concealed Finish: Apply pretreatment and manufacturer's standard white or lightcolored acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil (0.013 mm).

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.
 - 1. Examine primary and secondary roof framing to verify that rafters, purlins, angles, channels, and other structural panel support members and anchorages have been installed within alignment tolerances required by metal roof panel manufacturer.
 - 2. Examine solid roof sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal roof panel manufacturer.
 - a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal panel manufacturer's written recommendations.

3.3 UNDERLAYMENT INSTALLATION

- A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply at locations indicated below and on Drawings, wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches (152 mm) staggered 24 inches (610 mm) between courses. Overlap side edges not less than 3-1/2 inches (90 mm). Roll laps with roller. Cover underlayment within 14 days.
 - 1. Apply over the entire roof surface.
- B. Slip Sheet: Apply slip sheet over underlayment before installing metal roof panels.
- C. Flashings: Install flashings to cover underlayment to comply with requirements specified in Section 076200 "Sheet Metal Flashing and Trim."

3.4 METAL PANEL INSTALLATION

- A. General: Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
 - 1. Shim or otherwise plumb substrates receiving metal panels.
 - 2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
 - 3. Install screw fasteners in predrilled holes.
 - 4. Locate and space fastenings in uniform vertical and horizontal alignment.
 - 5. Install flashing and trim as metal panel work proceeds.
 - 6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
 - 7. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
 - 8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.
- B. Fasteners:
 - 1. Steel Panels: Use stainless-steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.
 - 2. Aluminum Panels: Use aluminum or stainless-steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.
 - 3. Copper Panels: Use copper, stainless-steel, or hardware-bronze fasteners.
 - 4. Stainless-Steel Panels: Use stainless-steel fasteners.
- C. Anchor Clips: Anchor metal roof panels and other components of the Work securely in place, using manufacturer's approved fasteners according to manufacturers' written instructions.
- D. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.
- E. Standing-Seam Metal Roof Panel Installation: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended in writing by manufacturer.
 - 1. Install clips to supports with self-tapping fasteners.
 - 2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
 - 3. Seamed Joint: Crimp standing seams with manufacturer-approved, motorized seamer tool so clip, metal roof panel, and factory-applied sealant are completely engaged.
 - 4. Watertight Installation:
 - a. Apply a continuous ribbon of sealant or tape to seal joints of metal panels, using sealant or tape as recommend in writing by manufacturer as needed to make panels watertight.

- b. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
- c. At panel splices, nest panels with minimum 6-inch (152-mm) end lap, sealed with sealant and fastened together by interlocking clamping plates.
- F. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
 - 1. Install components required for a complete metal panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal roof panel manufacturers; or, if not indicated, types recommended by metal roof panel manufacturer.
- G. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
 - 1. Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and achieve waterproof and weather-resistant performance.
 - 2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (610 mm) of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with mastic sealant (concealed within joints).
- H. Gutters: Join sections with riveted and soldered or lapped and sealed joints. Attach gutters to eave with gutter hangers spaced not more than 36 inches (914 mm) o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.
- I. Downspouts: Join sections with telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch (25 mm) away from walls; locate fasteners at top and bottom and at approximately 60 inches (1524 mm) o.c. in between.
 - 1. Connect downspouts to underground drainage system indicated.
- J. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to metal roof panels as recommended by manufacturer.

3.5 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align metal panel units within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines as indicated and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

3.6 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect metal roof panel installation, including accessories. Report results in writing.
- B. Remove and replace applications of metal roof panels where tests and inspections indicate that they do not comply with specified requirements.
- C. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.
- D. Prepare test and inspection reports.

3.7 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.
- B. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 074113.16

SECTION 074213.23 - METAL COMPOSITE MATERIAL WALL PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes metal composite material wall panels.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Meet with Owner, Architect, Owner's insurer if applicable, metal composite material panel Installer, metal composite material panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects metal composite material panels, including installers of doors, windows, and louvers.
 - 2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 3. Review methods and procedures related to metal composite material panel installation, including manufacturer's written instructions.
 - 4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
 - 5. Review flashings, special siding details, wall penetrations, openings, and condition of other construction that affect metal composite material panels.
 - 6. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
 - 7. Review temporary protection requirements for metal composite material panel assembly during and after installation.
 - 8. Review procedures for repair of panels damaged after installation.
 - 9. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.

- B. Shop Drawings:
 - 1. Include fabrication and installation layouts of metal composite material panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment assembly, trim, flashings, closures, and accessories; and special details.
 - 2. Accessories: Include details of the flashing, trim and anchorage, at a scale of not less than 1-1/2 inches per 12 inches (1:10).
- C. Samples for Initial Selection: For each type of metal composite material panel indicated with factory-applied color finishes.
 - 1. Include similar Samples of trim and accessories involving color selection.
- D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.
 - 1. Metal Composite Material Panels: 12 inches (305 mm) long by actual panel width. Include fasteners, closures, and other metal composite material panel accessories.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For each product, tests performed by a qualified testing agency.
- C. Field quality-control reports.
- D. Sample Warranties: For special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal composite material panels to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, metal composite material panels, and other manufactured items so as not to be damaged or deformed. Package metal composite material panels for protection during transportation and handling.
- B. Unload, store, and erect metal composite material panels in a manner to prevent bending, warping, twisting, and surface damage.

- C. Stack metal composite material panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal composite material panels to ensure dryness, with positive slope for drainage of water. Do not store metal composite material panels in contact with other materials that might cause staining, denting, or other surface damage.
- D. Retain strippable protective covering on metal composite material panels during installation.

1.9 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal composite material panels to be performed according to manufacturers' written instructions and warranty requirements.

1.10 COORDINATION

A. Coordinate metal composite material panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.11 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal composite material panel systems that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including rupturing, cracking, or puncturing.
 - b. Deterioration of metals and other materials beyond normal weathering.
 - 2. Warranty Period: Two years from date of Substantial Completion.
- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal composite material panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Finish Warranty Period: 20 years from date of Substantial Completion.

- C. Special Project Warranty: Submit metal panel Installer's warranty, signed by Installer, covering the Work of this Section, including all components of wall panel system including panels, sealant and flashing, for the following warranty period:
 - 1. Warranty Period: 5 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide metal composite material panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 330:
 - 1. Wind Loads: As indicated on Drawings.
 - 2. Other Design Loads: As indicated on Drawings.
 - 3. Deflection Limits: For wind loads, no greater than 1/180 of the span.
- B. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. (0.3 L/s per sq. m) when tested according to ASTM E 283 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 1.57 lbf/sq. ft. (75 Pa).
- C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 331 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 2.86 lbf/sq. ft. (137 Pa).
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 METAL COMPOSITE MATERIAL WALL PANELS ACP

- A. Metal Composite Material Wall Panel Systems: Provide factory-formed and -assembled, metal composite material wall panels fabricated from two metal facings that are bonded to a solid, extruded thermoplastic core; formed into profile for installation method indicated. Include attachment assembly components, panel stiffeners, and accessories required for weathertight system.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. <u>3A Composites USA, Inc</u>.; Alucobond.
 - b. <u>Alcoa Inc</u>.; Reynobond PE.

- c. <u>CENTRIA Architectural Systems</u>; Formabond Wall System.
- B. Aluminum-Faced Composite Wall Panels: Formed with 0.020-inch- (0.50-mm-) thick, anodized aluminum sheet facings.
 - 1. Panel Thickness: 0.157 inch (4 mm).
 - 2. Core: Standard.
 - 3. Exterior Finish: Mica fluoropolymer.
 - a. Color: Match Architect's samples.
- C. Attachment Assembly Components: Formed from extruded aluminum.
- D. Attachment Assembly: Manufacturer's standard.

2.3 MISCELLANEOUS MATERIALS

- A. Miscellaneous Metal Subframing and Furring: ASTM C 645, cold-formed, metallic-coated steel sheet ASTM A 653/A 653M, G90 (Z275 hot-dip galvanized) coating designation or ASTM A 792/A 792M, Class AZ50 (Class AZM150) aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal composite material panel system.
- B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal composite material panels unless otherwise indicated.
- C. Flashing and Trim: Provide flashing and trim formed from same material as metal composite material panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal composite material panels.
- D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal composite material panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.
- E. Panel Sealants: ASTM C 920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal composite material panels and remain weathertight; and as recommended in writing by metal composite material panel manufacturer.

2.4 FABRICATION

A. General: Fabricate and finish metal composite material panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance

requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

- B. Fabricate metal composite material panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.
- C. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.
 - 1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
 - 2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
 - 3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flatlock seams. Tin edges to be seamed, form seams, and solder.
 - 4. Sealed Joints: Form non-expansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
 - 5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
 - 6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.
 - a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel manufacturer for application but not less than thickness of metal being secured.

2.5 FINISHES

- A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Aluminum Panels and Accessories:
 - 1. Mica Fluoropolymer: AAMA 620. Two-coat fluoropolymer finish with suspended mica flakes containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 2. Exposed Anodized Finish:

a. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal composite material panel supports, and other conditions affecting performance of the Work.
 - 1. Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal composite material wall panel manufacturer.
 - 2. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal composite material wall panel manufacturer.
 - a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Examine roughing-in for components and assemblies penetrating metal composite material panels to verify actual locations of penetrations relative to seam locations of metal composite material panels before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal composite material panel manufacturer's written recommendations.

3.3 METAL COMPOSITE MATERIAL PANEL INSTALLATION

- A. General: Install metal composite material panels according to manufacturer's written instructions in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to supports unless otherwise indicated. Anchor metal composite material panels and other components of the Work securely in place, with provisions for thermal and structural movement.
 - 1. Shim or otherwise plumb substrates receiving metal composite material panels.
 - 2. Flash and seal metal composite material panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal composite material panels are installed.
 - 3. Install screw fasteners in predrilled holes.

- 4. Locate and space fastenings in uniform vertical and horizontal alignment.
- 5. Install flashing and trim as metal composite material panel work proceeds.
- 6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
- 7. Align bottoms of metal composite material panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
- 8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.
- B. Fasteners:
 - 1. Aluminum Panels: Use aluminum or stainless-steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.
- C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal composite material panel manufacturer.
- D. Attachment Assembly, General: Install attachment assembly required to support metal composite material wall panels and to provide a complete weathertight wall system, including subgirts, perimeter extrusions, tracks, drainage channels, panel clips, and anchor channels.
 - 1. Include attachment to supports, panel-to-panel joinery, panel-to-dissimilar-material joinery, and panel-system joint seals.
- E. Installation: Attach metal composite material wall panels to supports at locations, spacings, and with fasteners recommended by manufacturer to achieve performance requirements specified.
 - 1. Wet Seal Systems: Seal horizontal and vertical joints between adjacent metal composite material wall panels with sealant backing and sealant. Install sealant backing and sealant according to requirements specified in Section 079200 "Joint Sealants."
- F. Clip Installation: Attach panel clips to supports at locations, spacings, and with fasteners recommended by manufacturer. Attach routed-and-returned flanges of wall panels to panel clips with manufacturer's standard fasteners.
 - 1. Seal horizontal and vertical joints between adjacent panels with sealant backing and sealant. Install sealant backing and sealant according to requirements specified in Section 079200 "Joint Sealants."
 - 2. Seal horizontal and vertical joints between adjacent metal composite material wall panels with manufacturer's standard gaskets.
- G. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
 - 1. Install components required for a complete metal composite material panel assembly including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal composite material panel
University of South Carolina Softball Stadium Construction BID SET

manufacturer; or, if not indicated, provide types recommended in writing by metal composite material panel manufacturer.

- H. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.
 - 1. Install exposed flashing and trim that is without buckling and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof performance.
 - 2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (605 mm) of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with mastic sealant (concealed within joints).

3.4 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align metal composite material wall panel units within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m), non-accumulative, on level, plumb, and location lines as indicated, and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

3.5 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as metal composite material panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal composite material panel installation, clean finished surfaces as recommended by metal composite material panel manufacturer. Maintain in a clean condition during construction.
- B. After metal composite material panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.
- C. Replace metal composite material panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 074213.23

University of South Carolina Softball Stadium Construction BID SET

SECTION 075216 - STYRENE-BUTADIENE-STYRENE (SBS) MODIFIED BITUMINOUS MEMBRANE ROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Styrene-butadiene-styrene (SBS)-modified bituminous membrane roofing.
 - 2. Roof insulation.
- B. Related Requirements:
 - 1. Section 076200 "Sheet Metal Flashing and Trim" for metal roof flashings and counterflashings.

1.3 DEFINITIONS

A. Roofing Terminology: Definitions in ASTM D 1079 and glossary of NRCA's "The NRCA Roofing and Waterproofing Manual" apply to work of this Section.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Roofing Conference: Conduct conference at Project site.
 - 1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
 - 2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
 - 3. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
 - 5. Review structural loading limitations of roof deck during and after roofing.
 - 6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.

- 7. Review governing regulations and requirements for insurance and certificates if applicable.
- 8. Review temporary protection requirements for roofing system during and after installation.
- 9. Review roof observation and repair procedures after roofing installation.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other work, including:
 - 1. Base flashings and membrane terminations.
 - 2. Tapered insulation, including slopes.
 - 3. Crickets, saddles, and tapered edge strips, including slopes.
 - 4. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Manufacturer Certificates: Signed by roofing manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
 - 1. Submit evidence of complying with performance requirements.
- C. Product Test Reports: For components of membrane roofing system, for tests performed by manufacturer and witnessed by a qualified testing agency.
- D. Research/Evaluation Reports: For components of membrane roofing system, from ICC-ES.
- E. Field quality-control reports.
- F. Sample Warranties: For manufacturer's special warranties.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing system to include in maintenance manuals.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is FM Global approved for membrane roofing system identical to that used for this Project.

B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.
- B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.
 - 1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.
- C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.
- D. Handle and store roofing materials, and place equipment in a manner to avoid permanent deflection of deck.

1.10 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.11 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.
 - 1. Special warranty includes membrane roofing, base flashings, roof insulation, fasteners, cover boards, substrate board, roofing accessories, and other components of roofing system. Warranty shall include all materials either manufactured and/or supplied by the roofing manufacturer.
 - 2. Warranty Period: 20 years from date of Substantial Completion.
- B. Special Project Warranty: Submit roofing Installer's warranty, on warranty form at end of this Section, signed by Installer, covering the Work of this Section, including all components of roofing system such as membrane roofing, base flashing, roof insulation, fasteners, cover boards, substrate boards, vapor retarders, and walkway products, for the following warranty period:

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General Performance: Installed roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roofing and base flashings shall remain watertight.
 - 1. Accelerated Weathering: Roofing system shall withstand 2000 hours of exposure when tested according to ASTM G 152, ASTM G 154, or ASTM G 155.
 - 2. Impact Resistance: Roofing system shall resist impact damage when tested according to ASTM D 3746 or ASTM D 4272.
- B. Material Compatibility: Roofing materials shall be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roofing manufacturer based on testing and field experience.
- C. Roofing System Design: Tested by a qualified testing agency to resist the following uplift pressures:
 - 1. Corner Uplift Pressure: 67 lbf/sq. ft. (3.2 kPa/sq. m).
 - 2. Perimeter Uplift Pressure: 45 lbf/sq. ft. (2.2 kPa/sq. m).
 - 3. Field-of-Roof Uplift Pressure: 27 lbf/sq. ft. (1.3 kPa/sq. m).
- D. FM Global Listing: Roofing, base flashings, and component materials shall comply with requirements in FM Global 4450 or FM Global 4470 as part of a roofing system, and shall be listed in FM Global's "RoofNav" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Global markings.
 - 1. Fire/Windstorm Classification: Class 1A-90.
 - 2. Hail-Resistance Rating: SH.
- E. Solar Reflectance Index: Not less than 78 when calculated according to ASTM E 1980, based on testing identical products by a qualified testing agency.

2.2 ROOFING SHEET MATERIALS

- A. SBS-Modified Bituminous Membrane Roofing:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Johns Manville; JM 3FID-CA-CR, or comparable product by one of the following:
 - a. <u>GAF Materials Corporation</u>.
 - b. <u>Garland Company, Inc. (The)</u>.

- B. Roofing Membrane Sheet (JM DynaBase): ASTM D 6163, Grade S, Type I, SBS-modified asphalt sheet (reinforced with glass fibers); smooth surfaced; suitable for application method specified.
- C. Coverboard: (JM Invinsa): High density polyisocyanurate. Entire Roof.
- D. Granule-Surface Roofing Membrane Cap Sheet (JM DynaGlas FR CR): ASTM D 6163, Grade G, Type I, SBS-modified asphalt sheet (reinforced with glass fibers); granular surfaced with a covering layer of acrylic coating; suitable for application method specified, and as follows:
 - 1. Acrylic Coating or other cool roof rated (SRI 78 minimum) surfacing Color: White.

2.3 BASE FLASHING SHEET MATERIALS

- A. Granule-Surfaced Flashing Sheet (JM DynaFlex CR): ASTM D 6221, Type I, SBS-modified asphalt sheet (reinforced with a combination of polyester fabric and glass fibers); granular surfaced with a covering layer of acrylic coating; suitable for application method specified, and as follows:
 - 1. Acrylic Coating or other cool roof rated (SRI 78 minimum) surfacing Color: White.
- B. Other Manufacturer approved two-ply SBS-modified cool roof rated flashing system.
 - 1. Backer Sheet: ASTM D 6163, Grade S, Type I, SBS-modified asphalt sheet (reinforced with glass fibers); smooth surfaced; suitable for application method specified.
 - 2. Granule-Surface Roofing Membrane Cap Sheet: ASTM D 6163, Grade G, Type I, SBSmodified asphalt sheet (reinforced with glass fibers); granular surfaced with a covering layer of acrylic coating; suitable for application method specified, and as follows:
 - 3. Acrylic Coating or other cool roof rated (SRI 78 minimum) surfacing Color: White.
- C. Glass-Fiber Fabric: Woven glass-fiber cloth, treated with asphalt, complying with ASTM D 1668, Type I.

2.4 AUXILIARY ROOFING MATERIALS

- A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with roofing.
 - 1. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.
- B. Cold-Applied Adhesive (JM MBR Cold Application Adhesive): Roofing system manufacturer's standard asphalt-based, one- or two-part, asbestos-free, cold-applied adhesive specially formulated for compatibility and use with roofing membrane and base flashings.
- C. Asphalt Roofing Cement (JM Bestile Industrial Roof Cement): ASTM D 4586, asbestos free, of consistency required by roofing system manufacturer for application.

- D. Mastic Sealant: Polyisobutylene, plain or modified bitumen; nonhardening, nonmigrating, nonskinning, and nondrying.
- E. Johns Mannville JM CR Seam Coating for use in dressing side and end lap bleed-out and repair of adhesive errors.
- F. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosionresistance provisions in FM Global 4470, designed for fastening roofing components to substrate; tested by manufacturer for required pullout strength, and acceptable to roofing system manufacturer.
- G. Roofing Granules: Ceramic-coated roofing granules, No. 11 screen size with 100 percent passing No. 8 (2.36-mm) sieve and 98 percent of mass retained on No. 40 (0.425-mm) sieve, color to match roofing.
- H. Fluid Applied penetration flashing system. Basis of Design: Johns Manville PermaFlash or Architect approved equal. All penetrations treated by this system are to be covered by the manufacturers no dollar limit (NDL) warranty.
- I. Miscellaneous Accessories: Provide those recommended by roofing system manufacturer.

2.5 ROOF INSULATION

- A. General: Preformed roof insulation boards manufactured or approved by roofing manufacturer, selected from manufacturer's standard sizes suitable for application, of thicknesses indicated and that produce FM Global-approved roof insulation.
- B. Polyisocyanurate Board Insulation(JM Enrgy3): ASTM C 1289, Type II, Class 1, Grade 3, felt or glass-fiber mat facer on both major surfaces.
- C. Tapered Insulation: Provide factory-tapered insulation boards fabricated to slope of 1/4 inch per 12 inches (1:48) unless otherwise indicated.
- D. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

2.6 INSULATION ACCESSORIES

- A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with roofing.
- B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosionresistance provisions in FM Global 4470, designed for fastening roof insulation to substrate, and acceptable to roofing system manufacturer.
- C. Bead-Applied Insulation Adhesive (JM 2-Part Urethane Insulation Adhesive): Insulation manufacturer's recommended bead-applied, low-rise, one-component or multicomponent urethane adhesive formulated to attach roof insulation to substrate or to another insulation layer.

- A. Insulation Cant Strips (JM FesCant): ASTM C 728, perlite insulation board.
- B. Wood Nailer Strips: Comply with requirements in Section 061053 "Miscellaneous Rough Carpentry."]
- C. Tapered Edge Strips: ASTM C 728, perlite insulation board.
- D. Cover Board (JM DuraBoard or other architect approved equivalent): Perlite Board: ASTM C 728; composed of expanded perlite, cellulosic fibers, binders and waterproofing agents with top surface seal-coated, 1/2 inch (13 mm) thick.
- E. Substrate Joint Tape: 6- or 8-inch- (150- or 200-mm-) wide, coated, glass fiber.

2.7 WALKWAYS

- A. Walkway Pads: Reinforced asphaltic composition pads with slip-resisting mineral-granule surface, manufactured as a traffic pad for foot traffic and acceptable to roofing system manufacturer, 1/2 inch (13 mm) thick, minimum.
 - 1. Pad Size: 32"x32"

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work:
 - 1. Verify that roof openings and penetrations are in place, curbs are set and braced, and roof-drain bodies are securely clamped in place.
 - 2. Verify that wood cants, blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
 - 3. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Section 053100 "Steel Decking."
 - 4. Verify that deck is securely fastened with no projecting fasteners and with no adjacent units in excess of 1/16 inch (1.6 mm) out of plane relative to adjoining deck.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.
- B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

3.3 INSTALLATION, GENERAL

- A. Comply with roofing system manufacturer's written instructions.
- B. Asphalt Heating: Heat and apply SEBS-modified roofing asphalt according to roofing system manufacturer's written instructions.
- C. Substrate-Joint Penetrations: Prevent roofing asphalt and adhesives from penetrating substrate joints, entering building, or damaging roofing system components or adjacent building construction.

3.4 INSULATION INSTALLATION

- A. Comply with roofing system manufacturer's written instructions for installing roof insulation.
- B. Install one lapped base-sheet course and mechanically fasten to substrate according to roofing system manufacturer's written instructions.
- C. Insulation Cant Strips: Install and secure preformed 45-degree insulation cant strips at junctures of roofing system with vertical surfaces or angle changes greater than 45 degrees.
- D. Install tapered insulation under area of roofing to conform to slopes indicated.
- E. Install insulation with long joints of insulation in a continuous straight line, with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
 - 1. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
- F. Install insulation under area of roofing to achieve required thickness. Where overall insulation thickness is 2.7 inches (68 mm) or greater, install two or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches (150 mm) in each direction.
- G. Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.
- H. Install tapered edge strips at perimeter edges of roof that do not terminate at vertical surfaces.
- I. Mechanically Fastened and Adhered Insulation: Install first layer of insulation to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type.
 - 1. Fasten first layer of insulation according to requirements in FM Global's "RoofNav" for specified Windstorm Resistance Classification.
 - 2. Set each subsequent layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.

- J. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches (150 mm) in each direction. Loosely butt cover boards together. Tape joints if required by roofing system manufacturer.
 - 1. Fasten cover boards according to requirements in FM Global's "RoofNav" for specified Windstorm Resistance Classification.
 - 2. Fasten cover boards to resist uplift pressure at corners, perimeter, and field of roof.

3.5 ROOFING INSTALLATION, GENERAL

- A. Install roofing system according to roofing system manufacturer's written instructions and applicable recommendations in ARMA/NRCA's "Quality Control Guidelines for the Application of Polymer Modified Bitumen Roofing" and as follows:
 - 1. Deck Type: I (insulated).
 - 2. Adhering Method: L (cold-applied adhesive).
 - 3. Number of SBS-Modified Asphalt Sheets: Three
 - 4. Surfacing Type: M (mineral-granule-surfaced cap sheet).
- B. Start installation of roofing in presence of manufacturer's technical personnel.
- C. Coordinate installation of roofing system so insulation and other components of the roofing system not permanently exposed are not subjected to precipitation or left uncovered at the end of the workday or when rain is forecast.
 - 1. Provide tie-offs at end of each day's work to cover exposed roofing sheets and insulation with a course of coated felt set in roofing cement or hot roofing asphalt, with joints and edges sealed.
 - 2. Complete terminations and base flashings, and provide temporary seals to prevent water from entering completed sections of roofing system.
 - 3. Remove and discard temporary seals before beginning work on adjoining roofing.
- D. Substrate-Joint Penetrations: Prevent roofing asphalt and adhesives from penetrating substrate joints, entering building, or damaging roofing system components or adjacent building construction.

3.6 SBS-MODIFIED BITUMINOUS MEMBRANE INSTALLATION

- A. Install modified bituminous roofing sheet and cap sheet according to roofing manufacturer's written instructions, starting at low point of roofing system. Extend roofing membrane sheets over and terminate beyond cants, installing as follows:
 - 1. Adhere to substrate in cold-applied adhesive.
 - 2. Unroll roofing sheets and allow them to relax for minimum time period required by manufacturer.
- B. Laps: Accurately align roofing sheets, without stretching, and maintain uniform side and end laps. Stagger end laps. Completely bond and seal laps, leaving no voids.

- 1. Repair tears and voids in laps and lapped seams not completely sealed.
- 2. Apply roofing granules to cover exuded bead at laps while bead is hot.
- C. Install roofing sheets so side and end laps shed water.
- D. Finished aesthetic appearance is important. All side and end lap bleed-out and adhesive errors are to be repaired by the manufacturer approved solution. Provide 12-inch mock-up for architect review prior to installing.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.7 FLASHING AND STRIPPING INSTALLATION

- A. Install base flashing over cant strips and other sloped and vertical surfaces, at roof edges, and at penetrations through roof, and secure to substrates according to roofing system manufacturer's written instructions and as follows:
 - 1. Prime substrates with asphalt primer if required by roofing system manufacturer.
 - 2. Backer-Sheet Application: Mechanically fasten backer sheet to walls or parapets. Adhere backer sheet over roofing membrane at cants in cold-applied adhesive.
 - 3. Flashing-Sheet Application: Adhere flashing sheet to substrate in cold-applied adhesive at rate required by roofing system manufacturer.
- B. Extend base flashing up walls or parapets a minimum of 8 inches (200 mm) above roofing membrane and 4 inches (100 mm) onto field of roofing membrane.
- C. Mechanically fasten top of base flashing securely at terminations and perimeter of roofing.
 - 1. Seal top termination of base flashing with a strip of glass-fiber fabric set in asphalt roofing cement.
- D. Install roofing cap-sheet stripping where metal flanges and edgings are set on roofing according to roofing system manufacturer's written instructions.
- E. Roof Drains: Set 30-by-30-inch- (760-by-760-mm-) metal flashing in bed of asphaltic adhesive on completed roofing membrane. Cover metal flashing with roofing cap-sheet stripping, and extend a minimum of 6 inches (150 mm) beyond edge of metal flashing onto field of roofing membrane. Clamp roofing membrane, metal flashing, and stripping into roof-drain clamping ring.
 - 1. Install stripping according to roofing system manufacturer's written instructions.

3.8 WALKWAY INSTALLATION

- A. Walkway Pads: Install walkway pads using units of size indicated or, if not indicated, of manufacturer's standard size, according to walkway pad manufacturer's written instructions.
 - 1. Set walkway pads in cold-applied adhesive.

3.9 FIELD QUALITY CONTROL

- A. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion.
 - 1. Notify Architect and Owner 48 hours in advance of date and time of inspection.
- B. Roofing system will be considered defective if it does not pass tests and inspections.
 - 1. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

3.10 PROTECTING AND CLEANING

- A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.
- B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.
- C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

3.11 ROOFING INSTALLER'S WARRANTY

- A. WHEREAS ______ of ______, herein called the "Roofing Installer," has performed roofing and associated work ("work") on the following project:
 - 1. Owner: University of South Carolina
 - 2. Address: 743 Greene Street, Columbia, SC, 29208
 - 3. Building Name/Type: Softball Stadium
 - 4. Address: 200 S. Marion Street, Columbia, SC 29205
 - 5. Area of Work: Low slope roof and associated coping.
 - 6. Acceptance Date: ____
 - 7. Warranty Period: 2 YEARS
 - 8. Expiration Date: ______.
- B. AND WHEREAS Roofing Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant said work against leaks and faulty or defective materials and workmanship for designated Warranty Period,
- C. NOW THEREFORE Roofing Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period he will, at his own cost and expense, make or cause to be made such repairs to or replacements of said work as are necessary to correct faulty and defective work and as are necessary to maintain said work in a watertight condition.
- D. This Warranty is made subject to the following terms and conditions:
 - 1. Specifically excluded from this Warranty are damages to work and other parts of the building, and to building contents, caused by:
 - a. lightning;
 - b. peak gust wind speed exceeding 72 mph (m/s);
 - c. fire;
 - d. failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;
 - e. faulty construction of parapet walls, copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the work;
 - f. vapor condensation on bottom of roofing; and
 - g. activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner.
 - 2. When work has been damaged by any of foregoing causes, Warranty shall be null and void until such damage has been repaired by Roofing Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.
 - 3. Roofing Installer is responsible for damage to work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of work.
 - 4. During Warranty Period, if Owner allows alteration of work by anyone other than Roofing Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this

Warranty shall become null and void on date of said alterations, but only to the extent said alterations affect work covered by this Warranty. If Owner engages Roofing Installer to perform said alterations, Warranty shall not become null and void unless Roofing Installer, before starting said work, shall have notified Owner in writing, showing reasonable cause for claim, that said alterations would likely damage or deteriorate work, thereby reasonably justifying a limitation or termination of this Warranty.

- 5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray-cooled surface, flooded basin, or other use or service more severe than originally specified, this Warranty shall become null and void on date of said change, but only to the extent said change affects work covered by this Warranty.
- Owner shall promptly notify Roofing Installer of observed, known, or suspected leaks, 6. defects, or deterioration and shall afford reasonable opportunity for Roofing Installer to inspect work and to examine evidence of such leaks, defects, or deterioration.
- 7. This Warranty is recognized to be the only warranty of Roofing Installer on said work and shall not operate to restrict or cut off Owner from other remedies and resources lawfully available to Owner in cases of roofing failure. Specifically, this Warranty shall not operate to relieve Roofing Installer of responsibility for performance of original work according to requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner or a subcontract with Owner's General Contractor.
- E. IN WITNESS THEREOF, this instrument has been duly executed this day of _____, _____.
 - Authorized Signature: 1.
 - 2.
 - Name: _____. 3. Title: _____

END OF SECTION 075216

SECTION 075419 - POLYVINYL-CHLORIDE (PVC) ROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Mechanically fastened polyvinyl-chloride (PVC) roofing system.
 - 2. Roof insulation.
- B. Related Requirements:
 - 1. Section 061053 "Miscellaneous Rough Carpentry" for wood nailers, curbs, and blocking; and for wood-based, structural-use roof deck panels.
 - 2. Section 072100 "Thermal Insulation" for insulation beneath the roof deck.
 - 3. Section 076200 "Sheet Metal Flashing and Trim" for metal roof flashings and counterflashings.
 - 4. Section 079200 "Joint Sealants" for joint sealants, joint fillers, and joint preparation.

1.3 DEFINITIONS

A. Roofing Terminology: Definitions in ASTM D 1079 and glossary in NRCA's "The NRCA Roofing and Waterproofing Manual" apply to work of this Section.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Roofing Conference: Conduct conference at Project site.
 - 1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
 - 2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
 - 3. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
 - 5. Review structural loading limitations of roof deck during and after roofing.

- 6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.
- 7. Review governing regulations and requirements for insurance and certificates if applicable.
- 8. Review temporary protection requirements for roofing system during and after installation.
- 9. Review roof observation and repair procedures after roofing installation.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other work, including:
 - 1. Base flashings and membrane terminations.
 - 2. Tapered insulation, including slopes.
 - 3. Roof plan showing orientation of steel roof deck and orientation of roofing, fastening spacings, and patterns for mechanically fastened roofing.
 - 4. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
- C. Samples for Verification: For the following products:
 - 1. Sheet roofing, of color required.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and manufacturer.
- B. Manufacturer Certificates: Signed by roofing manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
 - 1. Submit evidence of compliance with performance requirements.
- C. Product Test Reports: For components of roofing system, for tests performed by manufacturer and witnessed by a qualified testing agency.
- D. Research/Evaluation Reports: For components of roofing system, from ICC-ES.
- E. Field quality-control reports.
- F. Sample Warranties: For manufacturer's special warranties.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing system to include in maintenance manuals.

1.8 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer that is UL listed for roofing system identical to that used for this Project.
- B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.
- B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.
 - 1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.
- C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.
- D. Handle and store roofing materials, and place equipment in a manner to avoid permanent deflection of deck.

1.10 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.11 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.
 - 1. Special warranty includes membrane roofing, base flashings, roof insulation, fasteners, cover boards, substrate board, roofing accessories, and other components of roofing system.
 - 2. Warranty Period: 15 years from date of Substantial Completion.
- B. Special Project Warranty: Submit roofing Installer's warranty, on warranty form at end of this Section, signed by Installer, covering the Work of this Section, including all components of

roofing system such as membrane roofing, base flashing, roof insulation, fasteners, cover boards, substrate boards, vapor retarders, roof pavers, and walkway products, for the following warranty period:

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General Performance: Installed roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roofing and base flashings shall remain watertight.
 - 1. Accelerated Weathering: Roofing system shall withstand 2000 hours of exposure when tested according to ASTM G 152, ASTM G 154, or ASTM G 155.
 - 2. Impact Resistance: Roofing system shall resist impact damage when tested according to ASTM D 3746 or ASTM D 4272.
- B. Material Compatibility: Roofing materials shall be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roofing manufacturer based on testing and field experience.
- C. Roofing System Design: Tested by a qualified testing agency to resist the following uplift pressures:
 - 1. Corner Uplift Pressure: 45 lbf/sq. ft. (kPa/sq. m).
 - 2. Perimeter Uplift Pressure: 35 lbf/sq. ft. (kPa/sq. m).
 - 3. Field-of-Roof Uplift Pressure: 25 lbf/sq. ft. (kPa/sq. m).
- D. Exterior Fire-Test Exposure: ASTM E 108 or UL 790, Class A; for application and roof slopes indicated; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- E. Fire-Resistance Ratings: Comply with fire-resistance-rated assembly designs indicated. Identify products with appropriate markings of applicable testing agency.

2.2 PVC ROOFING

- A. PVC Sheet: ASTM D 4434, Type III, fabric reinforced and fabric backed.
 - 1. <u>Manufacturers</u>: Subject to compliance with requirements, provide products by one of the following:
 - a. <u>Carlisle SynTec, Incorporated</u>.
 - b. Johns Manville.

- c. <u>Sarnafil Inc</u>.
- 2. Thickness: 60 mils (1.5 mm), nominal.
- 3. Exposed Face Color: White.

2.3 AUXILIARY ROOFING MATERIALS

- A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with roofing.
 - 1. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.
- B. Sheet Flashing: Manufacturer's standard sheet flashing of same material, type, reinforcement, thickness, and color as PVC sheet.
- C. Bonding Adhesive: Manufacturer's standard.
- D. Slip Sheet: Manufacturer's standard, of thickness required for application.
- E. Metal Termination Bars: Manufacturer's standard, predrilled stainless-steel or aluminum bars, approximately 1 by 1/8 inch (25 by 3 mm) thick; with anchors.
- F. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosionresistance provisions in FM Global 4470, designed for fastening roofing to substrate, and acceptable to roofing system manufacturer.
- G. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

2.4 SUBSTRATE BOARDS

- A. Substrate Board: ASTM C 1177/C 1177M, glass-mat, water-resistant gypsum substrate, Type X, 5/8 inch (16 mm) thick.
 - 1. <u>Products</u>: Subject to compliance with requirements, provide one of the following:
 - a. <u>CertainTeed Corporation</u>; GlasRoc Sheathing Type X.
 - b. <u>Georgia-Pacific Corporation</u>; Dens Deck.
 - c. <u>National Gypsum Company</u>; Gold Bond eXP Extended Exposure Sheathing.
 - d. <u>USG Corporation</u>; Securock Glass Mat Roof Board.
- B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Global 4470, designed for fastening substrate board to roof deck.

2.5 ROOF INSULATION

- A. General: Preformed roof insulation boards manufactured or approved by PVC roofing manufacturer, selected from manufacturer's standard sizes suitable for application, of thicknesses indicated.
- B. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class 1, Grade 2, felt or glass-fiber mat facer on both major surfaces.
- C. Tapered Insulation: Provide factory-tapered insulation boards fabricated to slope of 1/4 inch per 12 inches (1:48) unless otherwise indicated.

2.6 INSULATION ACCESSORIES

- A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with roofing.
- B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosionresistance provisions in FM Global 4470, designed for fastening roof insulation and cover boards to substrate, and acceptable to roofing system manufacturer.
- C. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer as follows:
 - 1. Modified asphaltic, asbestos-free, cold-applied adhesive.
 - 2. Bead-applied, low-rise, one-component or multicomponent urethane adhesive.
 - 3. Full-spread spray-applied, low-rise, two-component urethane adhesive.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work:
 - 1. Verify that roof openings and penetrations are in place, curbs are set and braced, and roof-drain bodies are securely clamped in place.
 - 2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.

B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

3.3 SUBSTRATE BOARD INSTALLATION

A. Install substrate board with long joints in continuous straight lines, perpendicular to roof slopes with end joints staggered between rows. Tightly butt substrate boards together.

3.4 ROOFING INSTALLATION, GENERAL

- A. Install roofing system according to roofing system manufacturer's written instructions.
- B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at end of workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

3.5 INSULATION INSTALLATION

- A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.
- B. Comply with roofing system and insulation manufacturer's written instructions for installing roof insulation.
- C. Install tapered insulation under area of roofing to conform to slopes indicated.
- D. Install insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
 - 1. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
- E. Adhered Insulation: Install each layer of insulation and adhere to substrate as follows:
 - 1. Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

3.6 MECHANICALLY FASTENED ROOFING INSTALLATION

- A. Mechanically fasten roofing over area to receive roofing according to roofing system manufacturer's written instructions. Unroll roofing and allow to relax before retaining.
 - 1. Install sheet according to ASTM D 5082.
- B. Start installation of roofing in presence of roofing system manufacturer's technical personnel.

- C. Accurately align roofing, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
- D. Mechanically fasten or adhere roofing securely at terminations, penetrations, and perimeter of roofing.
- E. Apply roofing with side laps shingled with slope of roof deck where possible.
- F. In-Seam Attachment: Secure one edge of PVC sheet using fastening plates or metal battens centered within seam, and mechanically fasten PVC sheet to roof deck.
- G. Seams: Clean seam areas, overlap roofing, and hot-air weld side and end laps of roofing and sheet flashings according to manufacturer's written instructions to ensure a watertight seam installation.
 - 1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of sheet.
 - 2. Verify field strength of seams a minimum of twice daily, and repair seam sample areas.
 - 3. Repair tears, voids, and lapped seams in roofing that do not comply with requirements.
- H. Spread sealant bed over deck-drain flange at roof drains, and securely seal roofing in place with clamping ring.

3.7 BASE FLASHING INSTALLATION

- A. Install sheet flashings and preformed flashing accessories, and adhere to substrates according to roofing system manufacturer's written instructions.
- B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate, and allow to partially dry. Do not apply to seam area of flashing.
- C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.
- D. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.
- E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.8 FIELD QUALITY CONTROL

- A. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion.
- B. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.

C. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

3.9 PROTECTING AND CLEANING

- A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.
- B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.
- C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

3.10 ROOFING INSTALLER'S WARRANTY

- A. WHEREAS ______ of _____, herein called the "Roofing Installer," has performed roofing and associated work ("work") on the following project:
 - 1. Owner: University of South Carolina
 - 2. Address: 743 Greene Street, Columbia, SC, 29208
 - 3. Building Name/Type: Softball Stadium
 - 4. Address: 200 S. Marion Street, Columbia, SC 29205
 - 5. Area of Work: Low slope roof and associated coping (under stadium)
 - 6. Acceptance Date: _____
 - 7. Warranty Period: 2 YEARS
 - 8. Expiration Date: ______.
- B. AND WHEREAS Roofing Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant said work against leaks and faulty or defective materials and workmanship for designated Warranty Period,
- C. NOW THEREFORE Roofing Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period he will, at his own cost and expense, make or cause to be made such repairs to or replacements of said work as are necessary to correct faulty and defective work and as are necessary to maintain said work in a watertight condition.
- D. This Warranty is made subject to the following terms and conditions:
 - 1. Specifically excluded from this Warranty are damages to work and other parts of the building, and to building contents, caused by:
 - a. lightning;
 - b. peak gust wind speed exceeding 72 mph (m/sec);
 - c. fire;

- d. failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;
- e. faulty construction of parapet walls, copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the work;
- f. vapor condensation on bottom of roofing; and
- g. activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner.
- 2. When work has been damaged by any of foregoing causes, Warranty shall be null and void until such damage has been repaired by Roofing Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.
- 3. Roofing Installer is responsible for damage to work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of work.
- 4. During Warranty Period, if Owner allows alteration of work by anyone other than Roofing Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty shall become null and void on date of said alterations, but only to the extent said alterations affect work covered by this Warranty. If Owner engages Roofing Installer to perform said alterations, Warranty shall not become null and void unless Roofing Installer, before starting said work, shall have notified Owner in writing, showing reasonable cause for claim, that said alterations would likely damage or deteriorate work, thereby reasonably justifying a limitation or termination of this Warranty.
- 5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray-cooled surface, flooded basin, or other use or service more severe than originally specified, this Warranty shall become null and void on date of said change, but only to the extent said change affects work covered by this Warranty.
- 6. Owner shall promptly notify Roofing Installer of observed, known, or suspected leaks, defects, or deterioration and shall afford reasonable opportunity for Roofing Installer to inspect work and to examine evidence of such leaks, defects, or deterioration.
- 7. This Warranty is recognized to be the only warranty of Roofing Installer on said work and shall not operate to restrict or cut off Owner from other remedies and resources lawfully available to Owner in cases of roofing failure. Specifically, this Warranty shall not operate to relieve Roofing Installer of responsibility for performance of original work according to requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner or a subcontract with Owner's General Contractor.
- E. IN WITNESS THEREOF, this instrument has been duly executed this _____ day of
 - 1. Authorized Signature:
 - 2. Name: _____.
 - 3. Title: _____.

END OF SECTION 075419

SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Formed roof-drainage sheet metal fabrications.
 - 2. Formed low-slope roof sheet metal fabrications.
 - 3. Formed equipment support flashing.
 - 4. Formed overhead-piping safety pans.
- B. Related Requirements:
 - 1. Section 061053 "Miscellaneous Rough Carpentry" for wood nailers, curbs, and blocking.

1.3 COORDINATION

- A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.
- B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.
- B. Shop Drawings: For sheet metal flashing and trim.
 - 1. Include plans, elevations, sections, and attachment details.
 - 2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work.
 - 3. Include identification of material, thickness, weight, and finish for each item and location in Project.
 - 4. Include details for forming, including profiles, shapes, seams, and dimensions.

- 5. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
- 6. Include details of termination points and assemblies.
- 7. Include details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction from fixed points.
- 8. Include details of roof-penetration flashing.
- 9. Include details of edge conditions, including eaves, ridges, valleys, rakes, crickets, and counterflashings as applicable.
- 10. Include details of special conditions.
- 11. Include details of connections to adjoining work.
- 12. Detail formed flashing and trim at scale of not less than 1-1/2 inches per 12 inches (1:10).
- C. Samples for Initial Selection: For each type of sheet metal and accessory indicated with factory-applied finishes.
- D. Samples for Verification: For each type of exposed finish.
 - 1. Sheet Metal Flashing: 12 inches (300 mm) long by actual width of unit, including finished seam and in required profile. Include fasteners, cleats, clips, closures, and other attachments.
 - 2. Trim, Metal Closures, Expansion Joints, Joint Intersections, and Miscellaneous Fabrications: 12 inches (300 mm) long and in required profile. Include fasteners and other exposed accessories.
 - 3. Unit-Type Accessories and Miscellaneous Materials: Full-size Sample.
 - 4. Anodized Aluminum Samples: Samples to show full range to be expected for each color required.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For fabricator.
- B. Product Certificates: For each type of coping and roof edge flashing that is SPRI ES-1 tested.
- C. Product Test Reports: For each product, for tests performed by a qualified testing agency.
- D. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For sheet metal flashing and trim, and its accessories, to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.

1. For copings and roof edge flashings that are SPRIES-1 tested and FM Approvals approved, shop shall be listed as able to fabricate required details as tested and approved.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
- B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

1.9 WARRANTY

- A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General: Sheet metal flashing and trim assemblies shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.
- B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.
- C. FM Approvals Listing: Manufacture and install copings that are listed in FM Approvals' "RoofNav" and approved for windstorm classification, Class 1-90. Identify materials with name of fabricator and design approved by FM Approvals.
- D. SPRI Wind Design Standard: Manufacture and install copings tested according to SPRI ES-1 and capable of resisting the following design pressure:

- 1. Design Pressure: As indicated on Drawings.
- E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 SHEET METALS

- A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.
- B. Aluminum Sheet: ASTM B 209 (ASTM B 209M), alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required; with smooth, flat surface.
 - 1. Exposed Coil-Coated Finish:
 - a. Mica Fluoropolymer: AAMA 620. Two-coat fluoropolymer finish with suspended mica flakes containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 2. Color: Match Architect's sample.
 - 3. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil (0.013 mm).
- C. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304, dead soft, fully annealed; with smooth, flat surface.
 - 1. Finish: 4 (polished directional satin).

2.3 UNDERLAYMENT MATERIALS

- A. Synthetic Underlayment: Laminated or reinforced, woven polyethylene or polypropylene, synthetic roofing underlayment; bitumen free; slip resistant; suitable for high temperatures over 220 deg F (111 deg C); and complying with physical requirements of ASTM D 226/D 226M for Type I and Type II felts.
 - 1. <u>Products</u>: Subject to compliance with requirements, provide one of the following:
 - a. <u>Atlas Roofing Corporation;</u> Summit.
 - b. <u>Engineered Coated Products</u>; Nova-Seal II.
 - c. <u>Kirsch Building Products, LLC</u>; Sharkskin Comp.
 - d. <u>SDP Advanced Polymer Products Inc;</u> Palisade.

- 2. Thermal Stability: ASTM D 1970; stable after testing at 240 deg F (116 deg C) or higher.
- 3. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F (29 deg C) or lower.

2.4 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, solder, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.
- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal.
 - 1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
 - a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
 - b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
 - c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.
 - 2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
 - 3. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.
- C. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.
- D. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- E. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.
- F. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.
- G. Bituminous Coating: Cold-applied asphalt emulsion according to ASTM D 1187.
- H. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

2.5 MANUFACTURED SHEET METAL FLASHING AND TRIM

- A. Through-Wall, Ribbed, Sheet Metal Flashing: Manufacture through-wall sheet metal flashing for embedment in masonry, with ribs at 3-inch (75-mm) intervals along length of flashing to provide integral mortar bond. Manufacture through-wall flashing with snaplock receiver on exterior face to receive counterflashing.
 - 1. Stainless Steel: 0.016 inch (0.40 mm) thick.
 - a. <u>Products</u>: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) <u>Cheney Flashing Company</u>; Cheney Flashing Dovetail.
 - 2) <u>Hohmann & Barnard, Inc</u>.; STF Sawtooth Flashing.
 - 3) <u>Keystone Flashing Company, Inc</u>.; Keystone Three-Way Interlocking Thruwall Flashing.
 - 4) <u>Sandell Manufacturing</u>; Pre-Formed Metal Flashing.

2.6 FABRICATION, GENERAL

- A. General: Custom fabricate sheet metal flashing and trim to comply with details shown and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
 - 1. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
 - 2. Obtain field measurements for accurate fit before shop fabrication.
 - 3. Form sheet metal flashing and trim to fit substrates without excessive oil canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
 - 4. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.
- B. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines indicated on Drawings and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.
- C. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."
- D. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.
 - 1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with butyl sealant concealed within joints.
 - 2. Use lapped expansion joints only where indicated on Drawings.

- E. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal to provide for proper installation of elastomeric sealant according to cited sheet metal standard.
- F. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
- G. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard for application, but not less than thickness of metal being secured.
- H. Seams: Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.
- I. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use.
- J. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints where necessary for strength.
- K. Do not use graphite pencils to mark metal surfaces.

2.7 ROOF-DRAINAGE SHEET METAL FABRICATIONS

A. Parapet Scuppers: Fabricate scuppers to dimensions required, with closure flange trim to exterior, 4-inch- (100-mm-) wide wall flanges to interior, and base extending 4 inches (100 mm) beyond cant or tapered strip into field of roof. Fabricate from the following materials:

 Aluminum: 0.032 inch (0.81 mm) thick.

2.8 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

- A. Roof Edge Flashing (Gravel Stop): Fabricate in minimum 96-inch- (2400-mm-) long, but not exceeding 12-foot- (3.6-m-) long sections. Furnish with 6-inch- (150-mm-) wide, joint cover plates. Shop fabricate interior and exterior corners.
 - 1. Joint Style: Overlapped, 4 inches (100 mm) wide.
 - 2. Fabricate with scuppers spaced 10 feet (3 m) apart, to dimensions required with 4-inch-(100-mm-) wide flanges and base extending 4 inches (100 mm) beyond cant or tapered strip into field of roof. Fasten gravel guard angles to base of scupper.
 - 3. Fabricate from the Following Materials: a. Aluminum: 0.050 inch (1.27 mm) thick.
- B. Copings: Fabricate in minimum 96-inch- (2400-mm-) long, but not exceeding 12-foot- (3.6-m-) long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and drill elongated holes for fasteners on interior leg. Miter corners, fasten and seal watertight. Shop fabricate interior and exterior corners.
 - 1. Coping Profile: see drawings
 - 2. Joint Style: Butted with expansion space and 6-inch- (150-mm-) wide, exposed cover plate.

- Fabricate from the Following Materials:
 a. Aluminum: 0.050 inch (1.27 mm) thick.
- C. Roof and Roof-to-Wall Transition Expansion-Joint Cover: Fabricate from the following materials: Shop fabricate interior and exterior corners.
 1. Aluminum: 0.050 inch (1.27 mm) thick.
- D. Base Flashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:
 - 1. Aluminum: 0.040 inch (1.02 mm) thick.
- E. Counterflashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:
 - 1. Aluminum: 0.032 inch (0.81 mm) thick.
- F. Roof-Drain Flashing: Fabricate from the following materials:
 - 1. Copper: 12 oz./sq. ft. (0.41 mm thick).

2.9 MISCELLANEOUS SHEET METAL FABRICATIONS

A. Overhead-Piping Safety Pans: Fabricate from the following materials:
1. Stainless Steel: 0.025 inch (0.64 mm) thick.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, substrate, and other conditions affecting performance of the Work.
 - 1. Verify compliance with requirements for installation tolerances of substrates.
 - 2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
 - 3. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 UNDERLAYMENT INSTALLATION

A. Felt Underlayment: Install felt underlayment, wrinkle free, using adhesive to minimize use of mechanical fasteners under sheet metal flashing and trim. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches (50 mm).

- B. Synthetic Underlayment: Install synthetic underlayment, wrinkle free, according to manufacturers' written instructions, and using adhesive where possible to minimize use of mechanical fasteners under sheet metal.
- C. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free. Prime substrate if recommended by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures. Apply in shingle fashion to shed water, with end laps of not less than 6 inches (150 mm) staggered 24 inches (600 mm) between courses. Overlap side edges not less than 3-1/2 inches (90 mm). Roll laps and edges with roller. Cover underlayment within 14 days.

3.3 INSTALLATION, GENERAL

- A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners[, solder], protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
 - 1. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
 - 2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
 - 3. Space cleats not more than 12 inches (300 mm) apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
 - 4. Install exposed sheet metal flashing and trim with limited oil canning, and free of buckling and tool marks.
 - 5. Torch cutting of sheet metal flashing and trim is not permitted.
 - 6. Do not use graphite pencils to mark metal surfaces.
- B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.
 - 1. Coat concealed side of uncoated-aluminum and stainless-steel sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
 - 2. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.
- C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at maximum of 10 feet (3 m) with no joints within 24 inches (600 mm) of corner or intersection.
 - 1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with sealant concealed within joints.
 - 2. Use lapped expansion joints only where indicated on Drawings.

- D. Fasteners: Use fastener sizes that penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.
- E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.
- F. Seal joints as required for watertight construction.
 - Use sealant-filled joints unless otherwise indicated. Embed hooked flanges of joint members not less than 1 inch (25 mm) into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is between 40 and 70 deg F (4 and 21 deg C), set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F (4 deg C).
 - 2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

3.4 ROOF-DRAINAGE SYSTEM INSTALLATION

- A. General: Install sheet metal roof-drainage items to produce complete roof-drainage system according to cited sheet metal standard unless otherwise indicated. Coordinate installation of roof perimeter flashing with installation of roof-drainage system.
- B. Parapet Scuppers: Continuously support scupper, set to correct elevation, and seal flanges to interior wall face, over cants or tapered edge strips, and under roofing membrane.
 - 1. Anchor scupper closure trim flange to exterior wall and solder or seal with elastomeric sealant to scupper.
 - 2. Loosely lock front edge of scupper with conductor head.
 - 3. Solder or seal with elastomeric sealant exterior wall scupper flanges into back of conductor head.

3.5 ROOF FLASHING INSTALLATION

- A. General: Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and cited sheet metal standard. Provide concealed fasteners where possible, and set units true to line, levels, and slopes. Install work with laps, joints, and seams that are permanently watertight and weather resistant.
- B. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in cited sheet metal standard unless otherwise indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at staggered 3-inch (75-mm) centers.
- C. Copings: Anchor to resist uplift and outward forces according to recommendations in cited sheet metal standard unless otherwise indicated.
- 1. Interlock exterior bottom edge of coping with continuous cleat anchored to substrate at 24-inch (600-mm) <**Insert dimension**> centers.
- 2. Anchor interior leg of coping with washers and screw fasteners through slotted holes at 24-inch (600-mm) centers.
- D. Copings: Anchor to resist uplift and outward forces according to recommendations in FM Global Property Loss Prevention Data Sheet 1-49 for specified FM Approvals' listing for required windstorm classification.
- E. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending minimum of 4 inches (100 mm) over base flashing. Install stainless-steel draw band and tighten.
- F. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches (100 mm) over base flashing. Lap counterflashing joints minimum of 4 inches (100 mm). Secure in waterproof manner by means of snap-in installation and sealant or lead wedges and sealant unless otherwise indicated.
- G. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomeric sealant and clamp flashing to pipes that penetrate roof.

3.6 WALL FLASHING INSTALLATION

- A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to cited sheet metal standard unless otherwise indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.
- B. Through-Wall Flashing: Installation of through-wall flashing is specified in Section 042000 "Unit Masonry."

3.7 MISCELLANEOUS FLASHING INSTALLATION

- A. Equipment Support Flashing: Coordinate installation of equipment support flashing with installation of roofing and equipment. Weld or seal flashing with elastomeric sealant to equipment support member.
- B. Overhead-Piping Safety Pans: Suspend pans from structure above, independent of other overhead items such as equipment, piping, and conduit, unless otherwise indicated on Drawings. Pipe and install drain line to plumbing waste or drainage system.

3.8 ERECTION TOLERANCES

- A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines indicated on Drawings and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.
- B. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

3.9 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder.
- C. Clean off excess sealants.
- D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended by sheet metal flashing and trim manufacturer. Maintain sheet metal flashing and trim in clean condition during construction.
- E. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 076200

SECTION 078100 - APPLIED FIREPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes sprayed fire-resistive materials (SFRM).

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Certificates: For each type of fireproofing.
- C. Evaluation Reports: For fireproofing, from ICC-ES.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A firm or individual certified, licensed, or otherwise qualified by fireproofing manufacturer as experienced and with sufficient trained staff to install manufacturer's products according to specified requirements.

1.6 FIELD CONDITIONS

- A. Environmental Limitations: Do not apply fireproofing when ambient or substrate temperature is 44 deg F (7 deg C) or lower unless temporary protection and heat are provided to maintain temperature at or above this level for 24 hours before, during, and for 24 hours after product application.
- B. Ventilation: Ventilate building spaces during and after application of fireproofing, providing complete air exchanges according to manufacturer's written instructions. Use natural means or, if they are inadequate, forced-air circulation until fireproofing dries thoroughly.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Assemblies: Provide fireproofing, including auxiliary materials, according to requirements of each fire-resistance design and manufacturer's written instructions.
- B. Fire-Resistance Design: Indicated on Drawings, tested according to ASTM E 119 or UL 263 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Steel members are to be considered unrestrained unless specifically noted otherwise.
- C. Asbestos: Provide products containing no detectable asbestos.

2.2 SPRAYED FIRE-RESISTIVE MATERIALS

- A. SFRM: Manufacturer's standard, factory-mixed, lightweight, dry formulation, complying with indicated fire-resistance design, and mixed with water at Project site to form a slurry or mortar before conveyance and application.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Carboline Company, subsidiary of RPM International, Fireproofing Products Div.; AD Southwest Fireproofing Type 7GP.
 - b. Grace, W. R. & Co. Conn.; Grace Construction Products; Monokote Z106/HY.
 - c. Isolatek International; Cafco 400.
 - 2. Application: Designated for exterior use by a qualified testing agency acceptable to authorities having jurisdiction.
 - 3. Bond Strength: Minimum 1000-lbf/sq. ft. (47.88-kPa) cohesive and adhesive strength based on field testing according to ASTM E 736.
 - 4. Density: Not less than 22 lb/cu. ft. (350 kg/cu. m) and as specified in the approved fire-resistance design, according to ASTM E 605.
 - 5. Thickness: As required for fire-resistance design indicated, measured according to requirements of fire-resistance design or ASTM E 605, whichever is thicker, but not less than 0.375 inch (9 mm).
 - 6. Combustion Characteristics: ASTM E 136.
 - 7. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Flame-Spread Index: 10 or less.
 - b. Smoke-Developed Index: 10 or less.
 - 8. Compressive Strength: Minimum 100 lbf/sq. in. (689 kPa) according to ASTM E 761.
 - 9. Corrosion Resistance: No evidence of corrosion according to ASTM E 937.
 - 10. Deflection: No cracking, spalling, or delamination according to ASTM E 759.

- 11. Effect of Impact on Bonding: No cracking, spalling, or delamination according to ASTM E 760.
- 12. Air Erosion: Maximum weight loss of 0.025 g/sq. ft. (0.270 g/sq. m) in 24 hours according to ASTM E 859.
- 13. Fungal Resistance: Treat products with manufacturer's standard antimicrobial formulation to result in no growth on specimens per ASTM G 21 or rating of 10 according to ASTM D 3274 when tested according to ASTM D 3273.

2.3 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that are compatible with fireproofing and substrates and are approved by UL or another testing and inspecting agency acceptable to authorities having jurisdiction for use in fire-resistance designs indicated.
- B. Substrate Primers: Primers approved by fireproofing manufacturer and complying with one or both of the following requirements:
 - 1. Primer and substrate are identical to those tested in required fire-resistance design by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
 - 2. Primer's bond strength in required fire-resistance design complies with specified bond strength for fireproofing and with requirements in UL's "Fire Resistance Directory" or in the listings of another qualified testing agency acceptable to authorities having jurisdiction, based on a series of bond tests according to ASTM E 736.
- C. Bonding Agent: Product approved by fireproofing manufacturer and complying with requirements in UL's "Fire Resistance Directory" or in the listings of another qualified testing agency acceptable to authorities having jurisdiction.
- D. Sealer: Transparent-drying, water-dispersible, tinted protective coating recommended in writing by fireproofing manufacturer for each fire-resistance design.
- E. Topcoat: Suitable for application over applied fireproofing; of type recommended in writing by fireproofing manufacturer for each fire-resistance design.
 - 1. Water-Based Permeable Topcoat: Factory-mixed formulation for brush, roller, or spray application over applied SFRM. Provide application at a rate of 60 sq. ft./gal. (1.5 sq. m/L).
 - a. Product: Subject to compliance with requirements, provide "Cafco Top-Coat" by Isolatek International.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrates and other conditions affecting performance of the Work and according to each fire-resistance design. Verify compliance with the following:
 - 1. Substrates are free of dirt, oil, grease, release agents, rolling compounds, mill scale, loose scale, incompatible primers, paints, and encapsulants, or other foreign substances capable of impairing bond of fireproofing with substrates under conditions of normal use or fire exposure.
 - 2. Objects penetrating fireproofing, including clips, hangers, support sleeves, and similar items, are securely attached to substrates.
 - 3. Substrates receiving fireproofing are not obstructed by ducts, piping, equipment, or other suspended construction that will interfere with fireproofing application.
- B. Verify that concrete work on steel deck has been completed before beginning fireproofing work.
- C. Verify that roof construction, installation of roof-top HVAC equipment, and other related work is complete before beginning fireproofing work.
- D. Conduct tests according to fireproofing manufacturer's written recommendations to verify that substrates are free of substances capable of interfering with bond.
- E. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Cover other work subject to damage from fallout or overspray of fireproofing materials during application.
- B. Clean substrates of substances that could impair bond of fireproofing.
- C. Prime substrates where included in fire-resistance design and where recommended in writing by fireproofing manufacturer unless compatible shop primer has been applied and is in satisfactory condition to receive fireproofing.

3.3 APPLICATION

A. Construct fireproofing assemblies that are identical to fire-resistance design indicated and products as specified, tested, and substantiated by test reports; for thickness, primers, sealers, topcoats, finishing, and other materials and procedures affecting fireproofing work.

- B. Comply with fireproofing manufacturer's written instructions for mixing materials, application procedures, and types of equipment used to mix, convey, and apply fireproofing; as applicable to particular conditions of installation and as required to achieve fire-resistance ratings indicated.
- C. Coordinate application of fireproofing with other construction to minimize need to cut or remove fireproofing.
 - 1. Do not begin applying fireproofing until clips, hangers, supports, sleeves, and other items penetrating fireproofing are in place.
 - 2. Defer installing ducts, piping, and other items that would interfere with applying fireproofing until application of fireproofing is completed.
- D. Metal Decks:
 - 1. Do not apply fireproofing to underside of metal deck substrates until concrete topping, if any, has been completed.
 - 2. Do not apply fireproofing to underside of metal roof deck until roofing has been completed; prohibit roof traffic during application and drying of fireproofing.
- E. Install auxiliary materials as required, as detailed, and according to fire-resistance design and fireproofing manufacturer's written recommendations for conditions of exposure and intended use. For auxiliary materials, use attachment and anchorage devices of type recommended in writing by fireproofing manufacturer.
- F. Spray apply fireproofing to maximum extent possible. Following the spraying operation in each area, complete the coverage by trowel application or other placement method recommended in writing by fireproofing manufacturer.
- G. Extend fireproofing in full thickness over entire area of each substrate to be protected.
- H. Install body of fireproofing in a single course unless otherwise recommended in writing by fireproofing manufacturer.
- I. Where sealers are used, apply products that are tinted to differentiate them from fireproofing over which they are applied.
- J. Provide a uniform finish complying with description indicated for each type of fireproofing material and matching finish approved for required mockups.
- K. Cure fireproofing according to fireproofing manufacturer's written recommendations.
- L. Do not install enclosing or concealing construction until after fireproofing has been applied, inspected, and tested and corrections have been made to deficient applications.
- M. Finishes: Where indicated, apply fireproofing to produce the following finishes:
 - 1. Manufacturer's Standard Finishes: Finish according to manufacturer's written instructions for each finish selected.

3.4 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
 - 1. Test and inspect as required by the IBC, 1704.10.
- B. Perform the tests and inspections of completed Work in successive stages. Do not proceed with application of fireproofing for the next area until test results for previously completed applications of fireproofing show compliance with requirements. Tested values must equal or exceed values as specified and as indicated and required for approved fire-resistance design.
- C. Fireproofing will be considered defective if it does not pass tests and inspections.
 - 1. Remove and replace fireproofing that does not pass tests and inspections, and retest.
 - 2. Apply additional fireproofing, per manufacturer's written instructions, where test results indicate insufficient thickness, and retest.
- D. Prepare test and inspection reports.

3.5 CLEANING, PROTECTING, AND REPAIRING

- A. Cleaning: Immediately after completing spraying operations in each containable area of Project, remove material overspray and fallout from surfaces of other construction and clean exposed surfaces to remove evidence of soiling.
- B. Protect fireproofing, according to advice of manufacturer and Installer, from damage resulting from construction operations or other causes, so fireproofing will be without damage or deterioration at time of Substantial Completion.
- C. As installation of other construction proceeds, inspect fireproofing and repair damaged areas and fireproofing removed due to work of other trades.
- D. Repair fireproofing damaged by other work before concealing it with other construction.
- E. Repair fireproofing by reapplying it using same method as original installation or using manufacturer's recommended trowel-applied product.

END OF SECTION 078100

SECTION 078446 - FIRE-RESISTIVE JOINT SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Joints in or between fire-resistance-rated constructions.
- B. Related Sections:
 - 1. Section 078413 "Penetration Firestopping" for penetrations in fire-resistance-rated walls, horizontal assemblies, and smoke barriers.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Product Schedule: For each fire-resistive joint system. Include location and design designation of qualified testing agency.
 - 1. Where Project conditions require modification to a qualified testing agency's illustration for a particular fire-resistive joint system condition, submit illustration, with modifications marked, approved by fire-resistive joint system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Installer Certificates: From Installer indicating fire-resistive joint systems have been installed in compliance with requirements and manufacturer's written recommendations.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for fire-resistive joint systems.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A firm experienced in installing fire-resistive joint systems similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its fire-resistive joint system products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.
- B. Fire-Test-Response Characteristics: Fire-resistive joint systems shall comply with the following requirements:
 - 1. Fire-resistive joint system tests are performed by a qualified testing agency acceptable to authorities having jurisdiction.
 - 2. Fire-resistive joint systems are identical to those tested per testing standard referenced in "Fire-Resistive Joint Systems" Article. Provide rated systems complying with the following requirements:
 - a. Fire-resistive joint system products bear classification marking of qualified testing agency.
 - b. Fire-resistive joint systems correspond to those indicated by reference to designations listed by the following:
 - 1) UL in its "Fire Resistance Directory."

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install fire-resistive joint systems when ambient or substrate temperatures are outside limits permitted by fire-resistive joint system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.
- B. Install and cure fire-resistive joint systems per manufacturer's written instructions using natural means of ventilation or, where this is inadequate, forced-air circulation.

1.7 COORDINATION

- A. Coordinate construction of joints to ensure that fire-resistive joint systems are installed according to specified requirements.
- B. Coordinate sizing of joints to accommodate fire-resistive joint systems.
- C. Notify Owner's testing agency at least seven days in advance of fire-resistive joint system installations; confirm dates and times on day preceding each series of installations.

PART 2 - PRODUCTS

2.1 FIRE-RESISTIVE JOINT SYSTEMS

- A. Where required, provide fire-resistive joint systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which fire-resistive joint systems are installed. Fire-resistive joint systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.
- B. Joints in or between Fire-Resistance-Rated Construction: Provide fire-resistive joint systems with ratings determined per ASTM E 1966 or UL 2079:
 - 1. Joints include those installed in or between fire-resistance-rated walls, floor or floor/ceiling assemblies and roofs or roof/ceiling assemblies.
 - 2. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of construction they will join.
 - 3. <u>Manufacturers</u>: Subject to compliance with requirements, provide products by one of the following:
 - a. <u>Grace Construction Products</u>.
 - b. <u>Hilti, Inc</u>.
 - c. <u>3M Fire Protection Products</u>.
 - d. <u>Tremco, Inc.; Tremco Fire Protection Systems Group</u>.
- C. Exposed Fire-Resistive Joint Systems: Provide products with flame-spread and smokedeveloped indexes of less than 25 and 450, respectively, as determined per ASTM E 84.
- D. Accessories: Provide components of fire-resistive joint systems, including primers and forming materials, that are needed to install fill materials and to maintain ratings required. Use only components specified by fire-resistive joint system manufacturer and approved by the qualified testing agency for systems indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Clean joints immediately before installing fire-resistive joint systems to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:

- 1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of fill materials.
- 2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with fill materials. Remove loose particles remaining from cleaning operation.
- 3. Remove laitance and form-release agents from concrete.
- B. Priming: Prime substrates where recommended in writing by fire-resistive joint system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
- C. Masking Tape: Use masking tape to prevent fill materials of fire-resistive joint system from contacting adjoining surfaces that will remain exposed on completion of the Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove stains. Remove tape as soon as possible without disturbing fire-resistive joint system's seal with substrates.

3.3 INSTALLATION

- A. General: Install fire-resistive joint systems to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Install forming materials and other accessories of types required to support fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
 - 1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.
- C. Install fill materials for fire-resistive joint systems by proven techniques to produce the following results:
 - 1. Fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.
 - 2. Apply fill materials so they contact and adhere to substrates formed by joints.
 - 3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 FIELD QUALITY CONTROL

- A. Inspecting Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Where deficiencies are found or fire-resistive joint systems are damaged or removed due to testing, repair or replace fire-resistive joint systems so they comply with requirements.
- C. Proceed with enclosing fire-resistive joint systems with other construction only after inspection reports are issued and installations comply with requirements.

3.5 CLEANING AND PROTECTING

- A. Clean off excess fill materials adjacent to joints as the Work progresses by methods and with cleaning materials that are approved in writing by fire-resistive joint system manufacturers and that do not damage materials in which joints occur.
- B. Provide final protection and maintain conditions during and after installation that ensure fireresistive joint systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated fire-resistive joint systems immediately and install new materials to produce fireresistive joint systems complying with specified requirements.

3.6 FIRE-RESISTIVE JOINT SYSTEM SCHEDULE

- A. Where UL-classified systems are indicated, they refer to system numbers in UL's "Fire Resistance Directory" under product Category XHBN or Category XHDG.
- B. Floor-to-Floor, Fire-Resistive Joint Systems:
 - 1. UL-Classified Systems: FF-D- 0000-0999.
 - 2. Assembly Rating: 1 hour.
 - 3. Nominal Joint Width: ¹/₂-inch to 1-inch
 - 4. Movement Capabilities: Class I 12-1/2percent compression or extension.
 - 5. W-Rating: No leakage of water at completion of water leakage testing.
- C. Wall-to-Wall, Fire-Resistive Joint Systems:
 - 1. UL-Classified Systems: WW-D- 0000-0999.
 - 2. Assembly Rating: 1 hour.
 - 3. Nominal Joint Width: 1/2-inch
 - 4. Movement Capabilities: Class I 12-1/2 percent compression or extension.
- D. Floor-to-Wall, Fire-Resistive Joint Systems:
 - 1. UL-Classified Systems: FW-D- 0000-0999.
 - 2. Assembly Rating: 1 hour.
 - 3. Nominal Joint Width: ¹/₂-inch to 1-inch.
 - 4. Movement Capabilities: Class I 12-1/2 percent compression or extension.
- E. Head-of-Wall, Fire-Resistive Joint Systems:
 - 1. UL-Classified Systems: HW-D- 0000-0999.
 - 2. Assembly Rating: 1 hour.
 - 3. Nominal Joint Width: As indicated.
 - 4. Movement Capabilities: Class I 12-1/2 percent compression or extension.
- F. Bottom-of-Wall, Fire-Resistive Joint Systems:
 - 1. UL-Classified Systems: BW-D- 0000-0999.

- 2. Assembly Rating: 1 hour.
- 3. Nominal Joint Width: As indicated.
- 4. Movement Capabilities: Class I 12-1/2 percent compression or extension.

END OF SECTION 078446

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Silicone joint sealants.
 - 2. Urethane joint sealants.
 - 3. Polysulfide joint sealants.
 - 4. Latex joint sealants.
 - 5. Solvent-release-curing joint sealants.
 - 6. Acoustical joint sealants.
- B. Related Sections:
 - 1. Section 042000 "Unit Masonry" for masonry control and expansion joint fillers and gaskets.
 - 2. Section 078446 "Fire-Resistive Joint Systems" for sealing joints in fire-resistance-rated construction.
 - 3. Section 088000 "Glazing" for glazing sealants.
 - 4. Section 092900 "Gypsum Board" for sealing perimeter joints.
 - 5. Section 093000 "Tiling" for sealing tile joints.
 - 6. Section 095113 "Acoustical Panel Ceilings" for sealing edge moldings at perimeters with acoustical sealant.

1.3 PRECONSTRUCTION TESTING

- A. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.
 - 1. Use ASTM C 1087 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
 - 2. Submit not fewer than eight pieces of each kind of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
 - 3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
 - 4. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.

5. Testing will not be required if joint-sealant manufacturers submit joint preparation data that are based on previous testing, not older than 24 months, of sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.

1.4 ACTION SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
- B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
- C. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- (13-mm-) wide joints formed between two 6-inch- (150-mm-) long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- D. Joint-Sealant Schedule: Include the following information:
 - 1. Joint-sealant application, joint location, and designation.
 - 2. Joint-sealant manufacturer and product name.
 - 3. Joint-sealant formulation.
 - 4. Joint-sealant color.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Product Certificates: For each kind of joint sealant and accessory, from manufacturer.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that sealants comply with requirements.
- D. Preconstruction Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:
 - 1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
 - 2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.
- E. Preconstruction Field-Adhesion Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.
- F. Warranties: Sample of special warranties.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.
- C. Product Testing: Test joint sealants using a qualified testing agency.
 - 1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.
- D. Mockups: Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.

1.7 PROJECT CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
 - 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F (5 deg C).
 - 2. When joint substrates are wet.
 - 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
 - 4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.8 WARRANTY

- A. Special Installer's Warranty: Manufacturer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer's standard form in which joint-sealant manufacturer agrees to furnish joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.
- C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:

- 1. Movement of the structure caused by structural settlement or errors attributable to design or construction resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
- 2. Disintegration of joint substrates from natural causes exceeding design specifications.
- 3. Mechanical damage caused by individuals, tools, or other outside agents.
- 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
- B. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
- C. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.
- D. Suitability for Contact with Food: Where sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.
- E. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 SILICONE JOINT SEALANTS

- A. Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 100/50, for Use NT.
 - 1. <u>Products</u>: Subject to compliance with requirements, provide one of the following:
 - a. <u>Dow Corning Corporation</u>; 790.
 - b. <u>GE Advanced Materials</u> Silicones; SilPruf LM SCS2700.
 - c. <u>Pecora Corporation;</u> 890.
 - d. <u>Sika Corporation, Construction Products Division;</u> SikaSil-C990.
 - e. <u>Tremco Incorporated</u>; Spectrem 1.
- B. Mildew-Resistant, Single-Component, Acid-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.
 - 1. <u>Products</u>: Subject to compliance with requirements, provide one of the following:

- a. <u>BASF Building Systems</u>; Omniplus.
- b. Dow Corning Corporation; 786 Mildew Resistant.
- c. GE Advanced Materials Silicones; Sanitary SCS1700.
- d. May National Associates, Inc.; Bondaflex Sil 100 WF.
- e. Tremco Incorporated; Tremsil 200 Sanitary.

2.3 URETHANE JOINT SEALANTS

- A. Single-Component, Nonsag, Urethane Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.
 - 1. <u>Products</u>: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. **<u>BASF Building Systems</u>**; Sonolastic NP1.
 - b. Bostik, Inc.; Chem-Calk 900.
 - c. <u>Pecora Corporation</u>; Dynatrol I-XL.
 - d. <u>Polymeric Systems, Inc.</u>; Flexiprene 1000.
 - e. <u>Sika Corporation, Construction Products Division; Sikaflex 1a.</u>
 - f. <u>Tremco Incorporated</u>; Dymonic.
- B. Immersible Multicomponent, Pourable, Traffic-Grade, Urethane Joint Sealant: ASTM C 920. Type M, Grade P, Class 25, for Use T and I.
 - 1. <u>Products</u>: Subject to compliance with requirements, provide one of the following:
 - a. <u>LymTal International, Inc</u>.; Iso-Flex 880 GB.
 - b. May National Associates, Inc.; Bondaflex PUR 2 SL.
 - c. <u>Tremco Incorporated</u>; Vulkem 245.

2.4 POLYSULFIDE JOINT SEALANTS

- A. Multicomponent, Nonsag, Polysulfide Joint Sealant: ASTM C 920, Type M, Grade NS, Class 25, for Use NT.
 - 1. <u>Products</u>: Subject to compliance with requirements, provide one of the following:
 - a. <u>BASF Building Systems</u>; Sonolastic Polysulfide Sealant.
 - b. <u>Pecora Corporation</u>; Synthacalk GC-2+.
 - c. <u>W. R. Meadows, Inc</u>.; Deck-O-Seal Gun Grade.

2.5 LATEX JOINT SEALANTS

- A. Latex Joint Sealant: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.
 - 1. <u>Products</u>: Subject to compliance with requirements, provide one of the following:

- a. <u>BASF Building Systems</u>; Sonolac.
- b. Bostik, Inc.; Chem-Calk 600.
- c. <u>Pecora Corporation</u>; AC-20+.
- d. <u>Schnee-Morehead, Inc</u>.; SM 8200.
- e. <u>Tremco Incorporated</u>; Tremflex 834.

2.6 SOLVENT-RELEASE-CURING JOINT SEALANTS

- A. Butyl-Rubber-Based Joint Sealant: ASTM C 1311.
 - 1. <u>Products</u>: Subject to compliance with requirements, provide one of the following:
 - a. <u>Bostik, Inc</u>.; Chem-Calk 300.
 - b. <u>Pecora Corporation</u>; BC-158.
 - c. <u>Tremco Incorporated</u>; Tremco Butyl Sealant.

2.7 ACOUSTICAL JOINT SEALANTS

- A. Acoustical Joint Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
 - 1. <u>Products</u>: Subject to compliance with requirements, provide one of the following:
 - a. <u>Pecora Corporation</u>; AC-20 FTR.
 - b. <u>USG Corporation</u>; SHEETROCK Acoustical Sealant.

2.8 JOINT SEALANT BACKING

- A. General: Provide sealant backings of material that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.9 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
 - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
 - 2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
 - a. Concrete.
 - b. Masonry.
 - c. Unglazed surfaces of ceramic tile.
 - d. Exterior insulation and finish systems.
 - 3. Remove laitance and form-release agents from concrete.

- 4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
 - a. Metal.
 - b. Glass.
 - c. Porcelain enamel.
 - d. Glazed surfaces of ceramic tile.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - 1. Do not leave gaps between ends of sealant backings.
 - 2. Do not stretch, twist, puncture, or tear sealant backings.
 - 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
 - 1. Place sealants so they directly contact and fully wet joint substrates.
 - 2. Completely fill recesses in each joint configuration.
 - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form

smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

- 1. Remove excess sealant from surfaces adjacent to joints.
- 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
- 3. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.
- 4. Provide flush joint profile where indicated per Figure 8B in ASTM C 1193.
- G. Installation of Preformed Silicone-Sealant System: Comply with the following requirements:
 - 1. Apply masking tape to each side of joint, outside of area to be covered by sealant system.
 - 2. Apply silicone sealant to each side of joint to produce a bead of size complying with preformed silicone-sealant system manufacturer's written instructions and covering a bonding area of not less than 3/8 inch (10 mm). Hold edge of sealant bead 1/4 inch (6 mm) inside masking tape.
 - 3. Within 10 minutes of sealant application, press silicone extrusion into sealant to wet extrusion and substrate. Use a roller to apply consistent pressure and ensure uniform contact between sealant and both extrusion and substrate.
 - 4. Complete installation of sealant system in horizontal joints before installing in vertical joints. Lap vertical joints over horizontal joints. At ends of joints, cut silicone extrusion with a razor knife.
- H. Acoustical Sealant Installation: At sound-rated assemblies and elsewhere as indicated, seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations.

3.4 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.5 **PROTECTION**

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.6 JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces JS-1.

- 1. Joint Locations:
 - a. Control and expansion joints in brick pavers.
 - b. Isolation and contraction joints in cast-in-place concrete slabs.
 - c. Joints between different materials listed above.
 - d. Other joints as indicated.
- 2. Polysulfide Joint Sealant: Multicomponent, nonsag, traffic grade.
- 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- B. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces subject to water immersion JS-2.
 - 1. Joint Locations:
 - a. Joints in pedestrian plazas.
 - b. Other joints as indicated.
 - 2. Urethane Joint Sealant: Immersible, single component, pourable, traffic grade.
 - 3. Polysulfide Joint Sealant: Immersible, multicomponent, nonsag, traffic grade.
 - 4. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- C. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces JS-3.
 - 1. Joint Locations:
 - a. Construction joints in cast-in-place concrete.
 - b. Joints between cast stone units.
 - c. Control and expansion joints in unit masonry.
 - d. Joints in glass unit masonry assemblies.
 - e. Joints between metal panels.
 - f. Joints between different materials listed above.
 - g. Perimeter joints between materials listed above and frames of doors, windows, and louvers.
 - h. Control and expansion joints in ceilings and other overhead surfaces.
 - i. Other joints as indicated.
 - 2. Silicone Joint Sealant: Single component, nonsag, neutral curing, Class 100/50.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- D. Joint-Sealant Application: Interior joints in horizontal traffic surfaces JS-4.
 - 1. Joint Locations:
 - a. Isolation joints in cast-in-place concrete slabs.
 - b. Control and expansion joints in tile flooring.
 - c. Other joints as indicated.
 - 2. Silicone Joint Sealant: Single component, nonsag, traffic grade, neutral curing.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

- E. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces JS-5.
 - 1. Joint Locations:
 - a. Control and expansion joints on exposed interior surfaces of exterior walls.
 - b. Perimeter joints of exterior openings where indicated.
 - c. Other joints as indicated.
 - 2. Silicone Joint Sealant: Single component, nonsag, neutral curing, Class 100/50.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- F. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces JS-6.
 - 1. Joint Locations:
 - a. Tile control and expansion joints.
 - b. Vertical joints on exposed surfaces of interior unit masonry, concrete walls, and partitions.
 - c. Perimeter joints between interior wall surfaces and frames of interior doors, windows and elevator entrances.
 - d. Other joints as indicated.
 - 2. Joint Sealant: Latex.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- G. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces **JS-7**.
 - 1. Joint Sealant Location:
 - a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
 - b. Tile control and expansion joints where indicated.
 - c. Other joints as indicated.
 - 2. Joint Sealant: Single component, nonsag, mildew resistant, acid curing.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- H. Joint-Sealant Application: Interior acoustical joints in vertical surfaces and horizontal nontraffic surfaces JS-8.
 - 1. Joint Location:
 - a. Acoustical joints where indicated.
 - b. Other joints as indicated.
 - 2. Joint Sealant: Acoustical.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

END OF SECTION 079200

JOINT SEALANTS

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes hollow-metal work.
- B. Related Requirements:
 1. Section 087100 "Door Hardware" for door hardware for hollow-metal doors.

1.3 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

1.4 COORDINATION

A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, core descriptions, fire-resistance ratings, temperature-rise ratings, and finishes.
- B. Shop Drawings: Include the following:
 - 1. Elevations of each door type.
 - 2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
 - 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
 - 4. Locations of reinforcement and preparations for hardware.
 - 5. Details of each different wall opening condition.
 - 6. Details of anchorages, joints, field splices, and connections.
 - 7. Details of accessories.
 - 8. Details of moldings, removable stops, and glazing.

C. Schedule: Provide a schedule of hollow-metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final Door Hardware Schedule.

1.6 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each type of hollow-metal door and frame assembly, for tests performed by a qualified testing agency.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow-metal work palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
 - 1. Provide additional protection to prevent damage to factory-finished units.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store hollow-metal work vertically under cover at Project site with head up. Place on minimum 4-inch- (102-mm-) high wood blocking. Provide minimum 1/4-inch (6-mm) space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. <u>Manufacturers</u>: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. <u>Ceco Door Products</u>; an Assa Abloy Group company.
 - 2. <u>Curries Company</u>; an Assa Abloy Group company.
 - 3. <u>Custom Metal Products</u>.
 - 4. <u>Mesker Door Inc</u>.
 - 5. <u>National Custom Hollow Metal</u>.
 - 6. <u>Republic Doors and Frames</u>.
 - 7. <u>Steelcraft</u>; an Ingersoll-Rand company.
- B. Source Limitations: Obtain hollow-metal work from single source from single manufacturer.

2.2 REGULATORY REQUIREMENTS

A. Fire-Rated Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings and temperature-rise limits indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.

- 1. Smoke- and Draft-Control Assemblies: Provide an assembly with gaskets listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.
- B. Fire-Rated, Borrowed-Light Assemblies: Complying with NFPA 80 and listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.

2.3 INTERIOR DOORS AND FRAMES

- A. Construct interior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Commercial Doors and Frames: NAAMM-HMMA 861..
 - 1. Physical Performance: Level A according to SDI A250.4.
 - 2. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches (44.5 mm.)
 - c. Face: Uncoated, cold-rolled steel sheet, minimum thickness of 0.042 inch (1.0 mm).
 - d. Edge Construction: Continuously welded with no visible seam.
 - e. Core: Steel stiffened.

3. Frames:

- a. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch (1.3 mm).
- b. Construction: Full profile welded.
- 4. Exposed Finish: Prime.

2.4 EXTERIOR HOLLOW-METAL DOORS AND FRAMES

- A. Construct exterior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Commercial Doors and Frames: NAAMM-HMMA 861..
 - 1. Physical Performance: Level A according to SDI A250.4.
 - 2. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches (44.5 mm.)
 - c. Face: Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.30 mm), with minimum G60 (Z180 or)A60 (ZF180) coating.

- d. Edge Construction: Continuously welded with no visible seam.
- e. Core: Steel stiffened.
 - 1) Thermal-Rated Doors: Provide doors fabricated with thermal-resistance value (R-value) of not less than 2.1 deg F x h x sq. ft./Btu (0.370 K x sq. m/W) when tested according to ASTM C 1363.
- 3. Frames:
 - a. Materials: Metallic-coated steel sheet, minimum thickness of 0.067 inch (1.7 mm), with minimum G60 (Z180 or)A60 (ZF180) coating.
 - b. Construction: Full profile welded.
- 4. Exposed Finish: Prime.

2.5 FRAME ANCHORS

- A. Jamb Anchors:
 - 1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch (1.0 mm) thick, with corrugated or perforated straps not less than 2 inches (51 mm) wide by 10 inches (254 mm) long; or wire anchors not less than 0.177 inch (4.5 mm) thick.
 - 2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch (1.0 mm) thick.
 - 3. Compression Type for Drywall Slip-on Frames: Adjustable compression anchors.
 - 4. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch-(9.5-mm-) diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.
- B. Floor Anchors: Formed from same material as frames, minimum thickness of 0.042 inch (1.0 mm), and as follows:
 - 1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
 - 2. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch (51-mm) height adjustment. Terminate bottom of frames at finish floor surface.

2.6 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B.

- D. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z (12G) coating designation; mill phosphatized.
 - 1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.
- E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- F. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.
- G. Grout: ASTM C 476, except with a maximum slump of 4 inches (102 mm), as measured according to ASTM C 143/C 143M.
- H. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.
- I. Glazing: Comply with requirements in Section 088000 "Glazing."
- J. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.7 FABRICATION

- A. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
- B. Hollow-Metal Doors:
 - 1. Steel-Stiffened Door Cores: Provide minimum thickness 0.026 inch (0.66 mm), steel vertical stiffeners of same material as face sheets extending full-door height, with vertical webs spaced not more than 6 inches (152 mm) apart. Spot weld to face sheets no more than 5 inches (127 mm) o.c. Fill spaces between stiffeners with glass- or mineral-fiber insulation.
 - 2. Fire Door Cores: As required to provide fire-protection and temperature-rise ratings indicated.
 - 3. Vertical Edges for Single-Acting Doors: Bevel edges 1/8 inch in 2 inches (3.2 mm in 51 mm).
 - 4. Top Edge Closures: Close top edges of doors with inverted closures, except provide flush closures at exterior doors of same material as face sheets.
 - 5. Bottom Edge Closures: Close bottom edges of doors where required for attachment of weather stripping with end closures or channels of same material as face sheets.

- 6. Exterior Doors: Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
- C. Hollow-Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
 - 1. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
 - 2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 - 3. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
 - 4. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.
 - 5. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Masonry Type: Locate anchors not more than 16 inches (406 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c., to match coursing, and as follows:
 - 1) Two anchors per jamb up to 60 inches (1524 mm) high.
 - 2) Three anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.
 - 3) Four anchors per jamb from 90 to 120 inches (2286 to 3048 mm) high.
 - 4) Four anchors per jamb plus one additional anchor per jamb for each 24 inches (610 mm) or fraction thereof above 120 inches (3048 mm) high.
 - b. Stud-Wall Type: Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c. and as follows:
 - 1) Three anchors per jamb up to 60 inches (1524 mm) high.
 - 2) Four anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.
 - 3) Five anchors per jamb from 90 to 96 inches (2286 to 2438 mm) high.
 - 4) Five anchors per jamb plus one additional anchor per jamb for each 24 inches (610 mm) or fraction thereof above 96 inches (2438 mm) high.
 - c. Postinstalled Expansion Type: Locate anchors not more than 6 inches (152 mm) from top and bottom of frame. Space anchors not more than 26 inches (660 mm) o.c.
 - 6. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
 - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
 - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
- D. Fabricate concealed stiffeners and edge channels from either cold- or hot-rolled steel sheet.

- E. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.
 - 1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
 - 2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.
- F. Stops and Moldings: Provide stops and moldings around glazed lites and louvers where indicated. Form corners of stops and moldings with mitered hairline joints.
 - 1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollowmetal work.
 - 2. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
 - 3. Provide loose stops and moldings on inside of hollow-metal work.
 - 4. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.

2.8 STEEL FINISHES

- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
 - 1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

2.9 ACCESSORIES

- A. Louvers: Provide louvers for interior doors, where indicated, which comply with SDI 111C, with blades or baffles formed of 0.0375-inch thick, cold-rolled steel sheet set into 0.050-inch thick steel frame.
 - 1. Sightproof Louver: Stationary louvers constructed with inverted-V or inverted-Y blades.
 - 2. Louver shall be 50% free area
 - 3. Frame to be self-attaching, vandal-proof design with flanged frame welded to face (exterior / corridor) side and separate removable flange frame on opposite side.
 - 4. Color to match door.
- B. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.
- C. Grout Guards: Formed from same material as frames, not less than 0.016 inch (0.4 mm) thick.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
- B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

- A. General: Install hollow-metal work plumb, rigid, properly aligned, and securely fastened in place. Comply with Drawings and manufacturer's written instructions.
- B. Hollow-Metal Frames: Install hollow-metal frames of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.
 - 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
 - a. At fire-rated openings, install frames according to NFPA 80.
 - b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
 - c. Install frames with removable stops located on secure side of opening.
 - d. Install door silencers in frames before grouting.
 - e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
 - f. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
 - g. Field apply bituminous coating to backs of frames that will be filled with grout containing antifreezing agents.

- 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
 - a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
- 3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation inside frames.
- 4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
- 5. Concrete Walls: Solidly fill space between frames and concrete with mineral-fiber insulation.
- 6. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
- 7. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
 - a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.
- C. Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.
 - 1. Non-Fire-Rated Steel Doors:
 - a. Between Door and Frame Jambs and Head: 1/8 inch (3.2 mm) plus or minus 1/32 inch (0.8 mm).
 - b. Between Edges of Pairs of Doors: 1/8 inch (3.2 mm) to 1/4 inch (6.3 mm) plus or minus 1/32 inch (0.8 mm).
 - c. At Bottom of Door: 5/8 inch (15.8 mm) plus or minus 1/32 inch (0.8 mm).
 - d. Between Door Face and Stop: 1/16 inch (1.6 mm) to 1/8 inch (3.2 mm) plus or minus 1/32 inch (0.8 mm).
 - 2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
- D. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollowmetal manufacturer's written instructions.
 - 1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches (230 mm) o.c. and not more than 2 inches (51 mm) o.c. from each corner.

3.4 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.
- B. Remove grout and other bonding material from hollow-metal work immediately after installation.
- C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- D. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.
- E. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 081113
SECTION 081416 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Solid-core doors with wood-veneer faces.
 - 2. Factory finishing flush wood doors.
 - 3. Factory fitting flush wood doors to frames and factory machining for hardware.
- B. Related Requirements:
 - 1. Section 088000 "Glazing" for glass view panels in flush wood doors.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of door. Include details of core and edge construction, louvers, and trim for openings. Include factory-finishing specifications.
- B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; and the following:
 - 1. Dimensions and locations of blocking.
 - 2. Dimensions and locations of mortises and holes for hardware.
 - 3. Dimensions and locations of cutouts.
 - 4. Undercuts.
 - 5. Requirements for veneer matching.
 - 6. Doors to be factory finished and finish requirements.
 - 7. Fire-protection ratings for fire-rated doors.
- C. Samples for Initial Selection: For factory-finished doors.
- D. Samples for Verification:
 - 1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches (200 by 250 mm), for each material and finish. For each wood species and transparent finish, provide set of three Samples showing typical range of color and grain to be expected in finished Work.

- 2. Louver blade and frame sections, 6 inches (150 mm) long, for each material and finish specified.
- 3. Frames for light openings, 6 inches (150 mm) long, for each material, type, and finish required.

1.4 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For special warranty.
- B. Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of referenced standard and manufacturer's written instructions.
- B. Package doors individually in plastic bags or cardboard cartons.
- C. Mark each door on top and bottom rail with opening number used on Shop Drawings.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during remainder of construction period.

1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Warping (bow, cup, or twist) more than 1/4 inch (6.4 mm) in a 42-by-84-inch (1067-by-2134-mm) section.
 - b. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch (0.25 mm in a 76.2-mm) span.
 - 2. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
 - 3. Warranty Period for Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. <u>Manufacturers</u>: Subject to compliance with requirements, provide products by the following:
 - 1. <u>Algoma Hardwoods, Inc</u>.
 - 2. <u>Eggers Industries</u>.
 - 3. <u>Graham Wood Doors; an Assa Abloy Group company</u>.
 - 4. <u>Marshfield Door Systems, Inc</u>.
 - 5. <u>Mohawk Doors; a Masonite company</u>.
 - 6. <u>Oshkosh Door Company</u>.
 - 7. <u>VT Industries, Inc</u>.

2.2 FLUSH WOOD DOORS, GENERAL

- A. Quality Standard: In addition to requirements specified, comply with AWI's, AWMAC's, and WI's "Architectural Woodwork Standards or WDMA I.S.1-A, "Architectural Wood Flush Doors."
 - 1. Contract Documents contain selections chosen from options in quality standard and additional requirements beyond those of quality standard. Comply with those selections and requirements in addition to quality standard.
- B. WDMA I.S.1-A Performance Grade: Extra Heavy Duty.
- C. Fire-Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.
 - 1. Temperature-Rise Limit: At vertical exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.
 - 2. Cores: Provide core specified or mineral core as needed to provide fire-protection rating indicated.
 - 3. Edge Construction: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed edges.
 - a. Finish steel edges and astragals to match door hardware (locksets or exit devices).
- D. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control, based on testing according to UL 1784.
- E. Particleboard-Core Doors:
 - 1. Particleboard: ANSI A208.1, Grade LD-2.
 - 2. Provide doors with structural-composite-lumber cores instead of particleboard cores for doors indicated to receive exit devices.
- F. Structural-Composite-Lumber-Core Doors:

- 1. Structural Composite Lumber: WDMA I.S.10.
 - a. Screw Withdrawal, Face: 700 lbf (3100 N).
 - b. Screw Withdrawal, Edge: 400 lbf (1780 N).
- G. Mineral-Core Doors:
 - 1. Core: Noncombustible mineral product complying with requirements of referenced quality standard and testing and inspecting agency for fire-protection rating indicated.
 - 2. Blocking: Provide composite blocking with improved screw-holding capability approved for use in doors of fire-protection ratings indicated as needed to eliminate through-bolting hardware. follows:
 - a. 5-inch (125-mm) top-rail blocking.
 - b. 5-inch (125-mm) bottom-rail blocking, in doors indicated to have protection plates.
 - c. 5-inch (125-mm) midrail blocking, in doors indicated to have armor plates.
 - d. 4-1/2-by-10-inch (114-by-250-mm) lock blocks, in doors indicated to have exit devices.
 - 3. Edge Construction: At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.
 - a. Screw-Holding Capability: 550 lbf (2440 N) per WDMA T.M.-10.

2.3 VENEER-FACED DOORS FOR TRANSPARENT FINISH

- A. Interior Solid-Core Doors
 - 1. Grade: Premium, with Grade AA faces.
 - 2. Species: Select white maple.
 - 3. Cut: Plain sliced (flat sliced).
 - 4. Match between Veneer Leaves: Slip match.
 - 5. Assembly of Veneer Leaves on Door Faces: Running match.
 - 6. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.
 - 7. Room Match: Provide door faces of compatible color and grain within each separate room or area of building.
 - 8. Exposed Vertical Edges: Same species as faces or a compatible species edge Type A.
 - 9. Core: Particleboard.
 - 10. Construction: Five plies. Stiles and rails are bonded to core, then entire unit is abrasive planed before veneering.
 - 11. WDMA I.S.1-A Performance Grade: Extra Heavy Duty.

2.4 LIGHT FRAMES AND LOUVERS

A. Wood Beads for Light Openings in Wood Doors: Provide manufacturer's standard wood beads unless otherwise indicated.

- 1. Wood Species: Same species as door faces.
- 2. Profile: Flush rectangular beads.
- 3. At wood-core doors with 20-minute fire-protection ratings, provide wood beads and metal glazing clips approved for such use.
- B. Wood-Veneered Beads for Light Openings in Fire-Rated Doors: Manufacturer's standard wood-veneered noncombustible beads matching veneer species of door faces and approved for use in doors of fire-protection rating indicated. Include concealed metal glazing clips where required for opening size and fire-protection rating indicated.
- C. Metal Louvers:
 - 1. <u>Manufacturers</u>: Subject to compliance with requirements, provide products by one of the following:
 - a. <u>Air Louvers, Inc</u>.
 - b. <u>Anemostat; a Mestek company</u>.
 - c. <u>L & L Louvers, Inc</u>.
 - d. Louvers & Dampers, Inc.; a division of Mestek, Inc.
 - e. <u>McGill Architectural Products</u>.
 - 2. Blade Type: Vision-proof, inverted or V Vision-proof, inverted Y.
 - 3. Metal and Finish: Hot-dip galvanized steel, 0.040 inch (1.0 mm) thick, factory primed for paint finish.
 - 4. Provide louvers for interior doors, where indicated, which comply with SDI 111C, with blades or baffles formed of 0.0375-inch thick, cold-rolled steel sheet set into 0.050-inch thick steel frame.
 - 5. Frame to be self-attaching, vandal-proof design with flanged frame welded to face (exterior / corridor) side and separate removable flange frame on opposite side.
 - 6. Louver shall be 50% free area

2.5 FABRICATION

- A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
 - 1. Comply with NFPA 80 requirements for fire-rated doors.
- B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, BHMA-156.115-W, and hardware templates.
 - 1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.
- C. Openings: Factory cut and trim openings through doors.
 - 1. Light Openings: Trim openings with moldings of material and profile indicated.

- 2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 088000 "Glazing."
- 3. Louvers: Factory install louvers in prepared openings.

2.6 FACTORY FINISHING

- A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
 - 1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on top and bottom edges, edges of cutouts, and mortises.
- B. Factory finish doors.
- C. Transparent Finish:
 - 1. Grade: Premium.
 - 2. Finish: AWI's, AWMAC's, and WI's "Architectural Woodwork Standards" System 11, catalyzed polyurethane.
 - 3. Finish: WDMA TR-6 catalyzed polyurethane.
 - 4. Staining: Marshfield Bombay 64-02
 - 5. Sheen: Satin.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine doors and installed door frames, with Installer present, before hanging doors.
 - 1. Verify that installed frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
 - 2. Reject doors with defects.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Hardware: For installation, see Section 087100 "Door Hardware."
- B. Installation Instructions: Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.
 - 1. Install fire-rated doors according to NFPA 80.
- C. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.

D. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 ADJUSTING

- A. Operation: Rehang or replace doors that do not swing or operate freely.
- B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 081416

SECTION 083113 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Access doors and frames for walls and ceilings.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, fire ratings, materials, individual components and profiles, and finishes.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, details, and attachments to other work.
 - 2. Detail fabrication and installation of access doors and frames for each type of substrate.
- C. Product Schedule: Provide complete access door and frame schedule, including types, locations, sizes, latching or locking provisions, and other data pertinent to installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Access Doors and Frames: Units complying with NFPA 80 that are identical to access door and frame assemblies tested for fire-test-response characteristics according to the following test method and that are listed and labeled by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
 - 1. NFPA 252 or UL 10B for fire-rated access door assemblies installed vertically.
 - 2. NFPA 288 for fire-rated access door assemblies installed horizontally.

2.2 ACCESS DOORS AND FRAMES FOR WALLS AND CEILINGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Jensen Industries; Div. of Broan-Nutone, LLC.
 - 2. J. L. Industries, Inc.; Div. of Activar Construction Products Group.
 - 3. <u>Larsen's Manufacturing Company</u>.
 - 4. <u>Metropolitan Door Industries Corp</u>.
 - 5. <u>MIFAB, Inc</u>.
 - 6. <u>Nystrom, Inc</u>.
- B. Flush Access Doors with Exposed Flanges
 - 1. Assembly Description: Fabricate door to fit flush to frame. Provide manufacturer's standard-width exposed flange, proportional to door size.
 - 2. Locations: Wall and ceiling.
 - 3. Door Size: As indicated.
 - 4. Metallic-Coated Steel Sheet for Door: Nominal 0.064 inch (1.63 mm), 16 gage.
 - a. Finish: Factory prime.
 - 5. Frame Material: Same material, thickness, and finish as door.
 - 6. Hinges: Manufacturer's standard.
 - 7. Hardware: Latch.
- C. Exterior Flush Access Doors
 - 1. Assembly Description: Fabricate door to be weatherproof and fit flush to frame. Provide manufacturer's standard 2-inch- (50-mm-) thick fiberglass insulation and extruded door gaskets. Provide manufacturer's standard-width frame for surface mounting, proportional to door size.
 - 2. Locations: Wall (Including exterior walls with doors on inside for access to shut-off valve at wash down system)
 - 3. Door Size: As indicated
 - 4. Metallic-Coated Steel Sheet for Door: Nominal 0.064 inch (1.63 mm), 16 gage.
 - a. Finish: Factory finish.
 - 5. Frame Material: Same material, thickness, and finish as door.
 - 6. Hinges: Manufacturer's standard.
 - 7. Hardware: Latch.
- D. Fire-Rated, Flush Access Doors with Exposed Flanges
 - 1. Assembly Description: Fabricate door to fit flush to frame, with a core of mineral-fiber insulation enclosed in sheet metal. Provide self-latching door with automatic closer and interior latch release. Provide manufacturer's standard-width exposed flange, proportional to door size.
 - 2. Locations: Wall and ceiling. (Including Elevator ceiling)
 - 3. Fire-Resistance Rating: Not less than that of adjacent construction.
 - 4. Temperature-Rise Rating: 450 deg F (250 deg C) at the end of 30 minutes.

- 5. Metallic-Coated Steel Sheet for Door: Nominal 0.040 inch (1.02 mm), 20 gage.
 - a. Finish: Factory prime.
- 6. Frame Material: Same material, thickness, and finish as door.
- 7. Hinges: Manufacturer's standard.
- 8. Hardware: Latch.
- E. Hardware:
 - 1. Latch: Cam latch operated by screwdriver or by ring turn.

2.3 MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.
- C. Frame Anchors: Same type as door face.
- D. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.

2.4 FABRICATION

- A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.
- B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access doors to types of supports indicated.
 - 1. For concealed flanges with drywall bead, provide edge trim for gypsum board securely attached to perimeter of frames.
 - 2. Provide mounting holes in frames for attachment of units to metal or wood framing.
 - 3. Provide mounting holes in frame for attachment of masonry anchors.
- D. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.

2.5 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Steel and Metallic-Coated-Steel Finishes:
 - 1. Factory Prime: Apply manufacturer's standard, fast-curing, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.
 - 2. Factory Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat, with a minimum dry-film thickness of 1 mil (0.025 mm) for topcoat.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's written instructions for installing access doors and frames.
- B. Install doors flush with adjacent finish surfaces or received to receive finish material.

3.3 ADJUSTING

- A. Adjust doors and hardware, after installation, for proper operation.
- B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION 083113

SECTION 083313 - COILING COUNTER DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Counter doors.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type and size of coiling counter door and accessory.
 - 1. Include construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.
- B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.
 - 1. Include plans, elevations, sections, and mounting details.
 - 2. Include details of equipment assemblies, and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
- C. Samples for Initial Selection: Manufacturer's finish charts showing full range of colors and textures available for units with factory-applied finishes.
 - 1. Include similar Samples of accessories involving color selection.
- D. Samples for Verification: For each type of exposed finish on the following components, in manufacturer's standard sizes:
 - 1. Curtain slats.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For coiling counter doors to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.

PART 2 - PRODUCTS

2.1 MANUFACTURERS, GENERAL

- A. Source Limitations: Obtain coiling counter doors from single source from single manufacturer.
 - 1. Obtain operators and controls from coiling counter door manufacturer.

2.2 COUNTER DOOR ASSEMBLY <u>DC</u>

- A. Counter Door: Coiling counter door formed with curtain of interlocking metal slats.
 - 1. <u>Basis-of-Design Product</u>: Subject to compliance with requirements, provide <u>Cookson</u> <u>Company CD10-3</u> or comparable product by one of the following:
 - a. McKeon Rolling Steel Door Company, Inc.
 - b. <u>Overhead Door Corporation</u>.
 - c. <u>Wayne-Dalton Corp</u>.
- B. Operation Cycles: Door components and operators capable of operating for not less than 20,000. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.
- C. Door Curtain Material: Galvanized steel.
- D. Door Curtain Slats: Flat profile slats of 1-1/4-inch (32-mm) center-to-center height.
- E. Bottom Bar: Manufacturer's standard continuous channel or tubular shape, fabricated hot-dip galvanized steel and finished to match door.
- F. Curtain Jamb Guides: Aluminum with exposed finish matching curtain slats.
- G. Hood: Match curtain material and finish.

- 1. Shape: Square.
- 2. Mounting: Face of wall.
- H. Locking Devices: Equip door with locking device assembly.
 - 1. Locking Device Assembly: Cremone type, both jamb sides locking bars, operable from inside with thumb turn.
- I. Curtain Accessories: Equip door with weatherseals, astragal, poll hook.
- J. Door Finish:
 - 1. Baked-Enamel or Powder-Coated Finish: Color matching Architect's sample.

2.3 DOOR CURTAIN MATERIALS AND CONSTRUCTION

- A. Door Curtains: Fabricate coiling counter-door curtain of interlocking metal slats in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:
 - 1. Steel Door Curtain Slats: Zinc-coated (galvanized), cold-rolled structural steel sheet; complying with ASTM A 653/A 653M, with G90 (Z275) zinc coating; nominal sheet thickness (coated) of 0.028 inch (0.71 mm); and as required.
- B. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain.

2.4 HOODS

- A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.
 - 1. Galvanized Steel: Nominal 0.028-inch- (0.71-mm-) thick, hot-dip galvanized steel sheet with G90 (Z275) zinc coating, complying with ASTM A 653/A 653M.

2.5 LOCKING DEVICES

A. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on both left and right jamb sides, operable from coil side.

2.6 CURTAIN ACCESSORIES

- A. Weatherseals: Equip door with weather-stripping gaskets fitted to entire perimeter of door for air-resistant installation unless otherwise indicated.
 - 1. At door head, use 1/8-inch- (3-mm-) thick, replaceable, continuous-sheet baffle secured to inside of hood or field- installed on the header.
 - 2. At door jambs, use replaceable, adjustable, continuous, flexible, 1/8-inch- (3-mm-) thick seals of flexible vinyl, rubber, or neoprene.
- B. Astragal: Equip each door bottom bar with a replaceable, adjustable, continuous, compressible gasket of flexible vinyl, rubber, or neoprene as a cushion bumper.
- C. Poll Hooks: Provide pole hooks and poles for doors more than 84 inches (2130 mm) high.

2.7 COUNTERBALANCING MECHANISM

- A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.
- B. Counterbalance Barrel: Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, seamless carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than 0.03 in./ft. (2.5 mm/m) of span under full load.
- C. Counterbalance Spring: One or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Secure ends of springs to barrel and shaft with cast-steel barrel plugs.
- D. Torsion Rod for Counterbalance Shaft: Fabricate of manufacturer's standard cold-rolled steel, sized to hold fixed spring ends and carry torsional load.
- E. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

2.8 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM/NOMMA's "Metal Finishes Manual for Architectural and Metal Products (AMP 500-06)" for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.9 ALUMINUM FINISHES

A. Baked-Enamel or Powder-Coat Finish: AAMA 2603. Comply with coating manufacturer's written instructions for cleaning, conversion coating, application, and baking.

2.10 STEEL AND GALVANIZED-STEEL FINISHES

A. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates areas and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.
- B. Examine locations of electrical connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install coiling counter doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.
- B. Install coiling counter doors, hoods, controls, and operators at the mounting locations indicated for each door.

3.3 ADJUSTING

- A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.
- B. Lubricate bearings and sliding parts as recommended by manufacturer.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain coiling counter doors.

END OF SECTION 083313

SECTION 083323 - OVERHEAD COILING DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Service doors.
 - 2. Insulated service doors.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type and size of overhead coiling door and accessory.
 - 1. Include construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.
- B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.
 - 1. Include plans, elevations, sections, and mounting details.
 - 2. Include details of equipment assemblies, and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
 - 4. For exterior components, include details of provisions for assembly expansion and contraction and for excluding and draining moisture to the exterior.
 - 5. Show locations of controls, locking devices, and other accessories.
 - 6. Include diagrams for power, signal, and control wiring.
- C. Samples for Initial Selection: Manufacturer's finish charts showing full range of colors and textures available for units with factory-applied finishes.
 - 1. Include similar Samples of accessories involving color selection.
- D. Samples for Verification: For each type of exposed finish on the following components, in manufacturer's standard sizes:

1. Curtain slats.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For overhead coiling doors to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.
 - 1. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.
- B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC A117.1.

PART 2 - PRODUCTS

2.1 MANUFACTURERS, GENERAL

- A. Source Limitations: Obtain overhead coiling doors from single source from single manufacturer.
 - 1. Obtain operators and controls from overhead coiling door manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Structural Performance, Exterior Doors: Capable of withstanding the design wind loads.
 - 1. Design Wind Load: As indicated on Drawings.
 - 2. Deflection Limits: Design overhead coiling doors to withstand design wind load without evidencing permanent deformation or disengagement of door components.
 - 3. Operability under Wind Load: Design overhead coiling doors to remain operable under uniform pressure (velocity pressure) of 20 lbf/sq. ft. (960 Pa) wind load, acting inward and outward.

2.3 DOOR ASSEMBLY DA

- A. Service Door: Overhead coiling door formed with curtain of interlocking metal slats.
 - 1. <u>Basis-of-Design Product</u>: Subject to compliance with requirements, provide <u>Cookson</u> <u>Company Type FC</u> or comparable product by one of the following:
 - a. <u>Clopay Building Products</u>.
 - b. Janus International Corporation.
 - c. <u>McKeon Rolling Steel Door Company, Inc</u>.
 - d. <u>Overhead Door Corporation</u>.
- B. Operation Cycles: Door components and operators capable of operating for not less than 50,000. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.
- C. Air Infiltration: Maximum rate of 0.08 cfm/sq. ft. (0.406 L/s per sq. m) at 15 and 25 mph (24.1 and 40.2 km/h) when tested according to ASTM E 283 or DASMA 105.
- D. Door Curtain Material: Galvanized steel.
- E. Door Curtain Slats: Flat profile slats of 2-5/8-inch (67-mm) center-to-center height.
- F. Bottom Bar: Two angles, each not less than 1-1/2 by 1-1/2 by 1/8 inch (38 by 38 by 3 mm) thick; fabricated from hot-dip galvanized steel and finished to match door.
- G. Curtain Jamb Guides: Galvanized steel with exposed finish matching curtain slats.
- H. Hood: Match curtain material and finish.
 - 1. Shape: Round.
 - 2. Mounting: Face of wall.
- I. Locking Devices: Equip door with locking device assembly and chain lock keeper.
 - 1. Locking Device Assembly: Single-jamb side locking bars, operable from inside with thumb turn and outside with cylinder.
- J. Manual Door Operator: Chain-hoist operator.
- K. Curtain Accessories: Equip door with weatherseals and astragal.
- L. Door Finish:
 - 1. Baked-Enamel or Powder-Coated Finish: Color matching Architect's sample.
 - 2. Interior Curtain-Slat Facing: Match finish of exterior curtain-slat face.

2.4 DOOR ASSEMBLY <u>DB</u>

 A. Insulated Service Door: Overhead coiling door formed with curtain of interlocking metal slats.
 1. <u>Basis-of-Design Product</u>: Subject to compliance with requirements, provide <u>Cookson</u> <u>Company FMWI</u> or comparable product by one of the following:

- a. <u>Clopay Building Products</u>.
- b. Janus International Corporation.
- c. <u>McKeon Rolling Steel Door Company, Inc</u>.
- d. <u>Overhead Door Corporation</u>.
- B. Operation Cycles: Door components and operators capable of operating for not less than 50,000. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.
- C. Air Infiltration: Maximum rate of 0.08 cfm/sq. ft. (0.406 L/s per sq. m) at 15 and 25 mph (24.1 and 40.2 km/h) when tested according to ASTM E 283 or DASMA 105.
- D. Curtain R-Value: 4.5 deg F x h x sq. ft./Btu (0.792 K x sq. m/W).
- E. Door Curtain Material: Galvanized steel.
- F. Door Curtain Slats: Flat profile slats of 2-5/8-inch (67-mm) center-to-center height.
 1. Insulated-Slat Interior Facing: Metal.
- G. Bottom Bar: Two angles, each not less than 1-1/2 by 1-1/2 by 1/8 inch (38 by 38 by 3 mm) thick; fabricated from hot-dip galvanized steel and finished to match door.
- H. Curtain Jamb Guides: Galvanized steel with exposed finish matching curtain slats.
- I. Hood: Match curtain material and finish.
 - 1. Shape: Round.
 - 2. Mounting: Face of wall.
- J. Electric Door Operator:
 - 1. Usage Classification: Light duty, up to 10 cycles per hour.
 - 2. Operator Location: Front of hood.
 - 3. Safety: Listed according to UL 325 by a qualified testing agency for commercial or industrial use; moving parts of operator enclosed or guarded if exposed and mounted at 8 feet (2.44 m) or lower.
 - 4. Motor Exposure: Interior.
 - 5. Emergency Manual Operation: Chain type.
 - 6. Obstruction-Detection Device: Automatic photoelectric sensor. Cookson Featheredge connected to motor operator with coiled cord.
 - a. Sensor Edge Bulb Color: Black.
 - 7. Control Station(s): Interior mounted.
 - 8. Controller shall be interlocked with 5 air curtains such that when door is opened, air curtains turn on and when door is closed, air curtains turn off.
- K. Curtain Accessories: Equip door with weatherseals, astragal.
- L. Door Finish:

- 1. Baked-Enamel or Powder-Coated Finish: Color matching Architect's sample.
- 2. Interior Curtain-Slat Facing: Match finish of exterior curtain-slat face.

2.5 DOOR ASSEMBLY **DD**

- A. Insulated Service Door: Overhead coiling door formed with curtain of interlocking metal slats.
 - 1. <u>Basis-of-Design Product</u>: Subject to compliance with requirements, provide <u>Cookson</u> <u>Company Type FMWI</u> or comparable product by one of the following:
 - a. <u>Clopay Building Products</u>.
 - b. Janus International Corporation.
 - c. <u>McKeon Rolling Steel Door Company, Inc</u>.
 - d. <u>Overhead Door Corporation</u>.
- B. Operation Cycles: Door components and operators capable of operating for not less than 50,000. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.
- C. Air Infiltration: Maximum rate of 0.08 cfm/sq. ft. (0.406 L/s per sq. m) at 15 and 25 mph (24.1 and 40.2 km/h) when tested according to ASTM E 283 or DASMA 105.
- D. Curtain R-Value: 4.5 deg F x h x sq. ft./Btu (0.792 K x sq. m/W).
- E. Door Curtain Material: Galvanized steel.
- F. Door Curtain Slats: Flat profile slats of 2-5/8-inch (67-mm) center-to-center height.
 1. Insulated-Slat Interior Facing: Metal.
- G. Bottom Bar: Two angles, each not less than 1-1/2 by 1-1/2 by 1/8 inch (38 by 38 by 3 mm) thick; fabricated from hot-dip galvanized steel and finished to match door.
- H. Curtain Jamb Guides: Galvanized steel with exposed finish matching curtain slats.
- I. Hood: Match curtain material and finish.
 - 1. Shape: Round.
 - 2. Mounting: Face of wall.
- J. Electric Door Operator:
 - 1. Usage Classification: Light duty, up to 10 cycles per hour.
 - 2. Operator Location: Top of hood or Front of hood.
 - 3. Safety: Listed according to UL 325 by a qualified testing agency for commercial or industrial use; moving parts of operator enclosed or guarded if exposed and mounted at 8 feet (2.44 m) or lower.
 - 4. Motor Exposure: Interior.
 - 5. Emergency Manual Operation: Chain type.
 - 6. Obstruction-Detection Device: Automatic photoelectric sensor. Cookson Featheredge connected to motor operator with coiled cord.

- a. Sensor Edge Bulb Color: Black.
- 7. Control Station(s): Interior mounted.
- K. Curtain Accessories: Equip door with weatherseals, astragal.
- L. Door Finish:
 1. Baked-Enamel or Powder-Coated Finish: Color matching Architect's sample.

2.6 MATERIALS, GENERAL

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.7 DOOR CURTAIN MATERIALS AND CONSTRUCTION

- A. Door Curtains: Fabricate overhead coiling-door curtain of interlocking metal slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:
 - 1. Steel Door Curtain Slats: Zinc-coated (galvanized), cold-rolled structural steel sheet; complying with ASTM A 653/A 653M, with G90 (Z275) zinc coating; nominal sheet thickness (coated) of 0.028 inch (0.71 mm); and as required.
 - 2. Insulation: Fill slats for insulated doors with manufacturer's standard thermal insulation complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E 84 or UL 723. Enclose insulation completely within slat faces.
 - 3. Metal Interior Curtain-Slat Facing: Match metal of exterior curtain-slat face, with minimum steel thickness of 0.010 inch (0.25 mm).
- B. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain.

2.8 HOODS

- A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.
 - 1. Galvanized Steel: Nominal 0.028-inch- (0.71-mm-) thick, hot-dip galvanized steel sheet with G90 (Z275) zinc coating, complying with ASTM A 653/A 653M.

2.9 LOCKING DEVICES

- A. Locking Device Assembly: Fabricate with cylinder lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.
 - 1. Lock Cylinders: Cylinders specified in Section 087100 "Door Hardware" and keyed to building keying system.
- B. Chain Lock Keeper: Suitable for padlock.
- C. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

2.10 CURTAIN ACCESSORIES

- A. Weatherseals for Exterior Doors: Equip each exterior door with weather-stripping gaskets fitted to entire exterior perimeter of door for a weather-resistant installation unless otherwise indicated.
 - 1. At door head, use 1/8-inch- (3-mm-) thick, replaceable, continuous-sheet baffle secured to inside of hood or field- installed on the header.
 - 2. At door jambs, use replaceable, adjustable, continuous, flexible, 1/8-inch- (3-mm-) thick seals of flexible vinyl, rubber, or neoprene.

2.11 COUNTERBALANCING MECHANISM

- A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.
- B. Counterbalance Barrel: Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, seamless carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than 0.03 in./ft. (2.5 mm/m) of span under full load.
- C. Counterbalance Spring: One or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Secure ends of springs to barrel and shaft with cast-steel barrel plugs.
- D. Torsion Rod for Counterbalance Shaft: Fabricate of manufacturer's standard cold-rolled steel, sized to hold fixed spring ends and carry torsional load.
- E. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

2.12 MANUAL DOOR OPERATORS

- A. General: Equip door with manual door operator by door manufacturer.
- B. Chain-Hoist Operator: Consisting of endless steel hand chain, chain-pocket wheel and guard, and gear-reduction unit with a maximum 30-lbf (133-N) force for door operation. Provide alloy-steel hand chain with chain holder secured to operator guide.

2.13 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM/NOMMA's "Metal Finishes Manual for Architectural and Metal Products (AMP 500-06)" for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.14 STEEL AND GALVANIZED-STEEL FINISHES

A. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates areas and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.
- B. Examine locations of electrical connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install overhead coiling doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.
- B. Install overhead coiling doors, hoods, controls, and operators at the mounting locations indicated for each door.
- C. Accessibility: Install overhead coiling doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.

3.3 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Perform installation and startup checks according to manufacturer's written instructions.
 - 2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

3.4 ADJUSTING

- A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.
 - 1. Adjust exterior doors and components to be weather-resistant.
- B. Lubricate bearings and sliding parts as recommended by manufacturer.
- C. Adjust seals to provide tight fit around entire perimeter.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling doors.

END OF SECTION 083323

SECTION 083613 - SECTIONAL DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes electrically operated sectional doors.
- B. Related Sections:
 - 1. Section 055000 "Metal Fabrications" for miscellaneous steel supports.

1.3 PERFORMANCE REQUIREMENTS

- A. General Performance: Sectional doors shall meet performance requirements specified without failure due to defective manufacture, fabrication, installation, or other defects in construction and without requiring temporary installation of reinforcing components.
- B. Delegated Design: Design sectional doors, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- C. Structural Performance: Exterior sectional doors shall withstand the effects of gravity loads, and the following loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
 - 1. Wind Loads: As indicated on Drawings.
 - a. Basic Wind Speed: 100 mph (44 m/s).
 - b. Importance Factor: 1.15
 - c. Exposure Category: C.
 - 2. Deflection Limits: Design sectional doors to withstand design wind loads without evidencing permanent deformation or disengagement of door components. Deflection of door in horizontal position (open) shall not exceed 1/120 of the door width.
- D. Air Infiltration: Maximum rate not more than indicated when tested according to ASTM E 283 or DASMA 105.
 - 1. Air Infiltration: Maximum rate of 0.08 cfm/sq. ft. (0.406 L/s per sq. m) at 15 and 25 mph (24.1 and 40.2 km/h).

E. Operation Cycles: Provide sectional door components and operators capable of operating for not less than number of cycles indicated for each door. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type and size of sectional door and accessory. Include the following:
 - 1. Construction details, material descriptions, dimensions of individual components, profile door sections, and finishes.
 - 2. Rated capacities, operating characteristics, electrical characteristics, and furnished accessories.
- B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Wiring Diagrams: For power, signal, and control wiring.
- C. Samples for Initial Selection: Manufacturer's finish charts showing full range of colors and textures available for units with factory-applied finishes.
 - 1. Include similar Samples of accessories involving color selection.
- D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:
 - 1. Flat Door Sections: 6 inches (150 mm) square.
 - 2. Frame for Paneled Door Sections: 6 inches (150 mm) long of each width of stile and rail required.
- E. Delegated-Design Submittal: For sectional doors indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Summary of forces and loads on walls and jambs.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Warranties: Sample of special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For sectional doors to include in maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for both installation and maintenance of units required for this Project.
- B. Source Limitations: Obtain sectional doors from single source from single manufacturer.
 - 1. Obtain operators and controls from sectional door manufacturer.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Standard for Sectional Doors: Fabricate sectional doors to comply with DASMA 102 unless otherwise indicated.
- E. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities" and ICC/ANSI A117.1.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of sectional doors that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including, but not limited to, excessive deflection.
 - b. Faulty operation of hardware.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use; rust through.
 - d. Delamination of exterior or interior facing materials.
 - 2. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 ALUMINUM DOOR SECTIONS

A. Sections: Construct door sections with stiles and rails formed from extruded-aluminum shapes, complying with ASTM B 221 (ASTM B 221M), alloy and temper recommended by manufacturer for type of use and finish indicated, with wall thickness not less than 0.065 inch

(1.7 mm) for door section 1-3/4 inches (44 mm) deep. Fabricate sections with stile and rail dimensions and profiles shown on Drawings. Join stiles and rails by welding or with concealed, 1/4-inch- (6-mm-) minimum diameter, aluminum or nonmagnetic stainless-steel through bolts, full height of door section. Form meeting rails to provide a weathertight-seal joint.

- 1. Reinforce sections with continuous horizontal and diagonal reinforcement, as required to stiffen door and for wind loading. Ensure that reinforcement does not obstruct vision lites.
- 2. Provide reinforcement for hardware attachment.
- B. Full-Vision Sections: Manufacturer's standard, tubular, aluminum-framed section fully glazed with 6-mm-thick, clear acrylic glazing set in vinyl, rubber, or neoprene glazing channel and with removable extruded-vinyl or aluminum stops.

2.2 TRACKS, SUPPORTS, AND ACCESSORIES

- A. Tracks: Manufacturer's standard, galvanized-steel track system of configuration indicated, sized for door size and weight, designed for lift type indicated and clearances shown on Drawings, and complying with ASTM A 653/A 653M for minimum G60 (Z180) zinc coating. Provide complete track assembly including brackets, bracing, and reinforcement for rigid support of ball-bearing roller guides for required door type and size. Slot vertical sections of track spaced 2 inches (51 mm) apart for door-drop safety device. Slope tracks at proper angle from vertical or design tracks to ensure tight closure at jambs when door unit is closed.
- B. Track Reinforcement and Supports: Galvanized-steel track reinforcement and support members, complying with ASTM A 36/A 36M and ASTM A 123/A 123M. Secure, reinforce, and support tracks as required for door size and weight to provide strength and rigidity without sag, sway, and vibration during opening and closing of doors.
 - 1. Vertical Track Assembly: Track with continuous reinforcing angle attached to track and attached to wall with jamb brackets.
 - 2. Horizontal Track Assembly: Track with continuous reinforcing angle attached to track and supported at points from curve in track to end of track by laterally braced attachments to overhead structural members.
- C. Weatherseals: Replaceable, adjustable, continuous, compressible weather-stripping gaskets of flexible vinyl, rubber, or neoprene fitted to bottom and top of sectional door unless otherwise indicated.

2.3 HARDWARE

- A. General: Provide heavy-duty, corrosion-resistant hardware, with hot-dip galvanized, stainlesssteel, or other corrosion-resistant fasteners, to suit door type.
- B. Hinges: Heavy-duty, galvanized-steel hinges of not less than 0.079-inch- (2.01-mm-) nominal coated thickness at each end stile and at each intermediate stile, according to manufacturer's written recommendations for door size. Attach hinges to door sections through stiles and rails with bolts and lock nuts or lock washers and nuts. Use rivets or self-tapping fasteners where

access to nuts is not possible. Provide double-end hinges where required, for doors over 16 feet (4.88 m) wide unless otherwise recommended by door manufacturer.

C. Rollers: Heavy-duty rollers with steel ball-bearings in case-hardened steel races, mounted with varying projections to suit slope of track. Extend roller shaft through both hinges where double hinges are required. Provide 3-inch- (76-mm-) diameter roller tires for 3-inch- (76-mm-) wide track and 2-inch- (51-mm-) diameter roller tires for 2-inch- (51-mm-) wide track.

2.4 LOCKING DEVICES

- A. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on single-jamb side, operable from inside only.
- B. Chain Lock Keeper: Suitable for padlock.
- C. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

2.5 COUNTERBALANCE MECHANISM

- A. Torsion Spring: Counterbalance mechanism consisting of adjustable-tension torsion springs fabricated from steel-spring wire complying with ASTM A 229/A 229M, mounted on torsion shaft made of steel tube or solid steel. Provide springs designed for number of operation cycles indicated.
- B. Cable Drums and Shaft for Doors: Cast-aluminum or gray-iron casting cable drums mounted on torsion shaft and grooved to receive door-lifting cables as door is raised. Mount counterbalance mechanism with manufacturer's standard ball-bearing brackets at each end of torsion shaft. Provide one additional midpoint bracket for shafts up to 16 feet (4.88 m) long and two additional brackets at one-third points to support shafts more than 16 feet (4.88 m) long unless closer spacing is recommended by door manufacturer.
- C. Cables: Galvanized-steel lifting cables with cable safety factor of at least 5 to 1.
- D. Cable Safety Device: Include a spring-loaded steel or spring-loaded bronze cam mounted to bottom door roller assembly on each side and designed to automatically stop door if either lifting cable breaks.
- E. Bracket: Provide anchor support bracket as required to connect stationary end of spring to the wall and to level the shaft and prevent sag.
- F. Provide a spring bumper at each horizontal track to cushion door at end of opening operation.

2.6 ELECTRIC DOOR OPERATORS

A. General: Electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and "operation cycles" requirement specified, with electric motor

and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, remote-control stations, control devices, integral gearing for locking door, and accessories required for proper operation.

- 1. Comply with NFPA 70.
- 2. Provide control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6; with NFPA 70, Class 2 control circuit, maximum 24-V ac or dc.
- B. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each door.
- C. Door-Operator Type: Unit consisting of electric motor, gears, pulleys, belts, sprockets, chains, and controls needed to operate door and meet required usage classification.
 - 1. Jackshaft, Center Mounted: Jackshaft operator mounted on the inside front wall above door and connected to torsion shaft with an adjustable coupling or drive chain.
 - 2. Jackshaft, Side Mounted: Jackshaft operator mounted on the inside front wall on right or left side of door and connected to torsion shaft with an adjustable coupling or drive chain.
- D. Electric Motors: Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 110513 "Common Motor Requirements for Equipment" unless otherwise indicated.
 - 1. Electrical Characteristics:
 - a. Phase: Single phase.
 - b. Volts: 120 V.
 - c. Hertz: 60.
 - 2. Motor Type and Controller: Reversible motor and controller (disconnect switch) for motor exposure indicated.
 - 3. Motor Size: Minimum size as indicated. If not indicated, large enough to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. (203 mm/s) and not more than 12 in./sec. (305 mm/s), without exceeding nameplate ratings or service factor.
 - 4. Operating Controls, Controllers (Disconnect Switches), Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.
 - 5. Coordinate wiring requirements and electrical characteristics of motors and other electrical devices with building electrical system and each location where installed.
 - 6. Use adjustable motor-mounting bases for belt-driven operators.
- E. Limit Switches: Equip each motorized door with adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.
- F. Obstruction Detection Device: Equip motorized door with indicated external automatic safety sensor capable of protecting full width of door opening. Activation of device immediately stops and reverses downward door travel.
 - 1. Photoelectric Sensor: Manufacturer's standard system designed to detect an obstruction in door opening without contact between door and obstruction.

- a. Self-Monitoring Type: Designed to interface with door operator control circuit to detect damage to or disconnection of sensor device. When self-monitoring feature is activated, door closes only with sustained pressure on close button.
- 2. Sensor Edge: Automatic safety sensor edge, located within astragal or weather stripping mounted to bottom bar. Contact with sensor activates device. Connect to control circuit using manufacturer's standard take-up reel or self-coiling cable.
 - a. Self-Monitoring Type: Four-wire configured device designed to interface with door-operator control circuit to detect damage to or disconnection of sensor edge.
- G. Remote-Control Station: Momentary-contact, three-button control station with push-button controls labeled "Open," "Close," and "Stop."
 - 1. Interior units, full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.
- H. Emergency Manual Operation: Equip each electrically powered door with capability for emergency manual operation. Design manual mechanism so required force for door operation does not exceed 25 lbf (111 N).
- I. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.
- J. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.

2.7 DOOR ASSEMBLY

- A. Full-Vision Aluminum Sectional Door: Sectional door formed with hinged sections.
 - 1. <u>Basis-of-Design Product</u>: Subject to compliance with requirements, provide <u>CHI</u> <u>Overhead Doors Model 3290</u> or comparable product by one of the following:
 - a. <u>C.H.I. Overhead Doors</u>.
 - b. <u>Clopay Building Products; a Griffon company</u>.
 - c. <u>Wayne-Dalton Corp</u>.
- B. Operation Cycles: Not less than 20,000.
- C. Aluminum Sections: Full vision.
- D. Track Configuration: High-lift and Vertical-lift track.
- E. Weatherseals: Fitted to bottom and top and around entire perimeter of door. Provide combination bottom weatherseal and sensor edge.
- F. Glazing: Clear full vision sections:

- 1. Laminated Glass: ASTM C 1172, and complying with testing requirements in 16 CFR 1201 for Category II materials, and with other requirements specified. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.
- 2. Construction: Laminate glass with polyvinyl butyral interlayer to comply with interlayer manufacturer's written recommendations.
- 3. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
- 4. GANA Publications: GANA's "Laminated Glazing Reference Manual" and GANA's "Glazing Manual."
- G. Glass Type **LG1**: Clear laminated glass with two plies of clear fully tempered float glass.
 - 1. Thickness of Each Glass Ply: 3.0 mm.
 - 2. Interlayer Thickness: 0.030 inch (0.76 mm).
 - 3. Interlayer Color: Clear.
 - 4. Provide safety glazing labeling.
 - 5. STC 35 or greater.
- H. Roller-Tire Material: Manufacturer's standard.
- I. Locking Devices: Equip door with slide bolt for padlock and chain lock keeper.
 - 1. Locking Device Assembly: Single-jamb side locking bars, operable from inside with thumbturn.
- J. Counterbalance Type: Torsion spring.
- K. Electric Door Operator:
 - 1. Usage Classification: Heavy duty, 60 to 90 cycles per hour.
 - 2. Operator Type: Jackshaft, center mounted or Jackshaft, side mounted as required for available space.
 - 3. Motor Exposure: Interior, clean, and dry.
 - 4. Emergency Manual Operation: Chain type.
 - 5. Obstruction-Detection Device: Automatic photoelectric sensor.
 - a. Sensor Edge Bulb Color: Black.
- L. Door Finish:
 - 1. Aluminum Finish: Clear anodized.

2.8 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.9 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.
- B. Examine locations of electrical connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install sectional doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.
- B. Tracks:
 - 1. Fasten vertical track assembly to opening jambs and framing, spaced not more than 24 inches (610 mm) apart.
 - 2. Hang horizontal track assembly from structural overhead framing with angles or channel hangers attached to framing by welding or bolting, or both. Provide sway bracing, diagonal bracing, and reinforcement as required for rigid installation of track and door-operating equipment.
 - 3. Repair galvanized coating on tracks according to ASTM A 780.
- C. Accessibility: Install sectional doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.

3.3 STARTUP SERVICES

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 ADJUSTING

- A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.
- B. Lubricate bearings and sliding parts as recommended by manufacturer.
- C. Adjust doors and seals to provide weathertight fit around entire perimeter.
- D. Align and adjust motors, pulleys, belts, sprockets, chains, and controls according to manufacturer's written instructions.
- E. Touch-up Painting: Immediately after welding galvanized materials, clean welds and abraded galvanized surfaces and repair galvanizing to comply with ASTM A 780.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain sectional doors.

END OF SECTION 083613

SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Exterior and interior storefront framing.
 - 2. Storefront framing for punched openings.
 - 3. Exterior manual-swing entrance doors and door-frame units.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
 - 2. Insulated panels.
- B. Shop Drawings: For aluminum-framed entrances and storefronts. Include plans, elevations, sections, full-size details, and attachments to other work.
 - 1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
 - 2. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.
- C. Samples for Initial Selection: For units with factory-applied color finishes.
- D. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.
- E. Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams.

Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.

F. Delegated-Design Submittal: For aluminum-framed entrances and storefronts indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Energy Performance Certificates: For aluminum-framed entrances and storefronts, accessories, and components, from manufacturer.
 - 1. Basis for Certification: NFRC-certified energy performance values for each aluminumframed entrance and storefront.
- C. Product Test Reports: For aluminum-framed entrances and storefronts, for tests performed by manufacturer and witnessed by a qualified testing agency.
- D. Source quality-control reports.
- E. Sample Warranties: For special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For aluminum-framed entrances and storefronts to include in maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.
 - 1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

1.8 MOCKUPS

A. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

- 1. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
- 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of aluminum-framed entrances and storefronts that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including, but not limited to, excessive deflection.
 - b. Noise or vibration created by wind and thermal and structural movements.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - d. Water penetration through fixed glazing and framing areas.
 - e. Failure of operating components.
 - 2. Warranty Period: Three years from date of Substantial Completion.
- B. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design aluminum-framed entrances and storefronts.
- B. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrances and storefronts representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

- 1. Aluminum-framed entrances and storefronts shall withstand movements of supporting structure including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
- 2. Failure also includes the following:
 - a. Thermal stresses transferring to building structure.
 - b. Glass breakage.
 - c. Noise or vibration created by wind and thermal and structural movements.
 - d. Loosening or weakening of fasteners, attachments, and other components.
 - e. Failure of operating units.
- C. Structural Loads:
 - 1. Wind Loads: As indicated on Drawings.
 - 2. Other Design Loads: As indicated on Drawings.
- D. Deflection of Framing Members: At design wind pressure, as follows:
 - 1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane not exceeding 1/175 of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to 3/4 inch (19.1 mm), whichever is less.
 - 2. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or 1/8 inch (3.2 mm), whichever is smaller.
 - a. Operable Units: Provide a minimum 1/16-inch (1.6-mm) clearance between framing members and operable units.
- E. Structural: Test according to ASTM E 330 as follows:
 - 1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
 - 2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
 - 3. Test Durations: As required by design wind velocity, but not less than 10 seconds.
- F. Air Infiltration: Test according to ASTM E 283 for infiltration as follows:
 - 1. Fixed Framing and Glass Area:
 - a. Maximum air leakage of 0.06 cfm/sq. ft. (0.30 L/s per sq. m) at a static-airpressure differential of 1.57 lbf/sq. ft. (75 Pa).
 - 2. Entrance Doors:
 - a. Pair of Doors: Maximum air leakage of 1.0 cfm/sq. ft. (5.08 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).
 - b. Single Doors: Maximum air leakage of 0.5 cfm/sq. ft. (2.54 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).

- G. Water Penetration under Static Pressure: Test according to ASTM E 331 as follows:
 - 1. No evidence of water penetration through fixed glazing and framing areas when tested according to a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 15 lbf/sq. ft. (720 Pa).
- H. Water Penetration under Dynamic Pressure: Test according to AAMA 501.1 as follows:
 - 1. No evidence of water penetration through fixed glazing and framing areas when tested at dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 15 lbf/sq. ft. (720 Pa).
 - 2. Maximum Water Leakage: No uncontrolled water penetrating assemblies or water appearing on assemblies' normally exposed interior surfaces from sources other than condensation. Water leakage does not include water controlled by flashing and gutters, or water that is drained to exterior.
- I. Seismic Performance: Aluminum-framed entrances and storefronts shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. Seismic Drift Causing Glass Fallout: Complying with criteria for passing based on building occupancy type when tested according to AAMA 501.6 at design displacement and 1.5 times the design displacement.
- J. Energy Performance: Certify and label energy performance according to NFRC as follows:
 - 1. Thermal Transmittance (U-factor): Fixed glazing and framing areas shall have U-factor of not more than 0.45 Btu/sq. ft. x h x deg F (2.55 W/sq. m x K) as determined according to NFRC 100.
 - 2. Solar Heat Gain Coefficient: Fixed glazing and framing areas shall have a solar heat gain coefficient of no greater than 0.35 as determined according to NFRC 200.
 - 3. Condensation Resistance: Fixed glazing and framing areas shall have an NFRC-certified condensation resistance rating of no less than 45 as determined according to NFRC 500.
- K. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes:
 - 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
 - 2. Thermal Cycling: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested according to AAMA 501.5.
 - a. High Exterior Ambient-Air Temperature: That which produces an exterior metalsurface temperature of 180 deg F (82 deg C).
 - b. Low Exterior Ambient-Air Temperature: 0 deg F (minus 18 deg C).
 - c. Interior Ambient-Air Temperature: 75 deg F (24 deg C).

2.2 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. <u>EFCO Corporation</u>.
 - 2. <u>Kawneer North America</u>.
 - 3. <u>Oldcastle BuildingEnvelope</u>.
 - 4. <u>TRACO</u>.
 - 5. <u>United States Aluminum</u>.
 - 6. <u>YKK AP America Inc</u>.
- B. Source Limitations: Obtain all components of aluminum-framed entrance and storefront system, including framing and accessories, from single manufacturer.

2.3 FRAMING

- A. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.
 - 1. Construction: Thermally broken.
 - 2. Glazing System: Retained mechanically with gaskets on four sides.
 - 3. Glazing Plane: Center
 - 4. Finish: Clear anodic finish.
 - 5. Fabrication Method: Field-fabricated stick system.
- B. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.
- C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- D. Materials:
 - 1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
 - a. Sheet and Plate: ASTM B 209 (ASTM B 209M).
 - b. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221 (ASTM B 221M).
 - c. Extruded Structural Pipe and Tubes: ASTM B 429/B 429M.
 - d. Structural Profiles: ASTM B 308/B 308M.
 - 2. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM, and prepare surfaces according to applicable SSPC standard.
 - a. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
 - b. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
 - c. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

2.4 INSULATED SPANDREL PANELS

- A. Insulated Spandrel Panels: Laminated, metal-faced flat panels with no deviations in plane exceeding 0.8 percent of panel dimension in width or length.
 - 1. Overall Panel Thickness: 2 inch, with off-set finished edges to glaze into storefront framing.
 - 2. Exterior Skin: Aluminum.
 - a. Thickness: .025-inch
 - b. Finish: Match framing system.
 - c. Texture: Smooth.
 - d. Backing Sheet: 0.157-inch- (4-mm-) thick, cement board.
 - 3. Interior Skin: Aluminum.
 - a. Thickness: .025-inch
 - b. Finish: Matching storefront framing.
 - c. Texture: Smooth.
 - d. Backing Sheet: 0.157-inch- (4-mm-) thick, cement board.
 - 4. Thermal Insulation Core: Manufacturer's standard rigid, closed-cell, polyisocyanurate board. Minimum R value of 12.
- B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: 25 or less.
 - 2. Smoke-Developed Index: 450 or less.

2.5 ENTRANCE DOOR SYSTEMS

- A. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing operation.
 - 1. Door Construction: 1-3/4-inch (44.5-mm) overall thickness, with minimum 0.125-inch-(3.2-mm-) thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
 - a. Thermal Construction: High-performance plastic connectors separate aluminum members exposed to the exterior from members exposed to the interior.
 - 2. Door Design: Wide stile; 5-inch (127-mm) nominal width.
 - 3. Glazing Stops and Gaskets: Square, snap-on, extruded-aluminum stops and preformed gaskets.
 - a. Provide nonremovable glazing stops on outside of door.

2.6 ENTRANCE DOOR HARDWARE

- A. Entrance Door Hardware: Hardware not specified in this Section is specified in Section 087100 "Door Hardware."
- B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of entrance door hardware are indicated in "Entrance Door Hardware Sets" Article. Products are identified by using entrance door hardware designations as follows:
- C. Weather Stripping: Manufacturer's standard replaceable components.
 - 1. Compression Type: Made of ASTM D 2000, molded neoprene, or ASTM D 2287, molded PVC.
 - 2. Sliding Type: AAMA 701/702, made of wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing.
- D. Weather Sweeps: Manufacturer's standard exterior-door bottom sweep with concealed fasteners on mounting strip.
- E. Thresholds: BHMA A156.21, raised thresholds beveled with a slope of not more than 1:2, with maximum height of 1/2 inch (12.7 mm).

2.7 GLAZING

- A. Glazing: Comply with Section 088000 "Glazing."
- B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.
- C. Glazing Sealants: As recommended by manufacturer.

2.8 ACCESSORIES

- A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
 - 1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
 - 2. Reinforce members as required to receive fastener threads.
 - 3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.
- B. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch (25.4 mm) that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.
 - 1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.

- C. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.
- D. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil (0.762-mm) thickness per coat.
- E. Subsills: Thermally broken, extruded-aluminum subsills in configurations indicated on Drawings.

2.9 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- C. Fabricate components that, when assembled, have the following characteristics:
 - 1. Profiles that are sharp, straight, and free of defects or deformations.
 - 2. Accurately fitted joints with ends coped or mitered.
 - 3. Physical and thermal isolation of glazing from framing members.
 - 4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 - 5. Provisions for field replacement of glazing from exterior.
 - 6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.
- E. Storefront Framing: Fabricate components for assembly using shear-block system or screw-spline system.
- F. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.
 - 1. At exterior doors, provide compression weather stripping at fixed stops.
- G. Entrance Doors: Reinforce doors as required for installing entrance door hardware.
 - 1. At pairs of exterior doors, provide sliding-type weather stripping retained in adjustable strip and mortised into door edge.
 - 2. At exterior doors, provide weather sweeps applied to door bottoms.
- H. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.

I. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.10 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

3.3 INSTALLATION

- A. General:
 - 1. Comply with manufacturer's written instructions.
 - 2. Do not install damaged components.
 - 3. Fit joints to produce hairline joints free of burrs and distortion.
 - 4. Rigidly secure nonmovement joints.
 - 5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
 - 6. Seal perimeter and other joints watertight unless otherwise indicated.
- B. Metal Protection:
 - 1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
 - 2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- C. Set continuous sill members and flashing in full sealant bed as specified in Section 079200 "Joint Sealants" to produce weathertight installation.
- D. Install components plumb and true in alignment with established lines and grades.
- E. Install operable units level and plumb, securely anchored, and without distortion. Adjust weather-stripping contact and hardware movement to produce proper operation.

- F. Install glazing as specified in Section 088000 "Glazing."
- G. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.
 - 1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
 - 2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

3.4 ERECTION TOLERANCES

- A. Erection Tolerances: Install aluminum-framed entrances and storefronts to comply with the following maximum tolerances:
 - 1. Plumb: 1/8 inch in 10 feet (3.2 mm in 3 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).
 - 2. Level: 1/8 inch in 20 feet (3.2 mm in 6 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).
 - 3. Alignment:
 - a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch (12.7 mm) wide, limit offset from true alignment to 1/16 inch (1.6 mm).
 - b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch (12.7 to 25.4 mm) wide, limit offset from true alignment to 1/8 inch (3.2 mm).
 - c. Where surfaces are separated by reveal or protruding element of 1 inch (25.4 mm) wide or more, limit offset from true alignment to 1/4 inch (6 mm).
 - 4. Location: Limit variation from plane to 1/8 inch in 12 feet (3.2 mm in 3.6 m); 1/2 inch (12.7 mm) over total length.

3.5 MAINTENANCE SERVICE

- A. Entrance Door Hardware:
 - 1. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of entrance door hardware.

END OF SECTION 084113

SECTION 085113 - ALUMINUM WINDOWS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes aluminum windows for exterior locations.
- B. Related Requirements:
 - 1. Section 084113 "Aluminum-Framed Entrances and Storefronts" for coordinating finish among aluminum fenestration units.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, glazing and fabrication methods, dimensions of individual components and profiles, hardware, and finishes for aluminum windows.
- B. Shop Drawings: Include plans, elevations, sections, hardware, accessories, insect screens, operational clearances, and details of installation, including anchor, flashing, and sealant installation.
- C. Samples: For each exposed product and for each color specified, 2 by 4 inches (50 by 100 mm) in size.
- D. Product Schedule: For aluminum windows. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer and Installer.
- B. Product Test Reports: For each type of aluminum window, for tests performed by a qualified testing agency.
- C. Sample Warranties: For manufacturer's warranties.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A manufacturer capable of fabricating aluminum windows that meet or exceed performance requirements indicated and of documenting this performance by test reports, and calculations.
- B. Installer Qualifications: An installer acceptable to aluminum window manufacturer for installation of units required for this Project.

1.6 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace aluminum windows that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Failure to meet performance requirements.
 - b. Structural failures including excessive deflection, water leakage, condensation, and air infiltration.
 - c. Faulty operation of movable sash and hardware.
 - d. Deterioration of materials and finishes beyond normal weathering.
 - e. Failure of insulating glass.
 - 2. Warranty Period:
 - a. Window: 10 years from date of Substantial Completion.
 - b. Glazing Units: 10 years from date of Substantial Completion.
 - c. Aluminum Finish: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. <u>Basis-of-Design Product</u>: Subject to compliance with requirements, provide EFCO Corporation 3500 Thermal AW-PG5-HS Grade Horizontal Sliding Windows Series or comparable product by one of the following:
 - 1. Kawneer North America; an Alcoa company.
 - 2. <u>TRACO</u>.
 - 3. <u>Wausau Window and Wall Systems</u>.
 - 4. YKK AP America Inc.
- B. Source Limitations: Obtain aluminum windows from single source from single manufacturer.

2.2 WINDOW PERFORMANCE REQUIREMENTS

- A. Product Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for definitions and minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.
 - 1. Window Certification: AMMA certified with label attached to each window.
- B. Performance Class and Grade: AAMA/WDMA/CSA 101/I.S.2/A440 as follows:
 - 1. Minimum Performance Class: AW.
 - 2. Minimum Performance Grade: 50.
- C. Thermal Transmittance: NFRC 100 maximum whole-window U-factor of 0.30 Btu/sq. ft. x h x deg F (1.71 W/sq. m x K).
- D. Solar Heat-Gain Coefficient (SHGC): NFRC 200 maximum whole-window SHGC of 0.40.
- E. Condensation-Resistance Factor (CRF): Provide aluminum windows tested for thermal performance according to AAMA 1503, showing a CRF of 45.
- F. Thermal Movements: Provide aluminum windows, including anchorage, that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C) material surfaces.

2.3 ALUMINUM WINDOWS

- A. Operating Types: Provide the following operating types in locations indicated on Drawings:
 - 1. Horizontal sliding.
 - 2. Fixed.
- B. Frames and Sashes: Aluminum extrusions complying with AAMA/WDMA/CSA 101/I.S.2/A440.
 - 1. Thermally Improved Construction: Fabricate frames, sashes, and muntins with an integral, concealed, low-conductance thermal barrier located between exterior materials and window members exposed on interior side in a manner that eliminates direct metal-to-metal contact.
- C. Insulating-Glass Units: ASTM E 2190, certified through IGCC as complying with requirements of IGCC.
 - 1. Glass: ASTM C 1036, Type 1, Class 1, q3.

- a. Tint: Clear.
- b. Kind: Fully tempered (inside), Laminated (outside)
- 2. Lites: Two.
- 3. Filling: Fill space between glass lites with air.
- 4. Low-E Coating: Sputtered on third surface.
- D. Hardware, General: Provide manufacturer's standard hardware fabricated from aluminum, stainless steel, carbon steel complying with AAMA 907, or other corrosion-resistant material compatible with adjacent materials; designed to smoothly operate, tightly close, and securely lock windows, and sized to accommodate sash weight and dimensions.
 - 1. Exposed Hardware Color and Finish: As selected by Architect from manufacturer's full range.
- E. Horizontal-Sliding Window Hardware:
 - 1. Sill Cap/Track: Extruded-aluminum track with natural anodized finish, of dimensions and profile indicated; designed to comply with performance requirements indicated and to drain to the exterior.
 - 2. Locks and Latches: Allow unobstructed movement of the sash across adjacent sash in direction indicated and operated from the inside only.
 - 3. Roller Assemblies: Low-friction design.
 - 4. Pole Operators: Tubular-shaped anodized aluminum; with rubber-capped lower end and standard push-pull hook at top to match hardware design; of sufficient length to operate window without reaching more than 60 inches (1500 mm) above floor; one pole operator and pole hanger per room that has operable windows more than 72 inches (1800 mm) above floor.
- F. Weather Stripping: Provide full-perimeter weather stripping for each operable sash unless otherwise indicated.
- G. Fasteners: Noncorrosive and compatible with window members, trim, hardware, anchors, and other components.
 - 1. Exposed Fasteners: Do not use exposed fasteners to the greatest extent possible. For application of hardware, use fasteners that match finish hardware being fastened.

2.4 ACCESSORIES

A. Subsills: Thermally broken, extruded-aluminum subsills in configurations indicated on Drawings.

2.5 FABRICATION

A. Fabricate aluminum windows in sizes indicated. Include a complete system for assembling components and anchoring windows.

- B. Glaze aluminum windows in the factory.
- C. Weather strip each operable sash to provide weathertight installation.
- D. Weep Holes: Provide weep holes and internal passages to conduct infiltrating water to exterior.
- E. Provide water-shed members above side-hinged sashes and similar lines of natural water penetration.
- F. Mullions: Provide mullions and cover plates, matching window units, complete with anchors for support to structure and installation of window units. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections, as indicated. Provide mullions and cover plates capable of withstanding design wind loads of window units.
- G. Complete fabrication, assembly, finishing, hardware application, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation.

2.6 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.7 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.

2.8 EXAMINATION

A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

- B. Verify rough opening dimensions, levelness of sill plate, and operational clearances.
- C. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure weathertight window installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

2.9 INSTALLATION

- A. Comply with manufacturer's written instructions for installing windows, hardware, accessories, and other components. For installation procedures and requirements not addressed in manufacturer's written instructions, comply with installation requirements in ASTM E 2112.
- B. Install windows level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction to produce weathertight construction.
- C. Install windows and components to drain condensation, water penetrating joints, and moisture migrating within windows to the exterior.
- D. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

2.10 ADJUSTING, CLEANING, AND PROTECTION

- A. Adjust operating sashes and hardware for a tight fit at contact points and weather stripping for smooth operation and weathertight closure.
- B. Clean exposed surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.
 - 1. Keep protective films and coverings in place until final cleaning.
- C. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.
- D. Protect window surfaces from contact with contaminating substances resulting from construction operations. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written instructions.

END OF SECTION 085113

SECTION 085600 – TICKET WINDOWS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Ticket Window and Accessories
 - 2. Counter with tray
 - 3. Intercom (Amplified Voice System)
- B. Related Sections:
 - 1. See Section "012300 Alternates" for description of Alternates.

1.3 COORDINATION

A. Electrical System Roughing-in: Coordinate layout and installation of Voice Transmission System with connections to power supplies.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For ticket windows and accessories.
 - 1. Include plans, elevations, sections, full-size details, and attachments to other work.
 - 2. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include diagrams for power, signal, and control wiring.
 - 4. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.
- C. Samples for Initial Selection: For units with factory-applied color finishes.

1.5 INFORMATIONAL SUBMITTALS

A. Sample Warranties: For special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For ticket window and accessories to include in operation and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Installer shall have five years of experience fabricating and installing windows of similar type and scope as those specified in this section.

1.8 WARRANTY

- A. Special Warranty: Installer agrees to repair or replace components of ticket windows and accessories that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum and stainless steel that shows evidence of deterioration within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrances representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

2.2 MANUFACTURERS

- A. <u>Basis-of-Design Product</u>: Subject to compliance with requirements, provide C.R. Lawrence S1EW18A Window and Counter system and Norcon TTU-7 Intercom System or comparable product by one of the following:
 - 1. <u>National Bullet Proof</u>
 - 2. <u>Creative Industries</u>

2.3 TICKET WINDOW AND ACCESSORIES

- A. Window Construction: 1-inch minimum overall thickness, with minimum 0.125-inch- (3.2-mm-) thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods. Inset frame system.
- B. Weather Flap: Manufacturer's standard.
- C. Framing Members: Manufacturer's standard extruded aluminum, minimum 0.125 inch (3.2 mm) thick and reinforced as required to support imposed loads.
- D. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- E. Materials:
 - 1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
 - a. Sheet and Plate: ASTM B 209 (ASTM B 209M).
 - b. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221 (ASTM B 221M).
- F. Weather Stripping: Manufacturer's standard replaceable components.
 - 1. Compression Type: Made of ASTM D 2000, molded neoprene, or ASTM D 2287, molded PVC.

2.4 GLAZING

- A. Glazing: Comply with Section 088000 "Glazing."
- B. Glazing Sealants: As recommended by manufacturer.

2.5 COUNTER AND TRAY

- A. Stainless steel counter with integral deal tray. Two (2)-inch thick with recessed tray.
- B. Materials:
 - 1. Stainless-Steel Sheet 16 ga minimum ASTM A 240/A 240M
 - 2. Stainless-Steel Finish Directional satin finish, No. 4
- C. Formed from Type 304 stainless steel, cold rolled annealed, 16 gauge.
- D. Fabrication: 18" deep x 2" high, width to match window system. Tray 11" wide by 8.25" deep by 1.5" high welded into counter. Ends welded and smooth. Drain hole with tail piece at underside of tray with flexible tubing.

2.6 INTERCOM (AMPLIFIED VOICE SYSTEM)

- A. Basis of Design: Norcon TTU-7
 - 1. Clear, 2-way hands-free voice communication
 - 2. Headset jack
 - 3. 1" Deep inside plate
- B. Exterior unit: 5" diameter by ½" deep aluminum (clear anodized), tamper resistant
- C. Interior Unit: Counter mount control unit, 6"x 2-3/8"x2-3/8" aluminum (clear anodized), tamper resistant. Controls include listen volume, talk volume, power on/off, LED power indicator. Locate per Owner.
- D. Control wiring to be concealed in frame and manufacturer conduit from microphone to frame.
- E. Electrical Requirements:
 - 1. Audio frequency response: selectively shaped for maximum voice intelligibility
 - 2. Audio power: 2 watts per amplifier
 - 3. Distortion: Less than 2%
 - 4. Listen mode: 20dB compression
 - 5. Talk mode: VOX
 - 6. Microphones: Electret
 - 7. Power supply: Input 120VAC, 60Hz, Output 15VDC, 175mA
- F. Provide all accessories required for a complete installation of intercom system.

2.7 ACCESSORIES

- A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
- B. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil (0.762-mm) thickness per coat.

2.8 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- C. Fabricate components that, when assembled, have the following characteristics:
 - 1. Profiles that are sharp, straight, and free of defects or deformations.
 - 2. Accurately fitted joints with ends coped or mitered.

3. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

2.9 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for electrical systems to verify actual locations of power connections before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General:
 - 1. Comply with manufacturer's written instructions.
 - 2. Do not install damaged components.
 - 3. Fit joints to produce hairline joints free of burrs and distortion.
 - 4. Rigidly secure nonmovement joints.
 - 5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
 - 6. Seal perimeter and other joints watertight unless otherwise indicated.
- B. Metal Protection:
 - 1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or installing nonconductive spacers.
 - 2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- C. Set continuous sill members and flashing in full sealant bed as specified in Section 079200 "Joint Sealants" to produce weathertight installation.
- D. Install components plumb and true in alignment with established lines and grades.
- E. Install glazing as specified in Section 088000 "Glazing." and per ticket window manufacturer.\
- F. Install intercom system per manufacturer's written instructions.

3.3 CLEANING

A. Clean glass and metal surfaces promptly after installation. Remove excess glazing and sealant compounds, dirt, and other substances. Repair damaged finish to match original finish.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain ticket window and accessories

END OF SECTION 085600

SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes:
 - 1. Mechanical door hardware for the following:
 - a. Swinging doors.
 - 2. Cylinders for door hardware specified in other Sections.
 - 3. Electrified door hardware.
- B. Related Sections:
 - 1. Section 064113 "Wood-Veneer-Faced Architectural Cabinets" and Section 064116 "Plastic-Laminate-Faced Architectural Cabinets" for cabinet door hardware provided with cabinets.
 - 2. Section 081113 "Hollow Metal Doors and Frames" for astragals provided as part of labeled fire-rated assemblies and for door silencers provided as part of hollow-metal frames.
 - 3. Section 081416 "Flush Wood Doors" for astragals and integral intumescent seals provided as part of labeled fire-rated assemblies.
 - 4. Section 083113 "Access Doors and Frames" for access door hardware, cylinders.
 - 5. Section 083323 "Overhead Coiling Doors" for door hardware provided as part of overhead door assemblies.
 - 6. Section 084113 "Aluminum-Framed Entrances and Storefronts" for installation of entrance door hardware, except cylinders.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction and installation details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: Details of electrified door hardware, indicating the following:
 - 1. Wiring Diagrams: For power, signal, and control wiring and including the following:

- a. Details of interface of electrified door hardware and building safety and security systems.
- b. Schematic diagram of systems that interface with electrified door hardware.
- c. Point-to-point wiring.
- d. Risers.
- e. Elevations doors controlled by electrified door hardware.
- 2. Operation Narrative: Describe the operation of doors controlled by electrified door hardware.
- C. Other Action Submittals:
 - 1. Door Hardware Schedule: Prepared by or under the supervision of Installer, detailing fabrication and assembly of door hardware, as well as installation procedures and diagrams. Coordinate final door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
 - a. Submittal Sequence: Submit door hardware schedule concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate the fabrication of other work that is critical in Project construction schedule.
 - b. Format: Use same scheduling sequence and format and use same door numbers as in the Contract Documents.
 - c. Content: Include the following information:
 - 1) Identification number, location, hand, fire rating, size, and material of each door and frame.
 - 2) Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
 - 3) Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
 - 4) Description of electrified door hardware sequences of operation and interfaces with other building control systems.
 - 5) Fastenings and other pertinent information.
 - 6) Explanation of abbreviations, symbols, and codes contained in schedule.
 - 7) Mounting locations for door hardware.
 - 8) List of related door devices specified in other Sections for each door and frame.
 - 2. Keying Schedule: Prepared by or under the supervision of Installer, detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations that are coordinated with the Contract Documents.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and Supplier.
- B. Product Certificates: For electrified door hardware, from the manufacturer.

- 1. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.
- C. Product Test Reports: For compliance with accessibility requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for door hardware on doors located in accessible routes.
- D. Warranty: Special warranty specified in this Section.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of door hardware to include in maintenance manuals. Include final hardware and keying schedule.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish specialty tools required for maintenance.
- 1.7 QUALITY ASSURANCE
 - A. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and an Architectural Hardware Consultant who is available during the course of the Work to consult with Contractor, Architect, and Owner about door hardware and keying.
 - 1. Warehousing Facilities: In Project's vicinity.
 - 2. Scheduling Responsibility: Preparation of door hardware and keying schedules.
 - 3. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
 - B. Source Limitations: Obtain each type of door hardware from a single manufacturer.
 - C. Fire-Rated Door Assemblies: Where fire-rated door assemblies are indicated, provide door hardware rated for use in assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C, unless otherwise indicated.
 - D. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meet requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.
 - 1. Air Leakage Rate: Maximum air leakage of 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at the tested pressure differential of 0.3-inch wg (75 Pa) of water.
 - E. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.

- F. Means of Egress Doors: Latches do not require more than 15 lbf (67 N) to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.
- G. Accessibility Requirements: For door hardware on doors in an accessible route, comply with the U.S. Architectural & Transportation Barriers Compliance Board's ADA,-ABA Accessibility Guidelines ICC/ANSI A117.1.
 - 1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf (22.2 N).
 - 2. Comply with the following maximum opening-force requirements:
 - a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf (22.2 N) applied perpendicular to door.
 - b. Sliding or Folding Doors: 5 lbf (22.2 N) applied parallel to door at latch.
 - c. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
 - 3. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than.
 - 4. Adjust door closer sweep periods so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches (75 mm) from the latch, measured to the leading edge of the door.
- H. Keying Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." In addition to Owner Contractor, and Architect, conference participants shall also include Installer's Architectural Hardware Consultant. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including, but not limited to, the following:
 - 1. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
 - 2. Preliminary key system schematic diagram.
 - 3. Requirements for key control system.
 - 4. Requirements for access control.
 - 5. Address for delivery of keys.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.
- B. Tag each item or package separately with identification coordinated with the final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.
- C. Deliver keys and permanent cores to Owner by registered mail or overnight package service.

1.9 COORDINATION

- A. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- B. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

1.10 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including excessive deflection, cracking, or breakage.
 - b. Faulty operation of doors and door hardware.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
 - 2. Warranty Period: Three years from date of Substantial Completion, unless otherwise indicated.
 - a. Exit Devices: Two years from date of Substantial Completion.
 - b. Manual Closers: 10 years from date of Substantial Completion.

1.11 MAINTENANCE SERVICE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

- A. Provide door hardware for each door as scheduled in Part 3 "Door Hardware Schedule" Article and on Drawings to comply with requirements in this Section.
 - 1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and named manufacturers' products.
 - 2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.

- B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in Part 3 "Door Hardware Schedule" Article. Products are identified by using door hardware designations, as follows:
 - 1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in Part 3 "Door Hardware Schedule" Article.
 - 2. References to BHMA Designations: Provide products complying with these designations and requirements for description, quality, and function.

2.2 HINGES

- A. Hinges: BHMA A156.1. Provide template-produced hinges for hinges installed on hollowmetal doors and hollow-metal frames.
 - 1. <u>Basis-of-Design Product</u>: Subject to compliance with requirements, provide product indicated on schedule or comparable product by one of the following:
 - a. <u>Hager Companies</u>.
 - b. McKinney Products Company; an ASSA ABLOY Group company.
 - c. <u>Stanley Commercial Hardware; Div. of The Stanley Works</u>.

2.3 CONTINUOUS HINGES

- A. Continuous Hinges: BHMA A156.26; minimum 0.120-inch- (3.0-mm-) thick, hinge leaves with minimum overall width of 4 inches (102 mm); fabricated to full height of door and frame and to template screw locations; with components finished after milling and drilling are complete.
- B. Pin-and-Barrel-Type Hinges:
 - 1. <u>Basis-of-Design Product</u>: Subject to compliance with requirements, provide product indicated on schedule or comparable product by one of the following:
 - a. <u>Hager Companies</u>.
 - b. McKinney Products Company; an ASSA ABLOY Group company.
- C. Continuous, Gear-Type Hinges: Extruded-aluminum, pinless, geared hinge leaves joined by a continuous extruded-aluminum channel cap; with concealed, self-lubricating thrust bearings.
 - 1. <u>Basis-of-Design Product</u>: Subject to compliance with requirements, provide product indicated on schedule or comparable product by one of the following:
 - a. <u>Hager Companies</u>.
 - b. McKinney Products Company; an ASSA ABLOY Group company.
 - c. <u>Stanley Commercial Hardware; Div. of The Stanley Works</u>.

2.4 MECHANICAL LOCKS AND LATCHES

A. Lock Functions: As indicated in door hardware schedule.

- B. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:
 - 1. Bored Locks: Minimum 1/2-inch (13-mm) latchbolt throw.
 - 2. Mortise Locks: Minimum 3/4-inch (19-mm) latchbolt throw.
 - 3. Deadbolts: Minimum 1-inch (25-mm)bolt throw.
- C. Lock Backset: 2-3/4 inches (70 mm), unless otherwise indicated.
- D. Lock Trim:
 - 1. Description: As indicated in door hardware schedule
 - 2. Levers: Cast.
 - 3. Escutcheons (Roses): Wrought [Cast].
 - 4. Dummy Trim: Match lever lock trim and escutcheons.
 - 5. Operating Device: Lever with escutcheons (roses).
- E. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.
 - 1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
 - 2. Aluminum-Frame Strike Box: Manufacturer's special strike box fabricated for aluminum framing.
- F. Mortise Locks: BHMA A156.13; Operational Grade 1; stamped steel case with steel or brass parts; Series 1000.
 - 1. <u>Basis-of-Design Product</u>: Subject to compliance with requirements, provide product indicated on schedule or comparable product by one of the following:
 - a. <u>Best Access Systems; Div. of Stanley Security Solutions, Inc</u>.
 - b. Corbin Russwin Architectural Hardware; an ASSA ABLOY Group company.
 - c. <u>SARGENT Manufacturing Company; an ASSA ABLOY Group company</u>.
 - d. <u>Schlage Commercial Lock Division; an Ingersoll-Rand company</u>.
 - e. <u>Yale Security Inc.; an ASSA ABLOY Group company</u>.

2.5 AUXILIARY LOCKS

A. Mortise Auxiliary Locks: BHMA A156.5; Grade 1; with strike that suits frame.

- 1. <u>Basis-of-Design Product</u>: Subject to compliance with requirements, provide product indicated on schedule or comparable product by one of the following:
 - a. <u>Accurate Lock & Hardware Co</u>.
 - b. <u>Adams Rite Manufacturing Co.; an ASSA ABLOY Group company</u>.
 - c. <u>Arrow USA; an ASSA ABLOY Group company</u>.
 - d. <u>Best Access Systems; Div. of Stanley Security Solutions, Inc</u>.
 - e. <u>SARGENT Manufacturing Company; an ASSA ABLOY Group company</u>.
 - f. <u>Schlage Commercial Lock Division; an Ingersoll-Rand company</u>.
 - g. <u>Yale Security Inc.; an ASSA ABLOY Group company</u>.

- B. Push-Button Combination Locks: BHMA A156.5; mortise; Grade 2; lock opens by entering a one- to five-digit code by pushing correct buttons in correct sequence; automatically relocks when door is closed; with strike that suits frame.
 - 1. <u>Basis-of-Design Product</u>: Subject to compliance with requirements, provide product indicated on schedule or comparable product by one of the following:
 - a. Kaba Ilco Corp.; a Kaba Group company.

2.6 MANUAL FLUSH BOLTS

- A. Manual Flush Bolts: BHMA A156.16; minimum 3/4-inch (19-mm) throw; designed for mortising into door edge.
 - 1. <u>Basis-of-Design Product</u>: Subject to compliance with requirements, provide product indicated on schedule or comparable product by one of the following:
 - a. Adams Rite Manufacturing Co.; an ASSA ABLOY Group company.
 - b. <u>Burns Manufacturing Incorporated</u>.
 - c. <u>Don-Jo Mfg., Inc</u>.
 - d. <u>Door Controls International, Inc</u>.
 - e. <u>Hiawatha, Inc</u>.
 - f. <u>IVES Hardware; an Ingersoll-Rand company</u>.
 - g. <u>Trimco</u>.

2.7 AUTOMATIC AND SELF-LATCHING FLUSH BOLTS

- A. Automatic and Self-Latching Flush Bolts: BHMA A156.16; minimum 3/4-inch (19-mm) throw; designed for mortising into door edge.
 - 1. <u>Basis-of-Design Product</u>: Subject to compliance with requirements, provide product indicated on schedule or comparable product by one of the following:
 - a. <u>Cal-Royal Products, Inc</u>.
 - b. <u>Door Controls International, Inc</u>.
 - c. <u>IVES Hardware; an Ingersoll-Rand company</u>.
 - d. <u>Trimco</u>.

2.8 EXIT DEVICES AND AUXILIARY ITEMS

- A. Exit Devices and Auxiliary Items: BHMA A156.3.
 - 1. <u>Basis-of-Design Product</u>: Subject to compliance with requirements, provide product indicated on schedule or comparable product by one of the following:
 - a. <u>Corbin Russwin Architectural Hardware; an ASSA ABLOY Group company</u>.
 - b. <u>SARGENT Manufacturing Company; an ASSA ABLOY Group company</u>.
 - c. <u>Von Duprin; an Ingersoll-Rand company</u>.
 - d. <u>Yale Security Inc.; an ASSA ABLOY Group company</u>.

2.9 LOCK CYLINDERS

- A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver.
 - 1. Manufacturer: Same manufacturer as for locking devices.
 - <u>Basis-of-Design Product</u>: Subject to compliance with requirements, provide product indicated on schedule or comparable product by one of the following:
 a. Best Access Systems; Div. of Stanley Security Solutions, Inc.
- B. Standard Lock Cylinders: BHMA A156.5; Grade 1; permanent cores that are interchangeable; face finished to match lockset.
- C. Construction Master Keys: Provide cylinders with feature that permits voiding of construction keys without cylinder removal. Provide 10 construction master keys.
- D. Construction Cores: Provide construction cores that are replaceable by permanent cores. Provide 10 construction master keys.

2.10 KEYING

- A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, Appendix A. Incorporate decisions made in keying conference.
 1. Existing System:
 - a. Master key or grand master key locks to Owner's existing system.
 - b. Re-key Owner's existing master key system into new keying system.
- B. Keys: Nickel silver.
 - 1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:
 - a. Notation: "DO NOT DUPLICATE."
 - 2. Quantity: In addition to one extra key blank for each lock, provide the following:
 - a. Cylinder Change Keys: Three.
 - b. Master Keys: Five.
 - c. Grand Master Keys: Five.
 - d. Great-Grand Master Keys: Five.

2.11 KEY CONTROL SYSTEM

A. Key Control Cabinet: BHMA A156.5; metal cabinet with baked-enamel finish; containing keyholding hooks, labels, 2 sets of key tags with self-locking key holders, key-gathering envelopes, and temporary and permanent markers; with key capacity of 150 percent of the number of locks.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. <u>American Key Boxes and Cabinets</u>.
 - b. <u>GE Security, Inc</u>.
 - c. <u>HPC, Inc</u>.
 - d. <u>Lund Equipment Co., Inc</u>.
 - e. <u>MMF Industries</u>.
 - f. <u>Tri Palm International</u>.
- 2. Wall-Mounted Cabinet: Cabinet with hinged-panel door equipped with key-holding panels and pin-tumbler cylinder door lock.

2.12 OPERATING TRIM

- A. Operating Trim: BHMA A156.6; stainless steel, unless otherwise indicated.
 - 1. <u>Basis-of-Design Product</u>: Subject to compliance with requirements, provide product indicated on schedule or comparable product by one of the following:
 - a. <u>Hager Companies</u>.
 - b. <u>Hiawatha, Inc</u>.
 - c. IVES Hardware; an Ingersoll-Rand company.
 - d. <u>Rockwood Manufacturing Company</u>.
 - e. <u>Trimco</u>.

2.13 ACCESSORIES FOR PAIRS OF DOORS

- A. Coordinators: BHMA A156.3; consisting of active-leaf, hold-open lever and inactive-leaf release trigger; fabricated from steel with nylon-coated strike plates; with built-in, adjustable safety release; and with internal override.
- B. Carry-Open Bars: BHMA A156.3; prevent the inactive leaf from opening before the active leaf; provide polished brass or bronze carry-open bars with strike plate for inactive leaves of pairs of doors unless automatic or self-latching bolts are used.
- C. Astragals: BHMA A156.22.

2.14 SURFACE CLOSERS

- A. Surface Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written recommendations for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.
 - 1. <u>Basis-of-Design Product:</u> Subject to compliance with requirements, provide product indicated on schedule or comparable product by one of the following:
 - a. <u>LCN Closers; an Ingersoll-Rand company</u>.
 - b. Norton Door Controls; an ASSA ABLOY Group company.
 - c. <u>SARGENT Manufacturing Company; an ASSA ABLOY Group company</u>.
d. <u>Yale Security Inc.; an ASSA ABLOY Group company</u>.

2.15 MECHANICAL STOPS AND HOLDERS

- A. Wall- and Floor-Mounted Stops: BHMA A156.16; polished cast brass, bronze, or aluminum base metal.
 - 1. <u>Basis-of-Design Product</u>: Subject to compliance with requirements, provide product indicated on schedule or comparable product by one of the following:
 - a. Architectural Builders Hardware Mfg., Inc.
 - b. <u>Baldwin Hardware Corporation</u>.
 - c. <u>Burns Manufacturing Incorporated</u>.
 - d. <u>Cal-Royal Products, Inc</u>.
 - e. <u>Don-Jo Mfg., Inc</u>.
 - f. <u>Door Controls International, Inc</u>.
 - g. <u>Hager Companies</u>.
 - h. <u>Hiawatha, Inc</u>.
 - i. <u>IVES Hardware; an Ingersoll-Rand company</u>.
 - j. <u>Rockwood Manufacturing Company</u>.
 - k. <u>Stanley Commercial Hardware; Div. of The Stanley Works</u>.
 - 1. <u>Trimco</u>.

2.16 OVERHEAD STOPS AND HOLDERS

- A. Overhead Stops and Holders: BHMA A156.8.
 - 1. <u>Basis-of-Design Product</u>: Subject to compliance with requirements, provide product indicated on schedule or comparable product by one of the following:
 - a. <u>Architectural Builders Hardware Mfg., Inc</u>.
 - b. <u>Glynn-Johnson; an Ingersoll-Rand company</u>.
 - c. <u>Rockwood Manufacturing Company</u>.
 - d. <u>SARGENT Manufacturing Company; an ASSA ABLOY Group company</u>.

2.17 DOOR GASKETING

- A. Door Gasketing: BHMA A156.22; air leakage not to exceed 0.50 cfm per foot (0.000774 cu. m/s per m) of crack length for gasketing other than for smoke control, as tested according to ASTM E 283; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.
 - 1. <u>Basis-of-Design Product</u>: Subject to compliance with requirements, provide product indicated on schedule or comparable product by one of the following:
 - a. <u>Hager Companies</u>.
 - b. <u>National Guard Products</u>.
 - c. <u>Pemko Manufacturing Co.; an ASSA ABLOY Group company</u>.

2.18 THRESHOLDS

- A. Thresholds: BHMA A156.21; fabricated to full width of opening indicated.
 - 1. <u>Basis-of-Design Product</u>: Subject to compliance with requirements, provide product indicated on schedule or comparable product by one of the following:
 - a. <u>Hager Companies</u>.
 - b. <u>National Guard Products</u>.
 - c. <u>Pemko Manufacturing Co.; an ASSA ABLOY Group company</u>.
 - d. Rixson Specialty Door Controls; an ASSA ABLOY Group company.
 - 2. Custom large sizes see details for specific conditions.

2.19 METAL PROTECTIVE TRIM UNITS

- A. Metal Protective Trim Units: BHMA A156.6; fabricated from 0.050-inch- (1.3-mm-) thick stainless steel; with manufacturer's standard machine or self-tapping screw fasteners.
 - 1. <u>Basis-of-Design Product</u>: Subject to compliance with requirements, provide product indicated on schedule or comparable product by one of the following:
 - a. IPC Door and Wall Protection Systems, Inc.; Div. of InPro Corporation.
 - b. <u>IVES Hardware; an Ingersoll-Rand company</u>.
 - c. <u>Rockwood Manufacturing Company</u>.
 - d. <u>Trimco</u>.

2.20 AUXILIARY DOOR HARDWARE

- A. Auxiliary Hardware: BHMA A156.16.
 - 1. <u>Basis-of-Design Product</u>: Subject to compliance with requirements, provide product indicated on schedule or comparable product by one of the following:
 - a. <u>Baldwin Hardware Corporation</u>.
 - b. <u>Cal-Royal Products, Inc</u>.
 - c. <u>Don-Jo Mfg., Inc</u>.
 - d. <u>Hager Companies</u>.
 - e. <u>Rockwood Manufacturing Company</u>.
 - f. <u>Stanley Commercial Hardware; Div. of The Stanley Works</u>.
 - g. <u>Trimco</u>.

2.21 AUXILIARY ELECTRIFIED DOOR HARDWARE

- 1. <u>Basis-of-Design Product</u>: Subject to compliance with requirements, provide product indicated on schedule or comparable product by one of the following:
 - a. <u>DynaLock Corp</u>.
 - b. <u>GE Security, Inc</u>.
 - c. <u>SARGENT Manufacturing Company; an ASSA ABLOY Group company</u>.
 - d. <u>Schlage Commercial Lock Division; an Ingersoll-Rand company</u>.
 - e. <u>Securitron Magnalock Corporation; an ASSA ABLOY Group company</u>.
 - f. <u>Security Door Controls</u>.

2.22 FABRICATION

- A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except in conjunction with required fire-rated labels and as otherwise approved by Architect.
 - 1. Manufacturer's identification is permitted on rim of lock cylinders only.
- B. Base Metals: Produce door hardware units of base metal indicated, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18.
- C. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.
 - 1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
 - 2. Fire-Rated Applications:
 - a. Wood or Machine Screws: For the following:
 - 1) Hinges mortised to doors or frames; use threaded-to-the-head wood screws for wood doors and frames.
 - 2) Strike plates to frames.
 - 3) Closers to doors and frames.
 - b. Steel Through Bolts: For the following unless door blocking is provided:
 - 1) Surface hinges to doors.
 - 2) Closers to doors and frames.
 - 3) Surface-mounted exit devices.
 - 3. Spacers or Sex Bolts: For through bolting of hollow-metal doors.
 - 4. Fasteners for Wood Doors: Comply with requirements in DHI WDHS.2, "Recommended Fasteners for Wood Doors."
 - 5. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

2.23 FINISHES

A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.

- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.
- B. Wood Doors: Comply with DHI WDHS.5 "Recommended Hardware Reinforcement Locations for Mineral Core Wood Flush Doors."

3.3 INSTALLATION

- A. Mounting Heights: Mount door hardware units at heights to comply with the following unless otherwise indicated or required to comply with governing regulations.
 - 1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
 - 2. Custom Steel Doors and Frames: HMMA 831.
 - 3. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
- B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing. Do not install surface-mounted items until finishes have been completed on substrates involved.

- 1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
- 2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- C. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches (750 mm) of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.
- D. Lock Cylinders: Install construction cores to secure building and areas during construction period.
 - 1. Replace construction cores with permanent cores as directed by Owner.
 - 2. Furnish permanent cores to Owner for installation.
- E. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.
- F. Boxed Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings. Verify location with Architect.
 - 1. Configuration: Provide one power supply for each door opening with electrified door hardware.
- G. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Section 079200 "Joint Sealants."
- H. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.
- I. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
- J. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

3.4 FIELD QUALITY CONTROL

- A. Independent Architectural Hardware Consultant: Owner will engage a qualified independent Architectural Hardware Consultant to perform inspections and to prepare inspection reports.
 - 1. Independent Architectural Hardware Consultant will inspect door hardware and state in each report whether installed work complies with or deviates from requirements, including whether door hardware is properly installed and adjusted.

3.5 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to

operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

- 1. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
- B. Occupancy Adjustment: Approximately six months after date of Substantial Completion, Installer's Architectural Hardware Consultant shall examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors, door hardware, and electrified door hardware.

3.6 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.
- B. Clean operating items as necessary to restore proper function and finish.
- C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain door hardware and door hardware finishes. Refer to Section 017900 "Demonstration and Training."

PART 4 - DOOR HARDWARE SCHEDULE

Notes: Provide UL approved fire rated hardware for rated doors. Provide Cylinders keyed to master keying system for hardware provided by storefront manufacturer. Provide all accessories required for fully functioning hardware systems.

Door Hardware Set No. 1 Alum X Alum -100A (threshold and weatherstripping by door provider) (right leaf to function with OFOI cardreader, left leaf inactive)

Each door to have:

No.	Item	Description	Finish	Manufacturer
1	Continuous Hinge	CFS 85 HD1 PT		PE
1	Continuous Hinge	CFS 85 HD1 QC4		PE
1	Mullion	4954 7'2''	SP28	VO
1	Exit Device	98Lx996L-DT 425- SNB (QTY-2)	US26D, US32D	VO
1	Exit Device	EL 98Lx996L-R&V 425-SNB (QTY-2)	US26D, US32D	VO
1	Rim Cylinder	1E-72-STD	626	BE
2	Closer	CLP-7500 SN-134	689	NO
1	Power Transfer	EPT 2	SP28	VO
1	Power Supply	PS914		VO

Door Hardware Set No. 2 - Gates-Stair ST02, Stair ST03, Stair ST04, Batting Cage 116

Each	door to have:					
No.	Item	Description	Finish	Manufacturer		
1	Exit Device	98NL-OP x 110MD-NL	US26D, US32D	VO		
		425-SNB (QTY-6)				
		48"				
1	Rim Cylinder	1E-72STD	626	BE		
Strik	Strike included with exit device, hinges are by gate provider					

Door Hardware Set No. 3- DR. Stair ST01C, Stair ST01A

No.	Item	Description	Finish	Manufacturer
3	Stnls Steel Hinge	TA2314 4 ¹ ⁄ ₂ x 4 ¹ ⁄ ₂ NRP	32D	MC
1	Exit Device	99EO 425-SNB (QTY-	US26D	VO
		6)		
1	Closer	CLP-7500-SN-134	680	NO
1	Simplex	LRP1010-B26D-41		VA01
1	Best Core	ICM-Best Core		VA01
1	Weatherstrip	290APK x36" 2x86"		PE

Door Hardware Set No. 4-DR. Batting Cage 116B, Stair ST01B (42" wide), H101B

Each door to have:

No.	Item	Description	Finish	Manufacturer
3	Stnls Steel Hinge	TA2314 4 ¹ ⁄ ₂ x 4 ¹ ⁄ ₂ NRP	32D	MC
1	Exit Device	99EO 425-SNB (QTY-	US26D	VO
		6)		
1	Closer	CLP-7500 SN-134	689	NO
1	Weatherstrip	290 APK 1x36" 2x86"		PE
1	Door Sweep	315 CN 36"		PE
1	¹ / ₂ x 5 Saddle Threshold	171 A 36"		PE
1	Door Top Rain Drip	346C		Pemko
1	Overhead Stop	9-336	689	RX

Door Hardware Set No. 5-Dr. Vest H101C

Each door to have:

No.	Item	Description	Finish	Manufacturer
3	Stnls Steel Hinge	TA2314 4 ¹ ⁄ ₂ x 4 ¹ ⁄ ₂ NRP	32D	MC
1	Exit Device	99EO 425-SNB (QTY-	US26D	VO
		6)		
1	Closer	CLP-7500-T SN-134	689	NO
1	Simplex	LRP1020-B26D-41		VA01
1	Best Core	ICM-Best Core		VA01
1	Wall Bumper	409	US32D	RO

Door Hardware Set No. 5.1-Dr.H101A, 116A

No.	Item	Description	Finish	Manufacturer
3	Stnls Steel Hinge	TA2314 4 ¹ ⁄ ₂ x 4 ¹ ⁄ ₂ NRP	32D	MC
1	Exit Device	99EO 425-SNB (QTY- 6) 48'	US26D	VO
1	Closer	CLP-7500-T SN-134	689	NO
1	Simplex	LRP1020-B26D-41		VA01
1	Best Core	ICM-Best Core		VA01
1	Closer	4400 SN-134	689	YA
1	Weatherstrip	290 APK 1 x 42" 2 x 86"		PE
1	Door Bottom	315 CN 42"		PE
1	Threshold	171 A 42"		PE
1	Overhead Stop	9-336	689	RX

Door Hardware Set No. 6-Dr. Coach Meeting 107A, Umpire Meeting 119A

Each door to have:

No.	Item	Description	Finish	Manufacturer
3	Bearing Hinge	TA2714 4 ½ x 4 1/2	26D	MC
1	Simplex Pushbutton	LR8146-B-26D-41		KA01
	Lock			
1	Closer	CLP-7500 SN-134	689	NO
1	Protection Plate	K1050 8" x 34"	US32D	RO
1	Best Core	ICM-Best Core		
3	Silencers	608	GREY	RO
1	Overhead Stop	9-336	689	RX

Door Hardware Set No. 6.1-Dr. Visiting Dugout117A, Home dugout 109A

Each door to have:

No.	Item	Description	Finish	Manufacturer
3	Bearing Hinge	TA2714 4 ¹ / ₂ x 4 1/2	26D	MC
1	Simplex Pushbutton	LR8146-B-26D-41		KA01
	Lock			
1	Closer	CLP-7500 SN-134	689	NO
1	Protection Plate	K1050 8" x 34"	US32D	RO
1	Wall Bumper	409	US32D	RO
1	Best Core	ICM-Best Core		
3	Silencers	608	GREY	RO
1	Overhead Stop	9-336	689	RX
1	Door Sweep	315 CN 42"		PE
1	¹ / ₂ x 5 Saddle Threshold	171 A 42"		PE

Door Hardware Set No. 6.2-Dr. Coach Meeting 107A,

No.	Item	Description	Finish	Manufacturer
3	Bearing Hinge	TA2714 4 ½ x 4 1/2	26D	MC
1	Simplex Pushbutton	LR8146-B-26D-41		KA01
	Lock			
1	Closer	CLP-7500 SN-134	689	NO
1	Protection Plate	K1050 8" x 34"	US32D	RO
1	Best Core	ICM-Best Core		
3	Silencers	608	GREY	RO
1	Overhead Stop	9-336	689	RX

Door Hardware Set No. 7-Training 113A

Each door to have:

No.	Item	Description	Finish	Manufacturer
3	Bearing Hinge	T42714 4 ½ x 4½	26D	MC
1	Lockset	ML2067LWA	630	CR
1	Mortise Cylinder	1E-74 STD	626	BE
1	Closer	CLP-7500-T SN-134	689	NO
1	Protection Plate	K1050 8" x 34"	US32D	RO
1	Overhead Stop	9-336	689	RX
1	Wall Bumper	409	US32D	RO
3	Silencers	608	GREY	RO

Door Hardware Set No. 7.1-Dr. 111A

Each door to have:

No.	Item	Description	Finish	Manufacturer
3	Bearing Hinge	TA2714 4 ¹ ⁄ ₂ x 4 ¹ ⁄ ₂	26D	MC
1	Lockset	ML2067 LWA	630	CR
1	Mortise Cylinder	1E-74 STD	626	BE
1	Closer	CLP-7500-T SN-134	689	NO
1	Protection Plate	K1050 8" x 40"	US32D	RO
1	Overhead Stop	9-336	689	RX
3	Silencers	608	GREY	RO
1	Weatherstrip	290 APK 1x42" 2x86"		PE
1	Door Sweep	315 CN 42"		PE
1	$\frac{1}{2}$ x 5 Saddle Threshold	171 A 42"		PE

Door Hardware Set No. 8- 118A

Each	Each door to have:			
No.	Item	Description	Finish	Manufacturer
3	Bearing Hinge	T4A3786 4 ½ x 4 ½	26D	MC
1	Lockset	ML2067 LWA	630	CR
1	Mortise Cylinder	1E-74 STD	626	BE
1	Closer	7500 SN-134	689	NO
1	Protection Plate	K1050 8" x 34"	US32D	RO
1	Weatherstrip	290 APK 1 x 36" 2 x		PE
		86"		
1	Door Sweep	315 CN 36"		PE
1	¹ / ₂ x 5 Saddle Threshold	171 A 36"		PE
1	Wall Bumper	409	US32D	RO

Door Hardware Set No. 8.1-Dr. 105A, 110A

No.	Item	Description	Finish	Manufacturer
3	Bearing Hinge	TA2714 4 ¹ ⁄ ₂ x 4 ¹ ⁄ ₂	26D	MC
1	Lockset	ML2059 LWA	630	CR
1	Mortise Cylinder	1E-74 STD	626	BE
1	Closer	7500 SN-134	689	NO
1	Protection Plate	K1050 8" x 46"	US32D	RO
1	Weatherstrip	290 APK 1 x 48" 2 x	US32D	PE
		86"		
1	Door Sweep	315 CN 48"	GREY	PE
1	Threshold	171 A 48"		PE

Door Hardware Set No. 8.2-Dr. 106A, 104A, 112A

Each door to have:

No.	Item	Description	Finish	Manufacturer
3	Bearing Hinge	TA2714 4 ½ x 4 ½	26D	MC
1	Lockset	ML2059 LWA	630	CR
1	Mortise Cylinder	1E-74 STD	626	BE
1	Closer	7500 SN-134	689	NO
1	Protection Plate	K1050 8" x 40"	US32D	RO
1	Overhead Stop	9-336	689	RX
1	Weatherstrip	290 APK 1x42"2 x 86"		PE
1	Door Bottom	315 CN 42"		PE
1	Threshold	171 A 42"		PE

Door Hardware Set No. 8.3- Cust 108A

No.	Item	Description	Finish	Manufacturer
3	Bearing Hinge	T4A3786 4 ½ x 4 ½	26D	MC
1	Lockset	ML2067 LWA	630	CR
1	Mortise Cylinder	1E-74 STD	626	BE
1	Closer	7500 SN-134	689	NO
1	Protection Plate	K1050 8" x 34"	US32D	RO
1	Weatherstrip	290 APK 1 x 36" 2 x 86"		PE
1	Door Sweep	315 CN 36"		PE
1	¹ / ₂ x 5 Saddle Threshold	171 A 36"		PE
1	Door Top Rain Drip	346C		Pemko

Door Hardware Set No. 9-Cust 121A

Each	Each door to have:				
No.	Item	Description	Finish	Manufacturer	
3	Bearing Hinge	TA2714 4 ¹ ⁄ ₂ x 4/1/2	26D	MC	
1	Lockset	ML2059 LWA	630	CR	
1	Mortise Cylinder	1E-74 STD	626	BE	
1	Closer	7500 SN-134	689	NO	
1	Protection Plate	K1050 8" x 34"	US32D	RO	
1	Weatherstrip	290 APK 1 x 36" 2 x 86"		PE	
1	Door Sweep	315 CN 36"		PE	
1	¹ / ₂ x 5 Saddle Threshold	171 A 36"		PE	

Door Hardware Set No. Dr. 9.1- 202A, 210A

Each door to have:				
No.	Item	Description	Finish	Manufacturer
3	Bearing Hinge	TA2714 4 ½ x 4 ½	26D	MC
1	Lockset	ML2059 LWA	630	CR
1	Mortise Cylinder	1E-74 STD	626	BE
1	Closer	7500 SN-134	689	NO
1	Protection Plate	K1050 8" x 34"	US32D	RO
1	Door Top Rain Drip	346C		Pemko
1	Threshold-Special	2750 A Series ¹ / ₂ " x 36" :	x 18"	VA01
1	Weatherstrip	290 APK 1 x 36" 2 x 86"		PE
1	Door Sweep	315 CN 36"		PE

Door Hardware Set No. 9.2-Dr. 103A, 103B

Each	Each door to have:				
No.	Item	Description	Finish	Manufacturer	
3	Bearing Hinge	TA2714 4 ¹ ⁄ ₂ x 4 ¹ ⁄ ₂	26D	MC	
1	Lockset	ML2059 LWA	630	CR	
1	Closer	7500 SN-134	689	NO	
1	Protection Plate	K1050 8" x 40"	US32D	RO	
1	Wall Bumper	409	US32D	RO	
1	Weatherstrip	290 APK 1 x 42" 2 x		PE	
		86"			
1	Door Bottom	315 CN 42"		PE	
1	Threshold	171 A 42''		PE	

Door Hardware Set No. 9.3-Ticket 211A

Each	Each door to have:			
No.	Item	Description	Finish	Manufacturer
3	Bearing Hinge	TA2714 4 ½ x 4/1/2	26D	MC
1	Lockset	ML2059 LWA	630	CR
1	Mortise Cylinder	1E-74 STD	626	BE
1	Closer	7500 SN-134	689	NO
1	Protection Plate	K1050 8" x 34"	US32D	RO
1	Weatherstrip	290 APK 1 x 36" 2 x 86"		PE
1	Door Sweep	315 CN 36"		PE
1	¹ / ₂ x 5 Saddle Threshold	171 A 36"		PE
1	Door Top Rain Drip	346C		Pemko

Door Hardware Set No. 10 Doors 203A, 107AA, 107BA

Each door to have:

No.	Item	Description	Finish	Manufacturer
3	Bearing Hinge	TA2714 4 ¹ / ₂ x 4 1/2	26D	MC
1	Lockset	ML2067 LWA M19V	630	CR
1	Mortise Cylinder	1E-74 STD	626	BE
1	Overhead Stop	9-336	689	RX
1	Protection Plate	K1050 8" x 34"	US32D	RO
1	Wall Bumper	409	US32D	RO
3	Silencers	608	GREY	RO

Door Hardware Set No10.1-Dr. H202A

Each door to have:					
No.	Item	Description	Finish	Manufacturer	
3	Bearing Hinge	TA2714 41/2 x 4	26D	MC	
1	Lockset	ML2067 LWA	630	CR	
		26D	MC		
1	Mortise Cylinder	1E-74 STD	626	BE	
1	Closer	7500 SN-134	689	NO	
1	Protection Plate	K1050 8'' x 40''	US32D	RO	
1	Threshold-Special	2750 A Series ¹ /2" x 4	2" x 18"	VA01	
1	Weatherstrip	290 APK 1 x 42" 2 x	86"	PE	
1	Door Sweep	315 CN 42"		PE	

Door Hardware Set No. 10.2-Dr. 205A

Each door to have:

No.	Item	Description	Finish	Manufacturer
3	Bearing Hinge	T4A2717 4 ¹ ⁄ ₂ x 4 ¹ ⁄ ₂	26D	MC
1	Lockset	ML2067 LWA	630	CR
1	Mortise Cylinder	1E-74 STD	626	BE
1	Overhead Stop	9-436	689	RX
1	Protection Plate	K1050 8'' x 40''	US32D	RO
3	Silencers	608	GREY	RO

Door Hardware Set No10.3-Dr. 301A, 302A, 303A, 304A, 305A, 306A, 307A

Each door to have:

No.	Item	Description	Finish	Manufacturer
3	Bearing Hinge	TA2714 41/2 x 4	26D	MC
1	Lockset	ML2067 LWA	630	CR
1	Mortise Cylinder	1E-74 STD	626	BE
1	Closer	7500T SN-134	689	NO
1	Protection Plate	K1050 8'' x 34''	US32D	RO
1	Threshold	171 A 36"		PE
1	Weatherstrip	290 APK 1 x 36" 2 x 86"	,	PE
1	Door Sweep	315 CN 36"		PE

Door Hardware Set No. 10.4-Dr. 101A

No.	Item	Description	Finish	Manufacturer
3	Bearing Hinge	T4A2717 4 ¹ ⁄ ₂ x 4 ¹ ⁄ ₂	26D	MC
1	Lockset	ML2067 LWA	630	CR
1	Mortise Cylinder	1E-74 STD	626	BE
1	Overhead Stop	9-436	689	RX
1	Protection Plate	K1050 8'' x 40''	US32D	RO
3	Silencers	608	GREY	RO
1	Wall Bumper	409	US32D	RO

Door Hardware Set No. 11-Restrooms 201A, 204A, 102A

Each door to have:

No.	Item	Description	Finish	Manufacturer
3	Bearing Hinge	TA2714 4 ¹ ⁄ ₂ x 4 ¹ ⁄ ₂	26D	MC
1	Lockset	ML2069 LWA M19V	630	CR
1	Closer	7500 SN-134	689	NO
1	Protection Plate	K1050 8" x 34"	US32D	RO
1	Wall Bumper	409	US32D	RO
3	Silencers	608	GREY	RO
1	Overhead Stop	9-436	689	RX

Door Hardware Set No. 11.1-Dr. 207A

Each door to have:

No.	Item	Description	Finish	Manufacturer
3	Bearing Hinge	T4A2714 4 ½ x 4 ½	26D	MC
1	Lockset	ML2069 LWA M19V	630	CR
1	Mortise Cylinder	1E-74 STD	626	BE
1	Closer	7500 SN-134	689	NO
1	Protection Plate	K1050 8" x 34"	US32D	RO
1	Wall Bumper	409	US32D	RO
1	Threshold-Special	2750 A Series ¹ /2" x 36" x	x 18"	VA01
1	Weatherstrip	290 APK 1 x 36" 2 x 86"		PE
1	Door Sweep	315 CN 36"		PE

Door Hardware Set No.11.2-Dr. 206A

No.	Item	Description	Finish	Manufacturer
6	Bearing Hinge	T4A2714 4 ¹ / ₂ x 4 ¹ / ₂	26D	MC
2	Flush Bolts	555	US26D	RO
1	Lockset	ML2067 LWA	630	CR
1	Mortise Cylinder	1E- 74 STD	626	BE
2	Closer	7500 SN-134	689	NO
1	Protection Plate	K1050 8"x 46"	US32D	RO
1	Protection Plate	K1050 8" x 22"	US32D	RO
1	Threshold-Special	2750-Series-1/2 "x 60"x 18"		VA01
1	Weatherstrip	290 APK 1 x 48" 1x24", 2 x 86"	US32D	PE
1	Door Sweep	315 CN 48", 24"		PE

Door Hardware Set No. 11.3-Restrooms 119AA, 119BA,

Each door to have:

No.	Item	Description	Finish	Manufacturer
3	Bearing Hinge	TA2714 4 ½ x 4 ½	26D	MC
1	Lockset	ML2069 LWA M19V	630	CR
1	Closer	7500 SN-134	689	NO
1	Protection Plate	K1050 8" x 34"	US32D	RO
1	Wall Bumper	409	US32D	RO
3	Silencers	608	GREY	RO
1	Overhead Stop	9-336	689	RX

Door Hardware Set No. 11.4-Restrooms 117AA. 109AA, 308A, 309A (closers to be mounted inside room)

Each door to have:

No.	Item	Description	Finish	Manufacturer
3	Bearing Hinge	TA2714 4 ¹ ⁄ ₂ x 4 ¹ ⁄ ₂	26D	MC
1	Lockset	ML2069 LWA M19V	630	CR
1	Closer	7500 SN-134	689	NO
1	Protection Plate	K1050 8" x 34"	US32D	RO
1	Wall Bumper	409	US32D	RO
3	Silencers	608	GREY	RO
1	Overhead Stop	9-336	689	RX
1	Door Sweep	315 CN 36"	PE	1
1	¹ / ₂ x 5 Saddle Threshold	171 A 36"		PE
1	Door Top Rain Drip	346C		Pemko

Door Hardware Set No. 12- 115A (Astragal by door supplier)

No.	Item	Description	Finish	Manufacturer
6	Stnls Steel Hinge	TA2314 4 ½ x 4 ½ NRP	32D	MC
2	Flush Bolts	555	US26D	RO
1	Lockset	ML2059 LWA	630	CR
1	Mortise Cylinder	1-E74 STD	626	BE
2	Closer	CLP-7500 SN-134	689	NO
2	Protection Plate	K1050 8" x 46"	US32D	RO
2	Door Sweep	315 CN 48"		PE
1	Threshold	171 A 96"		PE

Door Hardware Set No. 13-Small Storage- 115B

Each door to have:

No.	Item	Description	Finish	Manufacturer
2	Bearing Hinge	T4A2717 4 ¹ ⁄ ₂ x 4 ¹ ⁄ ₂	26D	MC
1	Deadlock	ML2017	630	CR
1	Mortise Cylinder	1E-74 STD	626	BE
1	Door Pull	102 Type 1 Fastening	US32D	RO
1	Weatherstrip	290 APK 1 x 36" 2 x		PE
		86"		

Door Hardware Set No. 14-Dr. ST01D

Each door to have:

No.	Item	Description	Finish	Manufacturer
3	Stnls Steel Hinge	TA2314 4 ¹ ⁄ ₂ x 4 ¹ ⁄ ₂ NRP	32D	MC
1	Exit Device	98L x 996L-R&V-BE 425-SNB (QTY-2) 48'	US26D, US32D	VO
1	Closer	CLP-7500 SN-134	689	NO
1	Protection Plate	K1050 8" x 40'	US32D	RO
1	Wall Bumper	409	US32D	RO
1	Threshold-Special	2750-Series-1/2' x 42" x 18"		VA01
1	Weatherstrip	290 APK 1 x 42" 2 x 86"		PE
1	Door Sweep	315 CN 42"		PE
1	Door Top Rain Drip	346C		Pemko

Door Hardware Set No. 15- Dr.201A

No.	Item	Description	Finish	Manufacturer
3	Stnls Steel Hinge	TA2314 4 ¹ ⁄ ₂ x 4 ¹ ⁄ ₂ NRP	32D	MC
1	Exit Device	CD 98L x 996L-R&V 425-SNB (QTY-2)	US26D, US32D	VO
1	Rim Cylinder	1E -72 STD	626	BE
1	Mortise Cylinder	1E -74 STD	626	BE
1	Closer	CLP-7500T SN-134	689	NO
1	Protection Plate	K1050 8" x 34"	US32D	RO
1	Threshold-Special	2750 A Series ¹ /2" x 36" x 18"		VA01
1	Weatherstrip	290 APK 1 x 36" 2 x 86"		PE
1	Door Sweep	315 CN 36"		PE

Door Hardware Set No. 16-Dr. 120A

Each door to have:

No.	Item	Description	Finish	Manufacturer
3	Stnls Steel Hinge	TA2314 4 ¹ ⁄ ₂ x 4 ¹ ⁄ ₂ NRP	32D	MC
1	Exit Device	98Lx996L-NL-R&V 425-SNB (QTY-2) 48"	US26D, US32D	VO
1	Closer	CLP-7500 SN-134	626	BE
1	Door Sweep	315 CN 48"		PE
1	Threshold	171 A 48"		PE
1	Rim Cylinder	1E-72 STD	626	MC
1	Weatherstrip	290 APK 1 x 36" 2 x 86"	US32D	PE
1	Door Sweep	315 CN 36"		PE

Door Hardware Set No. 17-Dr. 208A, 209A

Each door to have:

No.	Item	Description	Finish	Manufacturer
3	Stnls Steel Hinge	TA2314 4 ¹ ⁄ ₂ x 4 ¹ ⁄ ₂	32D	MC
1	Deadlock	ML2017	630	CR
1	Mortise Cylinder	1 ^E -74 STD	626	BE
1	Door Pull	102 x 70C	US32D	RO
1	Push Plate	70C 4x16	US32D	RO
1	Closer	CLP-7500 SN-134	689	NO
1	Protection Plate	K1050 8" x 34"	US32D	RO
1	Base Stop & Holder	476	US32D	RO
1	Threshold-Special	2750 A Series ¹ / ₂ " x 36" x 18"		VA01
1	Weatherstrip	290 APK 1 x 36" 2 x 86"		PE
1	Door Sweep	315 CN 36"		PE

Door Hardware Set No. 18-Roll up Doors-118B, 211B, Main Entry Gate

Each door to have:

No.	Item	Description	Finish		Manufacturer
1	Mortise Cylinder	1E-74 STD	626		BE
At Main entry gate provide 2 cylinders, and deadbolt. Coordinate with Gate fabricator.					

END OF SECTION 087100

SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
 - 1. Windows.
 - 2. Doors.
 - 3. Storefront framing.

1.3 DEFINITIONS

- A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.
- C. Interspace: Space between lites of an insulating-glass unit.

1.4 PERFORMANCE REQUIREMENTS

- A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
 - 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

1.5 ACTION SUBMITTALS

- A. Product Data: For each glass product and glazing material indicated.
- B. Glass Samples: For each type of the following products; 12 inches (300 mm) square.
 - 1. Coated glass.
 - 2. Fire-resistive glazing products.
 - 3. Insulating glass.
- C. Glazing Accessory Samples: For sealants, in 12-inch (300-mm) lengths. Install sealant Samples between two strips of material representative in color of the adjoining framing system.
- D. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For installers.
- B. Product Certificates: For glass and glazing products, from manufacturer.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for coated glass, insulating glass and glazing sealants.
 - 1. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-month period.
- D. Preconstruction adhesion and compatibility test report.
- E. Warranties: Sample of special warranties.

1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved and certified by coated-glass manufacturer.
- B. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.
- C. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.
- D. Source Limitations for Glass: Obtain coated float glass, laminated glass, and insulating glass from single source from single manufacturer for each glass type.
- E. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

- F. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
 - 1. GANA Publications: GANA's "Laminated Glazing Reference Manual" and GANA's "Glazing Manual."
 - 2. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
- G. Safety Glazing Labeling: Where safety glazing labeling is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- H. Fire-Protection-Rated Glazing Labeling: Permanently mark fire-protection-rated glazing with certification label of a testing agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, test standard, whether glazing is for use in fire doors or other openings, whether or not glazing passes hose-stream test, whether or not glazing has a temperature rise rating of 450 deg F (250 deg C), and the fire-resistance rating in minutes.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
- B. Comply with insulating-glass manufacturer's written recommendations for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.9 PROJECT CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
 - 1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or below 40 deg F (4.4 deg C).

1.10 WARRANTY

A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer's standard form in which coated-glass manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.

- 1. Warranty Period: 10 years from date of Substantial Completion.
- B. Manufacturer's Special Warranty on Laminated Glass: Manufacturer's standard form in which laminated-glass manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.
 - 1. Warranty Period: Five years from date of Substantial Completion.
- C. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form in which insulating-glass manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GLASS PRODUCTS, GENERAL

- A. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.
 - 1. Minimum Glass Thickness for Exterior Lites: Not less than 6.0 mm.
 - 2. Thickness of Tinted Glass: Provide same thickness for each tint color indicated throughout Project.
- B. Strength: Where float glass is indicated, provide annealed float glass, Kind HS heat-treated float glass, or Kind FT heat-treated float glass. Where heat-strengthened glass is indicated, provide Kind HS heat-treated float glass or Kind FT heat-treated float glass. Where fully tempered glass is indicated, provide Kind FT heat-treated float glass.
- C. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
 - 1. For monolithic-glass lites, properties are based on units with lites 6.0 mm thick.
 - 2. For laminated-glass lites, properties are based on products of construction indicated.
 - 3. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
 - 4. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F (W/sq. m x K).

- 5. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
- 6. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.2 GLASS PRODUCTS

- A. Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.
- B. Ultraclear Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I, complying with other requirements specified and with visible light transmission not less than 91 percent and solar heat gain coefficient not less than 0.87.
 - 1. <u>Products</u>: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. <u>AFG Industries, Inc</u>.; Krystal Klear.
 - b. <u>Guardian Industries Corp</u>.; Ultrawhite.
 - c. Pilkington North America; Optiwhite.
 - d. <u>PPG Industries, Inc</u>.; Starphire.
- C. Heat-Treated Float Glass: ASTM C 1048; Type I; Quality-Q3; Class I (clear) unless otherwise indicated; of kind and condition indicated.
 - 1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
 - 2. For uncoated glass, comply with requirements for Condition A.
 - 3. For coated vision glass, comply with requirements for Condition C (other coated glass).

2.3 LAMINATED GLASS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Viracon Laminated Glass
 - 2. DuPont Glass Laminating Solutions.
- B. Laminated Glass: ASTM C 1172, and complying with testing requirements in 16 CFR 1201 for Category II materials, and with other requirements specified. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.
 - 1. Construction: Laminate glass with polyvinyl butyral interlayer or cast-in-place and cured-transparent-resin interlayer to comply with interlayer manufacturer's written recommendations.
 - 2. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
 - 3. Interlayer Color: Clear unless otherwise indicated.

C. Glass: Comply with applicable requirements in "Glass Products" Article as indicated by designations in "Laminated-Glass Types" Article.

2.4 INSULATING GLASS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide PPG Industries, Inc.; Solarban 70XL Solar Control Low-E coating, or comparable product by one of the following:
 - 1. Viracon
 - 2. Guardian Sunguard
- B. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190, and complying with other requirements specified.
 - 1. Sealing System: Dual seal, with manufacturer's standard primary and secondary.
 - 2. Spacer: Aluminum with mill or clear anodic finish.
- C. Glass: Comply with applicable requirements in "Glass Products" Article and in "Laminated Glass" Article as indicated by designations in "Insulating-Glass Types" Article and in "Insulating-Laminated-Glass Types" Article.

2.5 FIRE-PROTECTION-RATED GLAZING

- A. Fire-Protection-Rated Glazing, General: Listed and labeled by a testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 252 for door assemblies and NFPA 257 for window assemblies.
- B. Laminated Glass with Intumescent Interlayers: Laminated glass made from multiple plies of uncoated, clear float glass; with intumescent interlayers; complying with testing requirements in 16 CFR 1201 for Category II materials.
 - 1. <u>Products</u>: Subject to compliance with requirements, provide one of the following:
 - a. <u>InterEdge, Inc., a subsidiary of AFG Industries, Inc.; Pyrobel</u>.
 - b. Pilkington Group Limited (distributed by Technical Glass Products); PyroStop.
 - c. <u>Vetrotech Saint-Gobain</u>; SGG Swissflam N2.

2.6 GLAZING GASKETS

- A. Dense Compression Gaskets: Molded or extruded gaskets of profile and hardness required to maintain watertight seal, made from one of the following:
 - 1. EPDM complying with ASTM C 864.
 - 2. Silicone complying with ASTM C 1115.
 - 3. Thermoplastic polyolefin rubber complying with ASTM C 1115.

- B. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned neoprene, EPDM, silicone, or thermoplastic polyolefin rubber gaskets complying with ASTM C 509, Type II, black; of profile and hardness required to maintain watertight seal.
 - 1. Application: Use where soft compression gaskets will be compressed by inserting dense compression gaskets on opposite side of glazing or pressure applied by means of pressure-glazing stops on opposite side of glazing.

2.7 GLAZING SEALANTS

A. General:

- 1. Compatibility: Provide glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
- 2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
- 3. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.
- B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.
 - 1. <u>Products</u>: Subject to compliance with requirements, provide one of the following:
 - a. <u>Dow Corning Corporation; 790</u>.
 - b. <u>GE Advanced Materials Silicones; SilPruf LM SCS2700</u>.
 - c. <u>May National Associates, Inc.; Bondaflex Sil 290</u>.
 - d. <u>Pecora Corporation; 890</u>.
 - e. <u>Sika Corporation, Construction Products Division; SikaSil-C990</u>.
 - f. <u>Tremco Incorporated; Spectrem 1</u>.
- C. Glazing Sealants for Fire-Rated Glazing Products: Products that are approved by testing agencies that listed and labeled fire-resistant glazing products with which they are used for applications and fire-protection ratings indicated.

2.8 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
 - 1. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
 - 2. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

- B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:
 - 1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
 - 2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.9 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.10 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
- B. Grind smooth and polish exposed glass edges and corners.

2.11 MONOLITHIC-GLASS TYPES

- A. Glass Type G1T: Clear fully tempered float glass.
 - 1. Thickness: 6.0 mm.
 - 2. Provide safety glazing labeling.

2.12 LAMINATED-GLASS TYPES

A. Glass Type LG1: Clear laminated glass with two plies of heat-strengthened float glass.

- 1. Thickness of Each Glass Ply: 3.0 mm.
- 2. Interlayer Thickness: 0.060 inch (1.52 mm).
- 3. Provide safety glazing labeling.
- B. Glass Type LG2: Low-e-coated, laminated vision glass with two plies of clear heatstrengthened float glass.
 - 1. Thickness of Each Glass Ply: 3.0 mm.
 - 2. Interlayer Thickness: 0.060 inch (1.52 mm).
 - 3. Low-E Coating: Sputtered on second surface.
 - 4. Visible Light Transmittance: 57 percent minimum.
 - 5. Winter Nighttime U-Factor: .95 maximum.
 - 6. Summer Daytime U-Factor: .86 maximum.
 - 7. Solar Heat Gain Coefficient: .39maximum.
 - 8. Provide safety glazing labeling.

2.13 INSULATING-GLASS TYPES

- A. Glass Type **IG1**: Low-e-coated, clear insulating glass.
 - 1. Overall Unit Thickness: 3/4 inch (19 mm).
 - 2. Thickness of Each Glass Lite: 6.0 mm.
 - 3. Outdoor Lite: Fully tempered float glass.
 - 4. Interspace Content: Air.
 - 5. Indoor Lite: Fully tempered float glass.
 - 6. Low-E Coating: Sputtered second surface.
 - 7. Visible Light Transmittance: 66 percent minimum.
 - 8. Winter Nighttime U-Factor: 0.28 maximum.
 - 9. Summer Daytime U-Factor: 0.26 maximum.
 - 10. Solar Heat Gain Coefficient: 0.27 maximum.
 - 11. Provide safety glazing labeling.
- B. Glass Type **IG2**: Low-e-coated, clear insulating glass.
 - 1. Overall Unit Thickness: 1 inch (25 mm).
 - 2. Thickness of Each Glass Lite: 6.0 mm.
 - 3. Outdoor Lite: Fully tempered float glass.
 - 4. Interspace Content: Air.
 - 5. Indoor Lite: Fully tempered float glass.
 - 6. Low-E Coating: Sputtered on second surface.
 - 7. Visible Light Transmittance: 66 percent minimum.
 - 8. Winter Nighttime U-Factor: 0.28 maximum.
 - 9. Summer Daytime U-Factor: 0.26 maximum.
 - 10. Solar Heat Gain Coefficient: 0.27 maximum.
- C. Glass Type **IG3**: Low-e-coated, acid etched translucent insulating glass.
 - 1. Overall Unit Thickness: 1 inch (25 mm).
 - 2. Thickness of Each Glass Lite: 6.0 mm.

- 3. Outdoor Lite: Fully tempered float glass.
- 4. Interspace Content: Air.
- 5. Indoor Lite: Fully tempered float glass.
- 6. Low-E Coating: Sputtered on second surface.
- 7. Acid Etch Location: Third surface.
- 8. Winter Nighttime U-Factor: .28 maximum.
- 9. Summer Daytime U-Factor: .26 maximum.
- 10. Solar Heat Gain Coefficient: .27 maximum.

2.14 INSULATING-LAMINATED-GLASS TYPES

- A. Glass Type IG4: Low-e-coated, clear insulating laminated glass.
 - 1. Overall Unit Thickness: 1 inch (25 mm).
 - 2. Outdoor Lite: Clear laminated glass with two plies of heat-strengthened float glass.
 - a. Thickness of Each Glass Ply: 3.0 mm.
 - b. Interlayer Thickness: 0.060 inch (1.52 mm).
 - 3. Thickness of Indoor Lite: 6.0 mm.
 - 4. Interspace Content: Air.
 - 5. Indoor Lite: Fully tempered float glass.
 - 6. Low-E Coating: Sputtered on second surface.
 - 7. Winter Nighttime U-Factor: .28 maximum.
 - 8. Summer Daytime U-Factor: .26 maximum.
 - 9. Solar Heat Gain Coefficient: .27 maximum.
 - 10. Provide safety glazing labeling.

2.15 FIRE-PROTECTION-RATED GLAZING TYPES

- A. Glass Type FR1: 60-minute fire-rated glazing with 450 deg F (250 deg C) temperature rise limitation; laminated glass with intumescent interlayers.
 - 1. Provide safety glazing labeling.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
 - 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
 - 2. Presence and functioning of weep systems.
 - 3. Minimum required face and edge clearances.
 - 4. Effective sealing between joints of glass-framing members.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
- B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that will leave visible marks in the completed work.

3.3 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.
- C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
- D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- G. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).
 - 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
 - 2. Provide 1/8-inch (3-mm) minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

- I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- J. Set glass lites with proper orientation so that coatings face exterior or interior as specified.
- K. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
- L. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.4 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Do not remove release paper from tape until right before each glazing unit is installed.
- F. Apply heel bead of elastomeric sealant.
- G. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
- H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without

developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

- D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- E. Install gaskets so they protrude past face of glazing stops.

3.6 CLEANING AND PROTECTION

- A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.
- C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.
- D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.
- E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION 088000

SECTION 089000 - LOUVERS AND VENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Fixed, extruded-aluminum and formed-metal louvers.
- B. Related Sections:
 - 1. Section 081113 "Hollow Metal Doors and Frames" for louvers in hollow-metal doors.
 - 2. Section 081416 "Flush Wood Doors" for louvers in flush wood doors.

1.3 DEFINITIONS

- A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.
- B. Horizontal Louver: Louver with horizontal blades; i.e., the axes of the blades are horizontal.
- C. Drainable-Blade Louver: Louver with blades having gutters that collect water and drain it to channels in jambs and mullions, which carry it to bottom of unit and away from opening.

1.4 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.
 - 1. Wind Loads: Determine loads based on pressures as indicated on Drawings.
- B. Seismic Performance: Louvers, including attachments to other construction, shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
 - 1. Design earthquake spectral response acceleration, short period (Sds) for Project as indicated on drawings.
 - 2. Component Importance Factor is 1.0.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.
- B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.
 - 1. Show weep paths, gaskets, flashing, sealant, and other means of preventing water intrusion.
 - 2. Show mullion profiles and locations.
- C. Samples for Initial Selection: For units with factory-applied color finishes.
- D. Samples for Verification: For each type of metal finish required.

1.6 INFORMATIONAL SUBMITTALS

A. Product Test Reports: Based on evaluation of comprehensive tests performed according to AMCA 500-L by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver and showing compliance with performance requirements specified.

1.7 QUALITY ASSURANCE

- A. Source Limitations: Obtain louvers and vents from single source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.
- B. Welding: Qualify procedures and personnel according to the following:
 - 1. AWS D1.2/D1.2M, "Structural Welding Code Aluminum."
 - 2. AWS D1.3, "Structural Welding Code Sheet Steel."
 - 3. AWS D1.6, "Structural Welding Code Stainless Steel."
- C. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.

1.8 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T5, T-52, or T6.
- B. Aluminum Sheet: ASTM B 209 (ASTM B 209M), Alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.
- C. Aluminum Castings: ASTM B 26/B 26M, Alloy 319.
- D. Galvanized-Steel Sheet: ASTM A 653/A 653M, [G60 (Z180)] [G90 (Z275)] zinc coating, mill phosphatized.
- E. Fasteners: Use types and sizes to suit unit installation conditions.
 - 1. Use Phillips flat-head screws for exposed fasteners unless otherwise indicated.
 - 2. For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.
 - 3. For fastening galvanized steel, use hot-dip-galvanized steel or 300 series stainless-steel fasteners.
 - 4. For color-finished louvers, use fasteners with heads that match color of louvers.
- F. Postinstalled Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, made from stainless-steel components, with capability to sustain, without failure, a load equal to 4 times the loads imposed, for concrete, or 6 times the load imposed, for masonry, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.
- G. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.2 FABRICATION, GENERAL

- A. Assemble louvers in factory to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- B. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.
- C. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
 - 1. Frame Type: Channel unless otherwise indicated.
- D. Include supports, anchorages, and accessories required for complete assembly.
- E. Provide vertical mullions of type and at spacings indicated, but not more than recommended by manufacturer, or 72 inches (1830 mm) o.c., whichever is less.

- 1. Semirecessed Mullions: Where indicated, provide mullions partly recessed behind louver blades so louver blades appear continuous. Where length of louver exceeds fabrication and handling limitations, fabricate with interlocking split mullions and close-fitting blade splices designed to permit expansion and contraction.
- F. Provide subsills made of same material as louvers or extended sills for recessed louvers.
- G. Join frame members to each other and to fixed louver blades with fillet welds, threaded fasteners, or both, as standard with louver manufacturer unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.3 FIXED, EXTRUDED-ALUMINUM LOUVERS

- A. Horizontal, Drainable-Blade Louver
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. <u>Airolite Company, LLC (The)</u> K6844.
 - b. <u>American Warming and Ventilating, Inc.; a Mestek company</u> LE24.
 - c. <u>Construction Specialties, Inc</u> A4097.
 - d. <u>Reliable Products, Inc</u>. 445RD
 - 2. Louver Depth: 4 inches (100 mm).
 - 3. Frame and Blade Nominal Thickness: Not less than 0.080 inch (2.03 mm).
 - 4. Mullion Type: Exposed.
 - 5. Louver Performance Ratings:
 - a. Free Area: Not less than 8.0 sq. ft. (0.74 sq. m) for 48-inch- (1220-mm-) wide by 48-inch- (1220-mm-) high louver.
 - b. Point of Beginning Water Penetration: Not less than 1000 fpm (5.1 m/s).
 - c. Air Performance: Not more than 0.20-inch wg static pressure drop at 1000-fpm (5.1-m/s) free-area intake velocity.
 - d. Air Performance: Not more than 0.18-inch wg static pressure drop at 1000-fpm (5.1-m/s) free-area exhaust velocity.
 - 6. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

2.4 FIXED, FORMED-METAL LOUVERS

- A. Horizontal, Drainable-Blade Louver:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. <u>Airolite Company, LLC (The)</u>.
 - b. <u>American Warming and Ventilating, Inc.; a Mestek company</u>.
 - c. <u>Construction Specialties, Inc.</u>
 - d. <u>Greenheck Fan Corporation</u>.
- e. <u>Ruskin Company; Tomkins PLC</u>.
- 2. Louver Depth: 4 inches (100 mm).
- 3. Frame and Blade Material and Nominal Thickness: Galvanized-steel sheet, not less than 0.052 inch (1.32 mm) for frames and 0.040 inch (1.02 mm) for blades.
- 4. Mullion Type: Exposed.
- 5. Louver Performance Ratings:
 - a. Free Area: Not less than 8.0 sq. ft. (0.74 sq. m) for 48-inch- (1220-mm-) wide by 48-inch- (1220-mm-) high louver.
 - b. Point of Beginning Water Penetration: Not less than 1000 fpm (5.1 m/s).
 - c. Air Performance: Not more than 0.20-inch wg static pressure drop at 1000-fpm (5.1-m/s) free-area intake velocity.
 - d. Air Performance: Not more than 0.18-inch wg static pressure drop at 1000-fpm (5.1-m/s) free-area exhaust velocity.
- 6. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

2.5 LOUVER SCREENS

- A. General: Provide screen at each exterior louver.
 - 1. Screen Location for Fixed Louvers: Interior face.
 - 2. Screening Type: Bird screening.
- B. Secure screen frames to louver frames with stainless-steel machine screws, spaced a maximum of 6 inches (150 mm) from each corner and at 12 inches (300 mm) o.c.
- C. Louver Screen Frames: Fabricate with mitered corners to louver sizes indicated.
 - 1. Metal: Same kind and form of metal as indicated for louver to which screens are attached. Reinforce extruded-aluminum screen frames at corners with clips.
 - 2. Finish: Mill finish unless otherwise indicated.
 - 3. Type: Non-rewirable, U-shaped frames.
- D. Louver Screening for Aluminum Louvers:
 - 1. Bird Screening: Aluminum, 1/2-inch- (13-mm-) square mesh, 0.063-inch (1.60-mm) wire.
- E. Louver Screening for Galvanized-Steel Louvers:
 - 1. Bird Screening: Galvanized steel, 1/2-inch- (13-mm-) square mesh, 0.041-inch (1.04-mm) wire.

2.6 BLANK-OFF PANELS

- A. Insulated, Blank-Off Panels: Laminated panels consisting of insulating core surfaced on back and front with metal sheets and attached to back of louver.
 - 1. Thickness: 4 inches.
 - 2. Metal Facing Sheets: Aluminum sheet, not less than 0.032-inch (0.81-mm) nominal thickness.
 - 3. Metal Facing Sheets: Galvanized-steel sheet, not less than 0.028-inch (0.71-mm) nominal thickness.
 - 4. Insulating Core: Rigid, glass-fiber-board insulation or extruded-polystyrene foam.
 - 5. Edge Treatment: Trim perimeter edges of blank-off panels with louver manufacturer's standard extruded-aluminum-channel frames, not less than 0.080-inch (2.03-mm) nominal thickness, with corners mitered and with same finish as panels.
 - 6. Seal perimeter joints between panel faces and louver frames with gaskets or sealant.
 - 7. Panel Finish: Same finish applied to louvers.
 - 8. Attach blank-off panels with clips.

2.7 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

2.8 ALUMINUM FINISHES

- A. Finish louvers after assembly.
- B. High-Performance Organic Finish: 2-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 1. Color and Gloss: Match Architect's sample. Include in bid two colors (one custom and one silver metallic) (as indicated on drawings)

2.9 GALVANIZED-STEEL SHEET FINISHES

- A. Finish louvers after assembly.
- B. Surface Preparation: Clean surfaces with nonpetroleum solvent so surfaces are free of oil and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas and repair according to ASTM A 780.
- C. Baked-Enamel or Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard 2-coat, baked-on finish consisting of prime coat and thermosetting topcoat, with a minimum dry film thickness of 1 mil (0.025 mm) for topcoat. Comply with

coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils (0.05 mm).

1. Color and Gloss: Match Architect's sample. (brown / gray to match brick)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and openings, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

3.3 INSTALLATION

- A. Locate and place louvers and vents level, plumb, and at indicated alignment with adjacent work.
- B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.
- C. Form closely fitted joints with exposed connections accurately located and secured.
- D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- E. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.
- F. Protect unpainted galvanized and nonferrous-metal surfaces that will be in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.
- G. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Section 079200 "Joint Sealants" for sealants applied during louver installation.

3.4 ADJUSTING AND CLEANING

- A. Clean exposed surfaces of louvers and vents that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.
- B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.
- C. Restore louvers and vents damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.
 - 1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION 089000

SECTION 092116.23 - GYPSUM BOARD SHAFT WALL ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Gypsum board shaft wall assemblies.

1.3 ACTION SUBMITTALS

A. Product Data: For each component of gypsum board shaft wall assembly.

1.4 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For shaft wall assemblies and firestop tracks, from ICC-ES.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.6 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or with gypsum board manufacturer's written recommendations, whichever are more stringent.
- B. Do not install interior products until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, moisture damaged, or mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, and irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

2.2 GYPSUM BOARD SHAFT WALL ASSEMBLIES

- A. Fire-Resistance Rating: 1 hour.
- B. Studs: Manufacturer's standard profile for repetitive members, corner and end members, and fire-resistance-rated assembly indicated.
 - 1. Depth: 6 inches (152 mm).
 - 2. Minimum Base-Metal Thickness: 0.033 inch (0.84 mm).
- C. Runner Tracks: Manufacturer's standard J-profile track with manufacturer's standard long-leg length, but at least 2 inches (51 mm) long and matching studs in depth.
 - 1. Minimum Base-Metal Thickness: 0.033 inch (0.84 mm).
- D. Room-Side Finish: Gypsum board.
- E. Shaft-Side Finish: Gypsum shaftliner board, moisture- and mold-resistant Type X.

2.3 PANEL PRODUCTS

- A. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.
- B. Gypsum Shaftliner Board, Moisture- and Mold-Resistant Type X: ASTM C 1396/C 1396M; manufacturer's proprietary fire-resistive liner panels with moisture- and mold-resistant core and surfaces.
 - 1. <u>Products</u>: Subject to compliance with requirements, provide one of the following:
 - a. <u>CertainTeed Corp</u>.; ProRoc Moisture and Mold Resistant Shaftliner.
 - b. <u>Georgia-Pacific Gypsum LLC</u>, Subsidiary of Georgia Pacific; Dens-Glass Ultra Shaftliner.
 - c. <u>Lafarge North America, Inc</u>.; Firecheck Moldcheck Type X Shaftliner.
 - d. <u>National Gypsum Company</u>; Gold Bond Brand Fire-Shield Shaftliner XP.
 - e. <u>PABCO Gypsum</u>; Pabcore Mold Curb Shaftliner Type X.
 - f. <u>Temple-Inland Inc</u>.; Fire-Rated SilentGuard TS Mold-Resistant Gypsum Shaftliner System.
 - g. <u>USG Corporation</u>; Sheetrock Brand Mold Tough Gypsum Liner Panel.

- 2. Thickness: 1 inch (25.4 mm).
- 3. Long Edges: Double bevel.
- 4. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
- C. Gypsum Board: As specified in Section 092900 "Gypsum Board."

2.4 NON-LOAD-BEARING STEEL FRAMING

- A. Steel Framing Members: Comply with ASTM C 645 requirements for metal unless otherwise indicated.
 - 1. Protective Coating: Coating with equivalent corrosion resistance of ASTM A 653/A 653M, G40 (Z120) unless otherwise indicated.

2.5 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with manufacturer's written recommendations.
- B. Trim Accessories: Cornerbead, edge trim, and control joints of material and shapes as specified in Section 092900 "Gypsum Board" that comply with gypsum board shaft wall assembly manufacturer's written recommendations for application indicated.
- C. Steel Drill Screws: ASTM C 1002 unless otherwise indicated.
- D. Track Fasteners: Power-driven fasteners of size and material required to withstand loading conditions imposed on shaft wall assemblies without exceeding allowable design stress of track, fasteners, or structural substrates in which anchors are embedded.
 - 1. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing according to ASTM E 488 conducted by a qualified testing agency.
 - 2. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing according to ASTM E 1190 conducted by a qualified testing agency.
- E. Sound Attenuation Blankets: As specified in Section 092900 "Gypsum Board."
- F. Acoustical Sealant: As specified in Section 092900 "Gypsum Board."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates to which gypsum board shaft wall assemblies attach or abut, with Installer present, including hollow-metal frames, elevator hoistway door frames, cast-in anchors, and

structural framing. Examine for compliance with requirements for installation tolerances and other conditions affecting performance.

- B. Examine panels before installation. Reject panels that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install gypsum board shaft wall assemblies to comply with requirements of fireresistance-rated assemblies indicated, manufacturer's written installation instructions, and ASTM C 754 other than stud-spacing requirements.
- B. Do not bridge building expansion joints with shaft wall assemblies; frame both sides of expansion joints with furring and other support.
- C. Install supplementary framing in gypsum board shaft wall assemblies around openings and as required for blocking, bracing, and support of gravity and pullout loads of fixtures, equipment, services, heavy trim, furnishings, wall-mounted door stops, and similar items that cannot be supported directly by shaft wall assembly framing.
- D. Penetrations: At penetrations in shaft wall, maintain fire-resistance rating of shaft wall assembly by installing supplementary steel framing around perimeter of penetration and fire protection behind boxes containing wiring devices, elevator call buttons, elevator floor indicators, and similar items.
- E. Isolate perimeter of gypsum panels from building structure to prevent cracking of panels, while maintaining continuity of fire-rated construction.
- F. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

3.3 PROTECTION

- A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- B. Remove and replace panels that are wet, moisture damaged, or mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, and irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092116.23

SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Non-load-bearing steel framing systems for interior gypsum board assemblies.
 - 2. Suspension systems for interior gypsum ceilings, soffits, and grid systems.
- B. Related Requirements:
 - 1. Section 054000 "Cold-Formed Metal Framing" for exterior and interior load-bearing and exterior non-load-bearing wall studs; floor joists; roof rafters and ceiling joists; and roof trusses.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For dimpled steel studs and runners, from ICC-ES.

PART 2 - PRODUCTS

2.1 FRAMING SYSTEMS

- A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.
 - 1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal unless otherwise indicated.
 - 2. Protective Coating: ASTM A 653/A 653M, G40 (Z120), hot-dip galvanized unless otherwise indicated.
- B. Studs and Runners: ASTM C 645. Use either steel studs and runners or dimpled steel studs and runners.

- 1. Steel Studs and Runners:
 - a. Minimum Base-Metal Thickness: 0.033 inch (0.84 mm).
 - b. Depth: As indicated on Drawings.
- 2. Dimpled Steel Studs and Runners:
 - a. Minimum Base-Metal Thickness: 0.025 inch (0.64 mm).
 - b. Depth: As indicated on Drawings.
- C. Slip-Type Head Joints: Where indicated, provide one of the following:
 - 1. Single Long-Leg Runner System: ASTM C 645 top runner with 2-inch- (51-mm-) deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top runner and with continuous bridging located within 12 inches (305 mm) of the top of studs to provide lateral bracing.
 - 2. Double-Runner System: ASTM C 645 top runners, inside runner with 2-inch- (51-mm-) deep flanges in thickness not less than indicated for studs and fastened to studs, and outer runner sized to friction fit inside runner.
- D. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
 - 1. Minimum Base-Metal Thickness: 0.033 inch (0.84 mm).
- E. Cold-Rolled Channel Bridging: Steel, 0.053-inch (1.34-mm) minimum base-metal thickness, with minimum 1/2-inch- (13-mm-) wide flanges.
 - 1. Depth: 1-1/2 inches (38 mm).
 - 2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches (38 by 38 mm), 0.068-inch- (1.72-mm-) thick, galvanized steel.
- F. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
 - 1. Minimum Base-Metal Thickness: 0.018 inch (0.45 mm).
 - 2. Depth: As indicated on Drawings.
- G. Cold-Rolled Furring Channels: 0.053-inch (1.34-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges.
 - 1. Depth: As indicated on Drawings.
 - 2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum uncoated-steel thickness of 0.033 inch (0.8 mm).
 - 3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.

2.2 SUSPENSION SYSTEMS

- A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.
- B. Hanger Attachments to Concrete:
 - 1. Anchors: Fabricated from corrosion-resistant materials with holes or loops for attaching wire hangers and capable of sustaining, without failure, a load equal to 5 times that imposed by construction as determined by testing according to ASTM E 488 by an independent testing agency.
 - a. Type: Postinstalled, expansion anchor.
 - 2. Powder-Actuated Fasteners: Suitable for application indicated, fabricated from corrosion-resistant materials with clips or other devices for attaching hangers of type indicated, and capable of sustaining, without failure, a load equal to 10 times that imposed by construction as determined by testing according to ASTM E 1190 by an independent testing agency.
- C. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch (4.12 mm) in diameter.
- D. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.053 inch (1.34 mm) and minimum 1/2-inch- (13-mm-) wide flanges.
 - 1. Depth: 2-1/2 inches (64 mm).
- E. Furring Channels (Furring Members):
 - 1. Cold-Rolled Channels: 0.053-inch (1.34-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges, 3/4 inch (19 mm) deep.
 - 2. Steel Studs and Runners: ASTM C 645.
 - a. Minimum Base-Metal Thickness: 0.033 inch (0.84 mm).
 - b. Depth: As indicated on Drawings.
 - 3. Dimpled Steel Studs and Runners: ASTM C 645.
 - a. Minimum Base-Metal Thickness: 0.025 inch (0.64 mm).
 - b. Depth: As indicated on Drawings.
 - 4. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch (22 mm) deep.
 - a. Minimum Base-Metal Thickness: 0.018 inch (0.45 mm).
- F. Grid Suspension System for Gypsum Board Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.
 - 1. <u>Products</u>: Subject to compliance with requirements, provide one of the following:

- a. <u>Armstrong World Industries, Inc.; Drywall Grid Systems</u>.
- b. Chicago Metallic Corporation; Drywall Grid System.
- c. USG Corporation; Drywall Suspension System.

2.3 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards.
 - 1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
- B. Isolation Strip at Exterior Walls: Provide the following:
 - 1. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch (3.2 mm) thick, in width to suit steel stud size.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C 754.
 - 1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.
- B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- C. Install bracing at terminations in assemblies.
- D. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.3 INSTALLING FRAMED ASSEMBLIES

- A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
 - 1. Single-Layer Application: 16 inches (406 mm) o.c. unless otherwise indicated.

NON-STRUCTURAL METAL FRAMING

- B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- C. Install studs so flanges within framing system point in same direction.
- D. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.
 - 1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
 - 2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
 - a. Install two studs at each jamb unless otherwise indicated.
 - b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch (13-mm) clearance from jamb stud to allow for installation of control joint in finished assembly.
 - 3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
- E. Direct Furring:
 - 1. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.
- F. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

3.4 INSTALLING SUSPENSION SYSTEMS

- A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
 - 1. Hangers: 48 inches (1219 mm) o.c.
 - 2. Carrying Channels (Main Runners): 48 inches (1219 mm) o.c.
 - 3. Furring Channels (Furring Members): 16 inches (406 mm) o.c.
- B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
- C. Suspend hangers from building structure as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.

- a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
- 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
 - a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
- 3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
- 4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
- 5. Do not attach hangers to steel roof deck.
- 6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
- 7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
- 8. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- D. Seismic Bracing: Sway-brace suspension systems with hangers used for support.
- E. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.
- F. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet (3 mm in 3.6 m) measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 092216

SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Interior gypsum board.
- B. Related Requirements:
 - 1. Section 061600 "Sheathing" for gypsum sheathing for exterior walls.
 - 2. Section 092216 "Non-Structural Metal Framing" for non-structural framing and suspension systems that support gypsum board panels.
 - 3. Section 092116.23 "Gypsum Board Shaft Wall Assemblies" for metal shaft-wall framing, gypsum shaft liners, and other components of shaft-wall assemblies.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 DELIVERY, STORAGE AND HANDLING

A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.5 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.
- B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.

- 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
- 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

2.2 GYPSUM BOARD, GENERAL

A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

- A. <u>Manufacturers</u>: Subject to compliance with requirements, provide products by one of the following:
 - 1. <u>American Gypsum</u>.
 - 2. <u>CertainTeed Corp.</u>
 - 3. <u>Georgia-Pacific Gypsum LLC</u>.
 - 4. <u>Lafarge North America Inc</u>.
 - 5. <u>National Gypsum Company</u>.
 - 6. <u>PABCO Gypsum</u>.
 - 7. <u>Temple-Inland</u>.
 - 8. <u>USG Corporation</u>.

B. Gypsum Wallboard: ASTM C 1396/C 1396M.

- 1. Thickness: 5/8 inch (15.9 mm).
- 2. Long Edges: Tapered.
- C. Gypsum Board, Type X: ASTM C 1396/C 1396M.
 - 1. Thickness: 5/8 inch (15.9 mm).
 - 2. Long Edges: Tapered.
- D. Gypsum Ceiling Board: ASTM C 1396/C 1396M.
 - 1. Thickness: 1/2 inch (12.7 mm).
 - 2. Long Edges: Tapered.

- E. Moisture- and Mold-Resistant Gypsum Board: ASTM C 1396/C 1396M. With moisture- and mold-resistant core and paper surfaces.
 - 1. Core: 1/2 inch (12.7 mm), regular type
 - 2. Core: 5/8 inch (15.9 mm), Type X for use where indicated.
 - 3. Long Edges: Tapered.
 - 4. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2.4 TRIM ACCESSORIES

- A. Interior Trim: ASTM C 1047.
 - 1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized steel sheet.
 - 2. Shapes:
 - a. Cornerbead.
 - b. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - c. L-Bead: L-shaped; exposed long flange receives joint compound.
 - d. U-Bead: J-shaped; exposed short flange does not receive joint compound.
 - e. Expansion (control) joint.
- B. Exterior Trim: ASTM C 1047.
 - 1. Material: Hot-dip galvanized steel sheet, plastic, or rolled zinc.
 - 2. Shapes:
 - a. Cornerbead.
 - b. LC-Bead: J-shaped; exposed long flange receives joint compound.

2.5 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475/C 475M.
- B. Joint Tape:
 - 1. Interior Gypsum Board: Paper.
- C. Joint Compound for Interior Gypsum Board: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.
 - 1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.
 - 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
 - a. Use setting-type compound for installing paper-faced metal trim accessories.
 - 3. Fill Coat: For second coat, use setting-type, sandable topping compound.

- 4. Finish Coat: For third coat, use drying-type, all-purpose compound.
- 5. Skim Coat: For final coat of Level 5 finish, use drying-type, all-purpose compound.
- D. Joint Compound for Exterior Applications:
 - 1. Exterior Gypsum Soffit Board: Use setting-type taping compound and setting-type, sandable topping compound.
 - 2. Glass-Mat Gypsum Sheathing Board: As recommended by sheathing board manufacturer.

2.6 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
- B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
- C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
 - 1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.
- D. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
 - 1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
- E. Acoustical Joint Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
 - 1. <u>Products</u>: Subject to compliance with requirements, provide one of the following:
 - a. <u>Accumetric LLC; BOSS 824 Acoustical Sound Sealant</u>.
 - b. <u>Grabber Construction Products; Acoustical Sealant GSC</u>.
 - c. <u>Pecora Corporation;</u> [AC-20 FTR] [AIS-919].
 - d. Specified Technologies, Inc.; Smoke N Sound Acoustical Sealant.
 - e. <u>USG Corporation; SHEETROCK Acoustical Sealant</u>.
- F. Thermal Insulation: As specified in Section 072100 "Thermal Insulation."
- G. Vapor Retarder: As specified in Section 072100 "Thermal Insulation."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates including welded hollow-metal frames and framing, with Installer present, for compliance with requirements and other conditions affecting performance.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C 840.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
 - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.
 - 2. Fit gypsum panels around ducts, pipes, and conduits.
 - 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- (6.4- to 9.5-mm-) wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

- I. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.
- J. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 APPLYING INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
 - 1. Wallboard Type: Vertical surfaces unless otherwise indicated.
 - 2. Type X: As indicated on Drawings.
 - 3. Moisture- and Mold-Resistant Type: As indicated on Drawings.
- B. Single-Layer Application:
 - 1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
 - 2. On partitions/walls, apply gypsum panels vertically (parallel to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
 - a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
 - 3. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
 - 4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.
- C. Multilayer Application:
 - 1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 16 inches (400 mm) minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
 - 2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
 - 3. On Z-furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
 - 4. Fastening Methods: Fasten base layers with screws; fasten face layers with adhesive and supplementary fasteners.

3.4 INSTALLING TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: Install control joints [at locations indicated on Drawings] [according to ASTM C 840 and in specific locations approved by Architect for visual effect].
- C. Interior Trim: Install in the following locations:
 - 1. Cornerbead: Use at outside corners unless otherwise indicated.
 - 2. LC-Bead: Use at exposed panel edges.
 - 3. L-Bead: Use where indicated.
 - 4. U-Bead: Use at exposed panel edges.

3.5 FINISHING GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
 - 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
 - 2. Level 2: Not Used
 - 3. Level 3: Not Used
 - 4. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.
 - a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."
 - 5. Level 5: At soffits adjacent to windows.
 - a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."

3.6 **PROTECTION**

A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.

- B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- C. Remove and replace panels that are wet, moisture damaged, and mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092900

SECTION 093000 - TILING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Ceramic tile.
 - 2. Stone thresholds.
 - 3. Waterproof membrane.
 - 4. Metal edge strips.

1.3 DEFINITIONS

- A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.
- B. ANSI A108 Series: ANSI A108.01, ANSI A108.02, ANSI A108.1A, ANSI A108.1B, ANSI A108.1C, ANSI A108.4, ANSI A108.5, ANSI A108.6, ANSI A108.8, ANSI A108.9, ANSI A108.10, ANSI A108.11, ANSI A108.12, ANSI A108.13, ANSI A108.14, ANSI A108.15, ANSI A108.16, and ANSI A108.17, which are contained in "American National Standard Specifications for Installation of Ceramic Tile."
- C. Module Size: Actual tile size plus joint width indicated.
- D. Face Size: Actual tile size, excluding spacer lugs.

1.4 PERFORMANCE REQUIREMENTS

- A. Static Coefficient of Friction: For tile installed on walkway surfaces, provide products with the following values as determined by testing identical products per ASTM C 1028:
 - 1. Level Surfaces: Minimum 0.6

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

- B. Samples for Initial Selection: For each type of tile and grout indicated. Include Samples of accessories involving color selection.
- C. Samples for Verification:
 - 1. Full-size units of each type and composition of tile and for each color and finish required.
 - 2. Assembled samples mounted on a rigid panel, with grouted joints, for each type and composition of tile and for each color and finish required. Make samples at least 12 inches (300 mm) square, but not fewer than 4 tiles. Use grout of type and in color or colors approved for completed Work.
 - 3. Full-size units of each type of trim and accessory for each color and finish required.
 - 4. Stone thresholds in 6-inch (150-mm) lengths.
 - 5. Metal edge strips in 6-inch (150-mm) lengths.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Product Certificates: For each type of product, signed by product manufacturer.
- C. Material Test Reports: For each tile-setting and -grouting product.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.
 - 2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated.

1.8 QUALITY ASSURANCE

- A. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from one manufacturer and each aggregate from one source or producer.
- B. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer for each product:
 - 1. Stone thresholds.
 - 2. Waterproof membrane.
 - 3. Joint sealants.
 - 4. Metal edge strips.

- C. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Build mockup of each type of floor tile installation.
 - 2. Build mockup of each type of wall tile installation.
 - 3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- D. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review requirements in ANSI A108.01 for substrates and for preparation by other trades.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.
- B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.
- D. Store liquid materials in unopened containers and protected from freezing.
- E. Handle tile that has temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

1.10 PROJECT CONDITIONS

A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 PRODUCTS, GENERAL

- A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
 - 1. Provide tile complying with Standard grade requirements unless otherwise indicated.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCA installation methods specified in tile installation schedules, and other requirements specified.

- C. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.
- D. Factory-Applied Temporary Protective Coating: Where indicated under tile type, protect exposed surfaces of tile against adherence of mortar and grout by precoating with continuous film of petroleum paraffin wax, applied hot. Do not coat unexposed tile surfaces.

2.2 TILE PRODUCTS

- A. Tile Type QT-1, QT-2 square-edged quarry tile.
 - 1. <u>Basis-of-Design Product</u>: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. <u>American Olean; Division of Dal-Tile International Inc</u>.
 - b. <u>Daltile; Division of Dal-Tile International Inc</u>.
 - c. <u>Quarry Tile Co</u>.
 - 2. Face Size: 8 by 8 inches (203 by 203 mm).
 - 3. Thickness: 1/2 inch (12.7 mm).
 - 4. Wearing Surface: Abrasive aggregate embedded in surface.
 - 5. Tile Color and Pattern: As indicated by manufacturer's designations.
 - 6. Grout Color: As selected by Architect from manufacturer's full range.
 - 7. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:
 - a. Base: Coved with surface bullnose top edge, face size 8 by 5 inches.
- B. Tile Type CT-1, CT-2, CT-3: Unglazed paver tile.
 - 1. <u>Basis-of-Design Product</u>: Subject to compliance with requirements, provide product indicated on Drawings or prior approved equal.
 - 2. Composition: Porcelain.
 - 3. Face Size: 6 by 6 inches, 12 by 12 inches
 - 4. Thickness: 1/4 inch (6.35 mm).
 - 5. Face: Plain with square or cushion edges.
 - 6. Tile Color and Pattern: As indicated by manufacturer's designations.
 - 7. Grout Color: As selected by Architect from manufacturer's full range.
- C. Tile Type CT-1A, CT-4, CT-5: Glazed wall tile.
 - 1. <u>Basis-of-Design Product</u>: Subject to compliance with requirements, provide product indicated on Drawings or prior approved equal.
 - 2. Module Size: as indicated.
 - 3. Thickness: 5/16 inch (8 mm).
 - 4. Face: Plain with modified square edges or cushion edges.
 - 5. Finish: as indicated.
 - 6. Tile Color and Pattern: As indicated by manufacturer's designations
 - 7. Grout Color: As selected by Architect from manufacturer's full range.

- 8. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:
 - a. External Corners for Thin-Set Mortar Installations: Surface bullnose, same size as adjoining flat tile.
 - b. Internal Corners: Field-butted square corners. For coved base and cap use angle pieces designed to fit with stretcher shapes.

2.3 THRESHOLDS

- A. General: Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes.
 - 1. Bevel edges at 1:2 slope, with lower edge of bevel aligned with or up to 1/16 inch (1.5 mm) above adjacent floor surface. Finish bevel to match top surface of threshold. Limit height of threshold to 1/2 inch (12.7 mm) or less above adjacent floor surface.
- B. Granite Thresholds: ASTM C 615, with honed finish.
 - 1. Description: Uniform, fine-grained, gray stone without veining.

2.4 WATERPROOF MEMBRANE FOR FLOORS

- A. General: Manufacturer's standard product that complies with ANSI A118.10 and is recommended by the manufacturer for the applications indicated. Include reinforcement and accessories recommended by manufacturer.
- B. Fabric-Reinforced, Fluid-Applied Membrane: System consisting of liquid-latex rubber or elastomeric polymer and continuous fabric reinforcement.
 - 1. <u>Basis-of-Design Product</u>: Subject to compliance with requirements, provide <u>Laticrete</u> <u>International, Inc.</u>; Laticrete 9235 Waterproof Membrane or approved equal.

2.5 WATERPROOF MEMBRANE FOR SHOWER WALLS

- A. General: Manufacturer's standard product that complies with ANSI A118.10 and is recommended by the manufacturer for the application indicated. Include taped corners and other accessories recommended by manufacturer.
- B. Fluid-Applied Membrane: Single component, self-curing liquid rubber polymer.
 - 1. <u>Basis-of-Design Product</u>: Subject to compliance with requirements, provide <u>Laticrete</u> <u>International, Inc.</u>; Hydro Ban or approved equal.

2.6 CRACK ISOLATION MEMBRANE

A. General: Include reinforcement and accessories recommended by manufacturer.

TILING

- B. Corrugated Polyethylene: Corrugated polyethylene with dovetail-shaped corrugations and with anchoring webbing on the underside; 3/16-inch (4-mm) nominal thickness.
 - 1. <u>Products</u>: Subject to compliance with requirements, provide the following:
 - a. <u>Schluter Systems L.P.; DITRA</u>.
 - b. Kerdi-Band waterproofing strips to seal butt joints and floor / wall connections.

2.7 SETTING MATERIALS

- A. Portland Cement Mortar (Thickset) Installation Materials: ANSI A108.02.
 - 1. Cleavage Membrane: Asphalt felt, ASTM D 226, Type I (No. 15); or polyethylene sheeting, ASTM D 4397, 4.0 mils (0.1 mm) thick.
 - 2. Reinforcing Wire Fabric: Galvanized, welded wire fabric, 2 by 2 inches (50.8 by 50.8 mm) by 0.062-inch (1.57-mm) diameter; comply with ASTM A 185 and ASTM A 82 except for minimum wire size.
 - 3. Latex Additive: Manufacturer's standard acrylic resin or styrene-butadiene-rubber water emulsion, serving as replacement for part or all of gaging water, of type specifically recommended by latex-additive manufacturer for use with field-mixed portland cement and aggregate mortar bed.
- B. Latex-Portland Cement Mortar (Thin Set): ANSI A118.4.
 - 1. <u>Basis-of-Design Product</u>: Subject to compliance with requirements, provide <u>Laticrete</u> <u>International, Inc.</u>; 254 Platinum Multipurpose Thin-Set Mortar, or comparable product by one of the following:
 - a. <u>Custom Building Products</u>.
 - b. <u>MAPEI Corporation</u>.
 - 2. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.4.

2.8 GROUT MATERIALS

- A. Polymer-Modified Tile Grout: ANSI A118.7.
 - 1. <u>Basis-of-Design Product</u>: Subject to compliance with requirements, provide <u>Laticrete</u> <u>International, Inc.</u>; 1600 unsanded grout or approved equal.
- B. Water-Cleanable Epoxy Grout: ANSI A118.3.
 - 1. <u>Basis-of-Design Product</u>: Subject to compliance with requirements, provide <u>Laticrete</u> <u>International, Inc.</u>; SpectraLOCK PRO Premium Grout, or approved equal.
 - 2. <u>Basis-of-Design Product</u>: Subject to compliance with requirements, provide <u>Laticrete</u> <u>International, Inc.</u>; SpectraLOCK 2000IG, or approved equal.

2.9 ELASTOMERIC SEALANTS

- A. General: Provide sealants, primers, backer rods, and other sealant accessories that comply with the following requirements and with the applicable requirements in Section 079200 "Joint Sealants."
- B. Colors: Provide colors of exposed sealants to match colors of grout in tile adjoining sealed joints unless otherwise indicated.
- C. One-Part, Mildew-Resistant Silicone Sealant: ASTM C 920; Type S; Grade NS; Class 25; Uses NT, G, A, and, as applicable to nonporous joint substrates indicated, O; formulated with fungicide, intended for sealing interior ceramic tile joints and other nonporous substrates that are subject to in-service exposures of high humidity and extreme temperatures.
 - 1. <u>Basis-of-Design Product</u>: Subject to compliance with requirements, provide <u>Laticrete</u> <u>International, Inc.; Latasil Tile & Stone Sealant</u>, or comparable product by one of the following:
 - a. <u>Dow Corning Corporation; Dow Corning 786</u>.
 - b. Pecora Corporation; Pecora 898 Sanitary Silicone Sealant.
 - c. Tremco Incorporated; Tremsil 600 White.

2.10 MISCELLANEOUS MATERIALS

- A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.
- B. Metal Edge Strips: Angle or L-shape, height to match tile and setting-bed thickness, metallic or combination of metal and PVC or neoprene base, designed specifically for flooring applications; white zinc alloy exposed-edge material.
- C. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.
- D. Grout Sealer: Aquamix or approved equal.

2.11 MIXING MORTARS AND GROUT

- A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.
- B. Add materials, water, and additives in accurate proportions.
- C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.
 - 1. Verify that substrates for setting tile are firm, dry, clean, free of coatings that are incompatible with tile-setting materials including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
 - 2. Verify that concrete substrates for tile floors installed with bonded mortar bed or thin-set mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.
 - a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
 - b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.
 - 3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
 - 4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thin-set mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.
- B. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot (1:50) toward drains.
- C. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.3 TILE INSTALLATION

A. Comply with TCA's "Handbook for Ceramic Tile Installation" for TCA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 Series "Specifications for Installation of Ceramic Tile" that are referenced in TCA installation

methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.

- 1. For the following installations, follow procedures in the ANSI A108 Series of tile installation standards for providing 95 percent mortar coverage:
 - a. Tile floors in wet areas.
- B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
- C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
- D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.
- E. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
 - 1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so joints between sheets are not apparent in finished work.
 - 2. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
 - 3. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.
- F. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
 - 1. Porcelain Stone Tile: 1/8 inch (4 mm).
 - 2. Quarry Tile: 1/4 inch (6.35 mm).
 - 3. Glazed Wall Tile: 1/16 inch (1.6 mm).
- G. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
 - 1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.
- H. Stone Thresholds: Install stone thresholds in same type of setting bed as adjacent floor unless otherwise indicated.
 - 1. At locations where mortar bed (thickset) would otherwise be exposed above adjacent floor finishes, set thresholds in latex-portland cement mortar (thin set).

- 2. Do not extend waterproofing under thresholds set in dry-set portland cement or latexportland cement mortar. Fill joints between such thresholds and adjoining tile set on waterproofing with elastomeric sealant.
- I. Metal Edge Strips: Install at locations indicated where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with or below top of tile and no threshold is indicated.
- J. Grout Sealer: Apply grout sealer to cementitious grout joints in tile floors according to groutsealer manufacturer's written instructions. As soon as grout sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

3.4 WATERPROOFING INSTALLATION

- A. Install waterproofing to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness and bonded securely to substrate.
- B. Do not install tile or setting materials over waterproofing until waterproofing has cured and been tested to determine that it is watertight.
- C. Test Concession waterproofing and drainage fittings for leaks before commencing tile work.
- D. Test Shower receptor and drainage fitting for leaks before commencing tile work.

3.5 CRACK ISOLATION MEMBRANE INSTALLATION

- A. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness and bonded securely to substrate.
- B. Do not install tile or setting materials over crack isolation membrane until membrane has cured.

3.6 CLEANING AND PROTECTING

- A. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
 - 1. Remove epoxy and latex-portland cement grout residue from tile as soon as possible.
 - 2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.
 - 3. Remove temporary protective coating by method recommended by coating manufacturer and that is acceptable to tile and grout manufacturer. Trap and remove coating to prevent drain clogging.

- B. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.
- C. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.
- D. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

3.7 INTERIOR TILE INSTALLATION SCHEDULE

- A. Interior Floor Installations, Concrete Subfloor:
 - 1. Tile Installation F113: Thin-set mortar; TCA F113.
 - a. Tile Type: Porcelain Tile
 - b. Thin-Set Mortar: Latex- portland cement mortar.
 - c. Grout: Epoxy Grout (Laticrete SpectraLOCK PRO Premium Grout or approved equal).
 - 2. Tile Installation F125A: Thin-set mortar on crack isolation membrane; TCA F125A.
 - a. Tile Type: Quarry Tile
 - b. Thin-Set Mortar: Latex- portland cement mortar.
 - c. Grout: Industrial epoxy Grout (Laticrete SpectraLOCK 2000IG or approved equal)
 - d. Crack isolation membrane / waterproofing: Schluter-Ditra or approved equal.
- B. Interior Wall Installations, Masonry or Concrete:
 - 1. Tile Installation W202: Thin-set mortar; TCA W202.
 - a. Tile Type: Porcelain Tile
 - b. Thin-Set Mortar: Latex- portland cement mortar.
 - c. Grout: Polymer-modified unsanded grout. Laticrete 1600
- C. Shower Receptor and Wall Installations, Concrete or Masonry:
 - 1. Tile Installation B421: Thin-set mortar on waterproof membrane; TCA B421.
 - a. Tile Type: Porcelain Tile
 - b. Thin-Set Mortar: Latex-portland cement mortar.
 - c. Grout: Epoxy Grout (Laticrete SpectraLOCK PRO Premium Grout or approved equal).

END OF SECTION 093000

SECTION 095113 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes acoustical panels and exposed suspension systems for ceilings.
- B. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified, 6 inches (150 mm) in size.
- C. Samples for Initial Selection: For components with factory-applied color finishes.
- D. Product Test Reports: For each acoustical panel ceiling, for tests performed by manufacturer and witnessed by a qualified testing agency.
- E. Evaluation Reports: For each acoustical panel ceiling suspension system and anchor and fastener type, from ICC-ES.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For finishes to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Acoustical Ceiling Panels: Full-size panels equal to 2 percent of quantity installed.
 - 2. Hold-Down Clips: Equal to 2 percent of quantity installed.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical panels, suspension-system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.
- C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Acoustical ceiling shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: Comply with ASTM E 1264 for Class A materials.
 - 2. Smoke-Developed Index: 50 or less.

2.2 ACOUSTICAL PANELS, GENERAL

- A. Source Limitations:
 - 1. Acoustical Ceiling Panel: Obtain each type from single source from single manufacturer.
 - 2. Suspension System: Obtain each type from single source from single manufacturer.
- B. Source Limitations: Obtain each type of acoustical ceiling panel and supporting suspension system from single source from single manufacturer.
- C. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances unless otherwise indicated.
- 1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches (400 mm) away from test surface according to ASTM E 795.
- D. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.

2.3 ACOUSTICAL PANELS APC-1

- A. <u>Basis-of-Design Product</u>: Subject to compliance with requirements, provide <u>Armstrong World</u> <u>Industries, Inc.</u> Ultima or comparable product by one of the following:
 - 1. <u>CertainTeed Corp</u>.
 - 2. <u>USG Interiors, Inc.; Subsidiary of USG Corporation</u>.
- B. Classification: Provide panels complying with ASTM E 1264 for type, form, and pattern as follows:
 - 1. Type and Form: Type IV, mineral base with membrane-faced overlay; Form 2, water felted; with vinyl overlay on face.
 - 2. Pattern: E (lightly textured).
- C. Color: White.
- D. LR: Not less than 0.85.
- E. NRC: Not less than 0.70.
- F. CAC: Not less than 35.
- G. Edge/Joint Detail: Square.
- H. Thickness: 3/4 inch (19 mm).
- I. Modular Size: 24 by 24 inches (610 by 610 mm).
- J. Broad Spectrum Antimicrobial Fungicide and Bactericide Treatment: Provide acoustical panels treated with manufacturer's standard antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274 or ASTM G 21.

2.4 ACOUSTICAL PANELS APC-2

- A. <u>Basis-of-Design Product</u>: Subject to compliance with requirements, provide <u>Armstrong World</u> <u>Industries, Inc.</u> Ceramaguard Fine Fissured or comparable product by one of the following:
 - 1. <u>CertainTeed Corp</u>.
 - 2. <u>USG Interiors, Inc.; Subsidiary of USG Corporation</u>.

- B. Classification: Provide panels complying with ASTM E 1264 for type, form, and pattern as follows:
 - 1. Type and Form: Type XX, other types; described as high-density, ceramic- and mineralbase panels with scrubbable finish, resistant to heat, moisture, and corrosive fumes.
 - 2. Pattern: CE (perforated, small holes and lightly textured).
- C. Color: White.
- D. LR: Not less than 0.80.
- E. NRC: Not less than 0.55.
- F. CAC: Not less than 40.
- G. Edge/Joint Detail: Square.
- H. Thickness: 5/8 inch (15 mm).
- I. Modular Size: 24 by 24 inches (610 by 610 mm).
- J. Broad Spectrum Antimicrobial Fungicide and Bactericide Treatment: Provide acoustical panels treated with manufacturer's standard antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274 or ASTM G 21.

2.5 ACOUSTICAL PANELS APC-3

- A. <u>Basis-of-Design Product</u>: Subject to compliance with requirements, provide <u>Armstrong World</u> <u>Industries, Inc.</u> Ceramaguard (unperforated) or comparable product by one of the following:
 - 1. <u>CertainTeed Corp</u>.
 - 2. <u>USG Interiors, Inc.; Subsidiary of USG Corporation</u>.
- B. Classification: Provide panels complying with ASTM E 1264 for type, form, and pattern as follows:
 - 1. Type and Form: Type XX, other types; described as high-density, ceramic- and mineralbase panels with scrubbable finish, resistant to heat, moisture, and corrosive fumes.
 - 2. Pattern: G (smooth).
- C. Color: White.
- D. LR: Not less than 0.80.
- E. NRC: Not less than 0.55.
- F. CAC: Not less than 40.
- G. Edge/Joint Detail: Square.

- H. Thickness: 5/8 inch (15 mm).
- I. Modular Size: 24 by 24 inches (610 by 610 mm).
- J. Broad Spectrum Antimicrobial Fungicide and Bactericide Treatment: Provide acoustical panels treated with manufacturer's standard antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274 or ASTM G 21.

2.6 METAL SUSPENSION SYSTEMS, GENERAL

- A. Metal Suspension-System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635/C 635M.
 - 1. High-Humidity Finish: Comply with ASTM C 635/C 635M requirements for "Coating Classification for Severe Environment Performance" where high-humidity finishes are indicated. (All spaces without HVAC with door direct to exterior– Group restrooms, custodial, data, etc.)
- B. Attachment Devices: Size for five times the design load indicated in ASTM C 635/C 635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
 - 1. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing according to ASTM E 1190, conducted by a qualified testing and inspecting agency.
- C. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
 - 1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
 - 2. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635/C 635M, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch- (2.69-mm-) diameter wire.
- D. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.
- E. Seismic Clips: Manufacturer's standard seismic clips designed and spaced to secure acoustical panels in place.
- F. Hold-Down Clips: Where indicated, provide manufacturer's standard hold-down clips spaced 24 inches (610 mm) o.c. on all cross tees.

2.7 METAL SUSPENSION SYSTEM

- A. <u>Basis-of-Design Product</u>: Subject to compliance with requirements, provide <u>Armstrong World</u> <u>Industries, Inc.</u> Prelude XL 15/16" or comparable product by one of the following:
 1. CertainTeed Corp.
 - USG Interiors, Inc.; Subsidiary of USG Corporation.
- B. Wide-Face, Single-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet electrolytically zinc coated, with prefinished flanges of width indicated.
 - 1. Structural Classification: Heavy-duty system.
 - 2. Face Finish: Painted white.

2.8 METAL EDGE MOLDINGS AND TRIM

- A. <u>Basis-of-Design Product</u>: Subject to compliance with requirements, provide <u>Armstrong World</u> <u>Industries, Inc. 7/8" wall molding</u> or comparable product by one of the following:
 - 1. <u>CertainTeed Corp</u>.
 - 2. <u>USG Interiors, Inc.; Subsidiary of USG Corporation</u>.
- B. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.
 - 1. Provide manufacturer's standard edge moldings that fit acoustical panel edge details and suspension systems indicated and that match width and configuration of exposed runners unless otherwise indicated.

2.9 ACOUSTICAL SEALANT

- A. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. <u>Acoustical Sealant for Exposed and Concealed Joints:</u>
 - a. <u>Pecora Corporation</u>; AC-20 FTR Acoustical and Insulation Sealant.
 - b. <u>USG Corporation</u>; SHEETROCK Acoustical Sealant.
 - 2. <u>Acoustical Sealant for Concealed Joints</u>:
 - a. <u>Henkel Corporation</u>; OSI Pro-Series SC-175 Acoustical Sound Sealant.
 - b. <u>Pecora Corporation;</u> AIS-919.
 - c. <u>Tremco, Inc</u>.; Tremco Acoustical Sealant.
- B. Acoustical Sealant: Manufacturer's standard sealant complying with ASTM C 834 and effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

- 1. Exposed and Concealed Joints: Nonsag, paintable, nonstaining latex sealant.
- 2. Concealed Joints: Nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber sealant.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.
- B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION

- A. General: Install acoustical panel ceilings to comply with ASTM C 636/C 636M and seismic design requirements indicated, according to manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
 - 1. Fire-Rated Assembly: Install fire-rated ceiling systems according to tested fire-rated design.
- B. Suspend ceiling hangers from building's structural members and as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 - 2. Splay hangers only where required and, if permitted with fire-resistance-rated ceilings, to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 - 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.

- 4. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
- 5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
- 6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
- 7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
- 8. Do not attach hangers to steel deck tabs.
- 9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
- 10. Space hangers not more than 48 inches (1200 mm) o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches (200 mm) from ends of each member.
- 11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
- C. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
 - 1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
 - 2. Screw attach moldings to substrate at intervals not more than 16 inches (400 mm) o.c. and not more than 3 inches (75 mm) from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet (3.2 mm in 3.6 m). Miter corners accurately and connect securely.
 - 3. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- D. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- E. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.
 - 1. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension-system runners and moldings.
 - 2. Install hold-down clips in areas indicated, in areas required by authorities having jurisdiction, and for fire-resistance ratings; space as recommended by panel manufacturer's written instructions unless otherwise indicated.

3.4 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
 - 1. Compliance of seismic design.
- B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections and prepare test reports.
- C. Perform the following tests and inspections of completed installations of acoustical panel ceiling hangers and anchors and fasteners in successive stages. Do not proceed with installations of acoustical panel ceiling hangers for the next area until test results for previously completed installations show compliance with requirements.
 - 1. Extent of Each Test Area: When installation of ceiling suspension systems on each floor has reached 20 percent completion but no panels have been installed.
 - a. Within each test area, testing agency will select one of every 10 power-actuated fasteners and postinstalled anchors used to attach hangers to concrete and will test them for 200 lbf (890 N) of tension; it will also select one of every two postinstalled anchors used to attach bracing wires to concrete and will test them for 440 lbf (1957 N) of tension.
 - b. When testing discovers fasteners and anchors that do not comply with requirements, testing agency will test those anchors not previously tested until 20 pass consecutively and then will resume initial testing frequency.
- D. Acoustical panel ceiling hangers and anchors and fasteners will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

3.5 CLEANING

A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095113

SECTION 096513 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Resilient base.
 - 2. Resilient molding accessories.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified, not less than 12 inches (300 mm) long.
- C. Samples for Initial Selection: For each type of product indicated.
- D. Samples for Verification: For each type of product indicated and for each color, texture, and pattern required in manufacturer's standard-size Samples, but not less than 12 inches (300 mm) long.
- E. Product Schedule: For resilient base and accessory products. Use same designations indicated on Drawings.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Furnish not less than 10 linear feet (3 linear m) for every 500 linear feet (150 linear m) or fraction thereof, of each type, color, pattern, and size of resilient product installed.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C).

1.6 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive resilient products during the following time periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).
- C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 THERMOPLASTIC-RUBBER BASE RB-#

- A. <u>Manufacturers</u>: Subject to compliance with requirements, provide products by one of the following:
 - 1. Armstrong World Industries, Inc.
 - 2. Burke Mercer Flooring Products, Division of Burke Industries Inc.
 - 3. <u>Flexco</u>.
 - 4. Johnsonite; A Tarkett Company.
 - 5. <u>Mondo Rubber International, Inc</u>.
 - 6. <u>Nora Systems, Inc</u>.
 - 7. <u>Roppe Corporation, USA</u>.
- B. Product Standard: ASTM F 1861, Type TP (rubber, thermoplastic).
 - 1. Group: I (solid, homogeneous).
 - 2. Style and Location:
 - a. Style B, Cove: .
- C. Thickness: 0.125 inch (3.2 mm).
- D. Height: 4 inches (102 mm).

- E. Lengths: Coils in manufacturer's standard length.
- F. Outside Corners: Job formed.
- G. Inside Corners: Job formed.
- H. Colors: As indicated by manufacturer's designations.

2.2 RUBBER MOLDING ACCESSORY

- A. <u>Manufacturers</u>: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Armstrong World Industries, Inc.
 - 2. Burke Mercer Flooring Products, Division of Burke Industries Inc.
 - 3. <u>Flexco</u>.
 - 4. Johnsonite; A Tarkett Company.
 - 5. <u>Mondo Rubber International, Inc</u>.
 - 6. <u>Nora Systems, Inc</u>.
 - 7. <u>Roppe Corporation, USA</u>.
- B. Description: nosing for carpet, reducer strip for resilient flooring, joiner for tile and carpet transition strips.
- C. Profile and Dimensions: As indicated.
- D. Locations: Provide rubber molding accessories in areas indicated.
- E. Colors and Patterns: As indicated by manufacturer's designations.

2.3 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.
- C. Metal Edge Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edges of flooring, and in maximum available lengths to minimize running joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
 - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
 - 1. Installation of resilient products indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates for Resilient Stair Accessories: Prepare horizontal surfaces according to ASTM F 710.
 - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
 - 3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.
 - 4. Moisture Testing: Proceed with installation only after substrates pass testing according to manufacturer's written recommendations, but not less stringent than the following:
 - a. Perform anhydrous calcium chloride test according to ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
 - b. Perform relative humidity test using in situ probes according to ASTM F 2170. Proceed with installation only after substrates have maximum 75 percent relative humidity level.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install resilient products until they are the same temperature as the space where they are to be installed.
 - 1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.

E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.3 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- G. Job-Formed Corners:
 - 1. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches (76 mm) in length.
 - a. Form without producing discoloration (whitening) at bends.
 - 2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches (76 mm) in length.
 - a. Miter or cope corners to minimize open joints.

3.4 RESILIENT ACCESSORY INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient accessories.
- B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

3.5 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.
- B. Perform the following operations immediately after completing resilient-product installation:
 - 1. Remove adhesive and other blemishes from exposed surfaces.

- 2. Damp-mop horizontal surfaces to remove marks and soil.
- C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION 096513

SECTION 099113 - EXTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes surface preparation and the application of paint systems on exterior substrates.
 - 1. Concrete.
 - 2. Concrete masonry units (CMU).
 - 3. Steel.
 - 4. Galvanized metal.
- B. Related Requirements:
 - 1. Section 051200 "Structural Steel Framing" for shop priming of metal substrates with primers specified in this Section.
 - 2. Section 099123 "Interior Painting" for surface preparation and the application of paint systems on interior substrates.

1.3 DEFINITIONS

- A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
- B. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- C. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
- D. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.
- E. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
- F. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
- B. Samples for Initial Selection: For each type of topcoat product.
- C. Samples for Verification: For each type of paint system and each color and gloss of topcoat.
 - 1. Submit Samples on rigid backing, 8 inches (200 mm) square.
 - 2. Step coats on Samples to show each coat required for system.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area.
- D. Product List: For each product indicated, include the following:
 - 1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
 - 2. Printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Paint: 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

1.6 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.
 - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
 - b. Other Items: Architect will designate items or areas required.
 - 2. Final approval of color selections will be based on mockups.
 - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
 - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste from storage areas daily.

1.8 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).
- B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. <u>Manufacturers</u>: Subject to compliance with requirements, provide products by one of the following:
 - 1. <u>Benjamin Moore & Co</u>.
 - 2. <u>Kelly-Moore Paints</u>.
 - 3. <u>PPG Architectural Finishes, Inc</u>.
 - 4. <u>Sherwin-Williams Company (The)</u>.

2.2 PAINT, GENERAL

- A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."
- B. Material Compatibility:
 - 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- C. Colors: As selected by Architect from manufacturer's full range and Match Architect's samples.
 - 1. 10 percent of surface area will be painted with deep tones.

EXTERIOR PAINTING

2.3 BLOCK FILLERS

- A. Block Filler, Latex, Interior/Exterior: MPI #4.
 - 1. Sherwin Williams B25W25 PrepRite Block Filler Interior / Exterior Latex

2.4 PRIMERS/SEALERS

- A. Primer, Acrylic emulsion conditioner
 - 1. Sherwin Williams Loxon Conditioner A24-100 Series
- B. Primer, Bonding, Water Based Epoxy primer /sealer:
 - 1. American Safety Technologies AST PS-100WB Primer

2.5 METAL PRIMERS

A. Primer, Alkyd, Quick Dry, for Metal: (touch-up)1. Sherwin-Williams Kem Kromik Universal Metal Primer

2.6 WATER-BASED PAINTS

- A. Light Industrial Coating, Exterior, Water Based, Semi-Gloss (Gloss Level 5): MPI #163.
 - 1. Sherwin Williams B66-650 Series Pro Industrial Zero VOC Acrylic
- B. Industrial Coating, Exterior, Water Based, Semi-Gloss (Gloss Level 5):
 - 1. Sherwin Williams B71-200 Series Bond-Plex Waterbased Acrylic Coating
- C. Coating, Waterborne dry-fall acrylic (Gloss Level 5)
 1. Sherwin Williams B42W17 Series Spraylastic Exterior Semi-gloss waterborne dryfall.
- D. Anti-slip coating water based epoxy
 1. American Safety, AST AS-175 Anti-slip coating

2.7 SOLVENT-BASED PAINTS

- A. Alkyd, Quick Dry, Semi-Gloss (Gloss Level 5):
 - 1. Sherwin Williams Pro Industrial Industrial Enamel 100 B54Z-200 Series
- B. Elastomeric Coating (Dugout Roof)
 1. Uniflex Elastomeric Coating 100% acrylic polymer coating.
- C. Water repellent system (Stair ST02, ST03, ST04 exterior stair concrete)

EXTERIOR PAINTING

1. H&C HB-150 Water Repellent

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - 1. Concrete: 12 percent.
 - 2. Masonry (Clay and CMU): 12 percent.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Proceed with coating application only after unsatisfactory conditions have been corrected.
 - 1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates and paint systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.

- F. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer, but not less than the following:
 - 1. SSPC-SP 2, "Hand Tool Cleaning."
 - 2. SSPC-SP 3, "Power Tool Cleaning."
 - 3. SSPC-SP 11, "Power Tool Cleaning to Bare Metal."
- G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Manual."
 - 1. Use applicators and techniques suited for paint and substrate indicated.
 - 2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
 - 3. Paint both sides and edges of exterior doors and entire exposed surface of exterior door frames.
 - 4. Paint entire exposed surface of window frames and sashes.
 - 5. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 - 6. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. Tint undercoats same color as topcoat, but tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
 - 1. Paint the following work where exposed to view:
 - a. Equipment, including panelboards.
 - b. Uninsulated metal piping.

- c. Uninsulated plastic piping.
- d. Pipe hangers and supports.
- e. Metal conduit.
- f. Plastic conduit.
- g. Tanks that do not have factory-applied final finishes.

F. Roof coating:

- 1. Install per manufacturer requirements.
- 2. Prepare concrete surface per manufacturer requirements.

3.4 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
 - 1. Contractor shall touch up and restore painted surfaces damaged by testing.
 - 2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 EXTERIOR PAINTING SCHEDULE

- A. Concrete Substrates, Nontraffic Surfaces:
 - 1. Acrylic System (Dugout walls, Garnet to match logo color)
 - a. Prime Coat: Acrylic Emulsion Conditioner
 - b. Intermediate Coat: matching topcoat.
 - c. Topcoat: waterborne acrylic low sheen (Gloss Level 3-4).
- B. Concrete Substrates, Nontraffic Surfaces, Dugout Roof:

- 1. Elastomeric Coating System
 - a. Prime Coat per manufacturer recommendations
 - b. Topcoat: Elastomeric acrylic polymer coating (thickness per manufacturer recommendations)
- C. Concrete Substrates, Traffic Surfaces, Stadium Bowl Stair Nosings
 - 1. Waterborne Epoxy System
 - a. Prime Coat two component epoxy sealing primer
 - b. Intermediate and Topcoats: Waterborne epoxy with moderate grit
- D. Concrete Substrates, Traffic Surfaces, Stair ST02, ST03, ST04
 - 1. Water repellent system
 - a. Prime Coat prepare per manufacturer's recommendations
 - b. Intermediate and Topcoats: Clear oligomeric siloxane water repellent
- E. CMU Substrates:
 - 1. Water-Based Light Industrial Coating System:(Concourse walls only, not Dugout)
 - a. Block Filler: Block filler, latex, interior/exterior, MPI #4.
 - b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
 - c. Topcoat: Light industrial coating, interior, water based, semi-gloss (Gloss Level 5), MPI #153.
 - 2. Acrylic System (Dugout walls, Garnet to match logo color)
 - a. Block Filler: Block filler, latex, interior/exterior, MPI #4.
 - b. Intermediate Coat: matching topcoat.
 - c. Topcoat: waterborne acrylic low sheen (Gloss Level 3-4).
- F. Steel Substrates:
 - 1. Waterborne Dryfall System: (High beams and exposed decking, transition at column connection).
 - a. Prime Coat: Shop primer specified in Section where substrate is specified.
 - b. Intermediate Coat: matching topcoat.
 - c. Topcoat: Acrylic, exterior, gloss (Gloss Level 6)
 - 2. Quick-Drying Enamel System: (Rails, Doors, Frames, columns, low beams, stair components)
 - a. Prime Coat: Primer, alkyd, quick dry, for metal. (touch-up)
 - b. Intermediate Coat: Alkyd, quick dry, matching topcoat.
 - c. Topcoat: Alkyd, quick dry, semi-gloss (Gloss Level 5).
- G. Galvanized-Metal Substrates:
 - 1. Waterborne Dryfall System: (High beams and exposed decking, transition at column connection).

- a. Prime Coat: Shop primer specified in Section where substrate is specified.
- b. Intermediate Coat: matching topcoat.
- c. Topcoat: Acrylic, exterior, gloss (Gloss Level 6)
- 2. Quick-Drying Enamel System: (Rails, Doors, Frames, columns, low beams, stair components)
 - a. Prime Coat: Primer, alkyd, quick dry, for metal. (touch-up)
 - b. Intermediate Coat: Alkyd, quick dry, matching topcoat.
 - c. Topcoat: Alkyd, quick dry, semi-gloss (Gloss Level 5).

END OF SECTION 099113

SECTION 099123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes surface preparation and the application of paint systems on interior substrates.
 - 1. Concrete.
 - 2. Concrete masonry units (CMU).
 - 3. Steel.
 - 4. Cast iron.
 - 5. Galvanized metal.
 - 6. Gypsum board.
- B. Related Requirements:
 - 1. Section 051200 "Structural Steel Framing" for shop priming of metal substrates with primers specified in this Section.
 - 2. Section 099113 "Exterior Painting" for surface preparation and the application of paint systems on exterior substrates.

1.3 DEFINITIONS

- A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
- B. Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- C. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- D. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
- E. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.
- F. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
- G. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
- B. Samples for Initial Selection: For each type of topcoat product.
- C. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.
 - 1. Submit Samples on rigid backing, 8 inches (200 mm) square.
 - 2. Step coats on Samples to show each coat required for system.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area.
- D. Product List: For each product indicated, include the following:
 - 1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
 - 2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Paint: 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

1.6 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.
 - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
 - b. Other Items: Architect will designate items or areas required.
 - 2. Final approval of color selections will be based on mockups.
 - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
 - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste from storage areas daily.

1.8 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. <u>Manufacturers</u>: Subject to compliance with requirements, provide products by one of the following:
 - 1. <u>Benjamin Moore & Co</u>.
 - 2. <u>Kelly-Moore Paints</u>.
 - 3. <u>PPG Architectural Finishes, Inc</u>.
 - 4. <u>Sherwin-Williams Company (The)</u>.

2.2 PAINT, GENERAL

- A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."
- B. Material Compatibility:
 - 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- C. Colors: As selected by Architect from manufacturer's full range and Match Architect's samples.
 - 1. 10 percent of surface area will be painted with deep tones.

INTERIOR PAINTING

2.3 BLOCK FILLERS

- A. Block Filler, Latex, Interior/Exterior: MPI #4.
 - 1. Sherwin Williams B25W25 PrepRite Block Filler Interior / Exterior Latex

2.4 PRIMERS/SEALERS

- A. Primer Sealer, Latex, Interior: MPI #50.
 - 1. Sherwin Williams B28W08200 Interior Latex Primer ProMar 200

2.5 METAL PRIMERS

A. Primer, Alkyd, Quick Dry, for Metal: (touch-up)1. Sherwin-Williams Kem Kromik Universal Metal Primer

2.6 WATER-BASED PAINTS

- A. Latex, Interior, Institutional Low Odor/VOC, (Gloss Level 2): MPI #144.
 - 1. Sherwin Williams B24W2651 ProMar 200 Zero VOC Interior Latex Low Sheen
- B. Latex, Interior, Institutional Low Odor/VOC, Semi-Gloss (Gloss Level 5): MPI #147.
 - 1. Sherwin Williams B31W2651 ProMar 200 Zero VOC Interior Latex Semi-Gloss
- C. Light Industrial Coating, Interior, Water Based, Semi-Gloss (Gloss Level 5): MPI #153.
 - 1. Sherwin Williams B66-650 Series Pro Industrial Zero VOC Acrylic
- D. Epoxy, Interior, High Performance Architectural, Semi-Gloss (Gloss Level 5): MPI #141.
 - 1. Sherwin Williams K46-150 Series Pre-Catalyzed Waterbased Epoxy

2.7 SOLVENT-BASED PAINTS

- A. Alkyd, Quick Dry, Semi-Gloss (Gloss Level 5):
 - 1. Sherwin Williams Pro Industrial Industrial Enamel 100 B54Z-200 Series

2.8 FLOOR COATINGS

A. Sealer, Water Based, for Concrete Floors: MPI #99. (Restroom concrete floors, interior concrete stairs)

- 1. Sherwin Williams H&C Shield-Crete Garage Floor Epoxy (Pewter Gray)
- 2. Sherwin Williams H&C Shield-Crete Acrylic Clear Glaze
- 3. Sherwin Williams H&C SharkGrip Slip Resistant Additive
- B. Sealer, Water Based, for Concrete Floors: MPI #99.
 - 1. Sherwin Williams H&C Wet Look Sealer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - 1. Concrete: 12 percent.
 - 2. Masonry (Clay and CMU): 12 percent.
 - 3. Gypsum Board: 12 percent.
- C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- D. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- E. Proceed with coating application only after unsatisfactory conditions have been corrected.
 - 1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

- 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceed that permitted in manufacturer's written instructions.
- F. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer. but not less than the following:
 - 1. SSPC-SP 2, "Hand Tool Cleaning."
 - 2. SSPC-SP 3, "Power Tool Cleaning."
 - 3. SSPC-SP 11, "Power Tool Cleaning to Bare Metal."
- G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."
 - 1. Use applicators and techniques suited for paint and substrate indicated.
 - 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 - 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 - 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 - 5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
 - 1. Paint the following work where exposed in equipment rooms:
 - a. Equipment, including panelboards.
 - b. Uninsulated metal piping.
 - c. Uninsulated plastic piping.
 - d. Pipe hangers and supports.
 - e. Metal conduit.
 - f. Tanks that do not have factory-applied final finishes.
 - g. As indicated in mechanical, electrical and plumbing specifications.
 - 2. Paint the following work where exposed in occupied spaces:
 - a. Equipment, including panelboards.
 - b. Pipe hangers and supports.
 - c. Metal conduit.
 - d. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
 - e. Other items as directed by Architect.
 - 3. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

3.4 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
 - 1. Contractor shall touch up and restore painted surfaces damaged by testing.
 - 2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 INTERIOR PAINTING SCHEDULE

- A. Concrete Substrates, Nontraffic Surfaces:
 - 1. Water-Based Light Industrial Coating System: (Interior Concrete columns, etc.)
 - a. Prime Coat: Primer, alkali resistant, water based, MPI #3.
 - b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
 - c. Topcoat: Light industrial coating, interior, water based, gloss (Gloss Level 6), MPI #154.
- B. Concrete Substrates, Traffic Surfaces:
 - 1. Epoxy System: (restrooms as indicated)
 - a. First Coat: Epoxy based, for concrete floors with hand broadcast blend of garnet, black and white colored paint chips into wet epoxy resin. (Color Pewter Gray)
 - b. Intermediate Coat: matching topcoat.
 - c. Topcoat: Sealer, acrylic glaze for concrete floors. (add non-slip additive to final coat)
 - 2. Water-Based Clear Sealer System:
 - a. First Coat: Sealer, water based, for concrete floors, MPI #99.
 - b. Topcoat: Sealer, water based, for concrete floors, MPI #99.
- C. CMU Substrates:
 - 1. Water-Based Light Industrial Coating System:
 - a. Block Filler: Block filler, latex, interior/exterior, MPI #4.
 - b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
 - c. Topcoat: Light industrial coating, interior, water based, semi-gloss (Gloss Level 5), MPI #153.
- D. Steel Substrates:
 - 1. Quick-Drying Enamel System:
 - a. Prime Coat: Primer, alkyd, quick dry, for metal.

- b. Intermediate Coat: Alkyd, quick dry, matching topcoat.
- c. Topcoat: Alkyd, quick dry, semi-gloss (Gloss Level 5).
- E. Galvanized-Metal Substrates:
 - 1. Quick-Drying Enamel System:
 - a. Prime Coat: Touch-up with Anticorrosive metal primer
 - b. Intermediate Coat: Alkyd, quick dry, matching topcoat.
 - c. Topcoat: Alkyd, quick dry, semi-gloss (Gloss Level 5).
- F. Gypsum Board Substrates:
 - 1. Institutional Low-Odor/VOC Latex System: (low sheen ceilings and soffits)
 - a. Prime Coat: Primer sealer, interior, institutional low odor/VOC, MPI #149.
 - b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
 - c. Topcoat: Latex, interior, institutional low odor/VOC, (Gloss Level 2), MPI #144.
 - 2. Institutional Low-Odor/VOC Latex System: (semi-gloss walls verify locations)
 - a. Prime Coat: Primer sealer, interior, institutional low odor/VOC, MPI #149.
 - b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
 - c. Topcoat: Latex, interior, institutional low odor/VOC, (Gloss Level 2), MPI #147.
 - 1. High-Performance Architectural Epoxy System: (ceilings and soffits in all rooms with showers)
 - a. Prime Coat: Primer sealer, latex, interior, MPI #50.
 - b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
 - c. Topcoat: Epoxy, interior, high performance architectural, semi-gloss (Gloss Level 5), MPI #141.

END OF SECTION 099123

SECTION 101100 - VISUAL DISPLAY UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:1. Markerboards.

1.3 DEFINITIONS

- A. Visual Display Board Assembly: Visual display surface that is factory fabricated into composite panel form, either with or without a perimeter frame; includes chalkboards, markerboards, and tackboards.
- B. Visual Display Surface: Surfaces that are used to convey information visually, including surfaces of chalkboards, markerboards, tackboards, and surfacing materials that are not fabricated into composite panel form but are applied directly to walls.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For visual display surfaces. Include plans, elevations, sections, details, and attachments to other work.
 Include sections of tunical trim members.
 - 1. Include sections of typical trim members.
- C. Product Schedule: For visual display surfaces.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For visual display surfaces to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain visual display surfaces from single source from single manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver factory-built visual display surfaces, including factory-applied trim where indicated, completely assembled in one piece without joints, where possible. If dimensions exceed maximum manufactured panel size, provide two or more pieces of equal length as acceptable to Architect. When overall dimensions require delivery in separate units, prefit components at the factory, disassemble for delivery, and make final joints at the site.
- B. Store visual display surfaces vertically with packing materials between each unit.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install visual display surfaces until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.9 WARRANTY

- A. Special Warranty for Porcelain-Enamel Face Sheets: Manufacturer's standard form in which manufacturer agrees to repair or replace porcelain-enamel face sheets that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Surfaces lose original writing and erasing qualities.
 - b. Surfaces exhibit crazing, cracking, or flaking.
 - 2. Warranty Period: 50 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Porcelain-Enamel Face Sheet: Manufacturer's standard steel sheet with porcelain-enamel coating fused to steel; uncoated thickness indicated.
 - 1. Gloss Finish: Gloss as indicated; dry-erase markers wipe clean with dry cloth or standard eraser.
- B. Melamine: Thermally fused, melamine-impregnated decorative paper complying with LMA SAT-1.
- C. Natural Cork Sheet: Seamless, single-layer, compressed fine-grain cork sheet; bulletin board quality; face sanded for natural finish.
- D. Particleboard: ANSI A208.1, Grade M-1.
E. Extruded Aluminum: ASTM B 221 (ASTM B 221M), Alloy 6063.

2.2 MARKERBOARD ASSEMBLIES

- A. Porcelain-Enamel Markerboards: Balanced, high-pressure, factory-laminated markerboard assembly of three-ply construction consisting of backing sheet, core material, and porcelain-enamel face sheet with high-gloss finish.
 - 1. <u>Manufacturers</u>: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. <u>AARCO Products, Inc</u>.
 - b. <u>ADP Lemco, Inc</u>.
 - c. <u>Aywon</u>.
 - d. <u>Bangor Cork Company, Inc</u>.
 - e. <u>Best-Rite Manufacturing</u>.
 - f. <u>Claridge Products and Equipment, Inc.</u>
 - g. Egan Visual Inc.
 - h. <u>Ghent Manufacturing, Inc</u>.
 - i. Marsh Industries, Inc.; Visual Products Group.
 - j. <u>Platinum Visual Systems; a division of ABC School Equipment, Inc.</u>
 - k. <u>PolyVision Corporation; a Steelcase company</u>.
 - 1. <u>Tri-Best Visual Display Products</u>.
 - 2. Particleboard Core: 1/2 inch (13 mm) thick; with 0.013-inch- (0.35-mm-) thick, galvanized-steel sheet backing.
 - 3. Laminating Adhesive: Manufacturer's standard, moisture-resistant thermoplastic type.
- B. Melamine Markerboards: Fabricated from 1/4-inch- (6-mm-) thick, sealed and primed hardboard panels permanently bonded with melamine or another high-pressure-laminate writing surface.

2.3 MARKERBOARD ACCESSORIES

- A. Aluminum Frames: Fabricated from not less than 0.062-inch- (1.57-mm-) thick, extruded aluminum; standard size and shape.
 - 1. Factory-Applied Trim: Manufacturer's standard.
- B. Chalktray: Manufacturer's standard, continuous.
 - 1. Box Type: Extruded aluminum with slanted front, grooved tray, and cast-aluminum end closures.
 - 2. Solid Type: Extruded aluminum with ribbed section and smoothly curved exposed ends.
- C. Map Rail: Provide the following accessories:
 - 1. Display Rail: Continuous and integral with map rail; fabricated from cork approximately 1 to 2 inches (25 to 50 mm) wide.

2. End Stops: Located at each end of map rail.

2.4 FABRICATION

- A. Porcelain-Enamel Visual Display Assemblies: Laminate porcelain-enamel face sheet and backing sheet to core material under heat and pressure with manufacturer's standard flexible, waterproof adhesive.
- B. Visual Display Boards: Factory assemble visual display boards unless otherwise indicated.
 - 1. Where factory-applied trim is indicated, trim shall be assembled and attached to visual display boards at manufacturer's factory before shipment.
- C. Factory-Assembled Visual Display Units: Coordinate factory-assembled units with trim and accessories indicated. Join parts with a neat, precision fit.
- D. Modular Visual Display Boards: Fabricated with integral panel clips attached to core material.
- E. Aluminum Frames and Trim: Fabricate units straight and of single lengths, keeping joints to a minimum. Miter corners to a neat, hairline closure.
 - 1. Where factory-applied trim is indicated, trim shall be assembled and attached to visual display units at manufacturer's factory before shipment.

2.5 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.6 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

2.7 VISUAL DISPLAY SURFACE SCHEDULE

- A. Visual Display Board: Factory assembled.
 - 1. Markerboard: Porcelain-enamel markerboard assembly.
 - a. Color: White.

- 2. Corners: Square.
- 3. Width: As indicated on Drawings.
- 4. Height: As indicated on Drawings.
- 5. Mounting: Wall.
- 6. Mounting Height: As indicated on Drawings.
- 7. Factory-Applied Aluminum Trim: Manufacturer's standard with clear anodic finish.
- 8. Accessories:
 - a. Chalktray: Box or Solid type.
 - b. Map rail with display rail.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, surface conditions of wall, and other conditions affecting performance of the Work.
- B. Examine walls and partitions for proper preparation and backing for visual display surfaces.
- C. Examine walls and partitions for suitable framing depth where sliding visual display units will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions for surface preparation.
- B. Clean substrates of substances that could impair the performance of and affect the smooth, finished surfaces of visual display boards, including dirt, mold, and mildew.
- C. Prepare surfaces to achieve a smooth, dry, clean surface free of flaking, unsound coatings, cracks, defects, projections, depressions, and substances that will impair bond between visual display surfaces and wall surfaces.
 - 1. Prime wall surfaces indicated to receive direct-applied, visual display tack wall panels and as recommended in writing by primer/sealer manufacturer and wall covering manufacturer.

3.3 INSTALLATION, GENERAL

A. General: Install visual display surfaces in locations and at mounting heights indicated on Drawings, or if not indicated, at heights indicated below. Keep perimeter lines straight, level,

and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.

3.4 INSTALLATION OF FACTORY-FABRICATED VISUAL DISPLAY BOARDS AND ASSEMBLIES

- A. Visual Display Boards: Attach visual display boards to wall surfaces with egg-size adhesive gobs at 16 inches (400 mm) o.c., horizontally and vertically.
- B. Visual Display Boards: Attach concealed clips, hangers, and grounds to wall surfaces and to visual display boards with fasteners at not more than 16 inches (400 mm) o.c. Secure both top and bottom of boards to walls.

3.5 CLEANING AND PROTECTION

- A. Clean visual display surfaces according to manufacturer's written instructions. Attach one cleaning label to visual display surface in each room.
- B. Touch up factory-applied finishes to restore damaged or soiled areas.
- C. Cover and protect visual display surfaces after installation and cleaning.

END OF SECTION 101100

SECTION 102113 - TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 1. Phenolic-core toilet compartments configured as toilet enclosures and urinal screens.
- B. Related Sections:
 - 1. Section 102800 "Toilet and Bath Accessories" for toilet tissue dispensers, grab bars, purse shelves, and similar accessories.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For toilet compartments. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Show locations of cutouts for compartment-mounted toilet accessories.
 - 2. Show locations of reinforcements for compartment-mounted grab bars.
 - 3. Show locations of centerlines of toilet fixtures.
- C. Samples for Initial Selection: For each type of unit indicated. Include Samples of hardware and accessories involving material and color selection.
- D. Samples for Verification: For the following products, in manufacturer's standard sizes unless otherwise indicated:
 - 1. Each type of material, color, and finish required for units, prepared on 6-inch- (152-mm-) square Samples of same thickness and material indicated for Work.
 - 2. Each type of hardware and accessory.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of toilet compartment, from manufacturer.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For toilet compartments to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Comply with requirements in GSA's CID-A-A-60003, "Partitions, Toilets, Complete."
- B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84, or another standard acceptable to authorities having jurisdiction, by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: 75 or less.
 - 2. Smoke-Developed Index: 450 or less.
- C. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities" and ICC/ANSI A117.1 for toilet compartments designated as accessible.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication.

1.8 WARRANTY

- A. Provide manufacturer's Twenty-Five (25) year written limited warranty on panels, pilasters and doors, against chipping, breakage, corrosion, delamination, and defects in workmanship; to be replaced without charge.
- B. Provide manufacturer's Ten (10) year written limited warranty on all cast stainless steel hardware, hinges and brackets, against defects in materials and workmanship. All other hardware shall have a one (1) year written warranty against all defects in material and workmanship.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Aluminum Castings: ASTM B 26/B 26M.
- B. Aluminum Extrusions: ASTM B 221 (ASTM B 221M).

- C. Steel Sheet: Commercial steel sheet for exposed applications; mill phosphatized and selected for smoothness.
 - 1. Electrolytically Zinc Coated: ASTM A 879/A 879M, 01Z (03G).
 - 2. Hot-Dip Galvanized: ASTM A 653/A 653M, either hot-dip galvanized or galvannealed.
- D. Stainless-Steel Sheet: ASTM A 666, Type 304, stretcher-leveled standard of flatness.
- E. Stainless-Steel Castings: ASTM A 743/A 743M.
- F. Solid Phenolic
 - 1. Graffiti Resistance Requirements: When tested in accordance with ASTM D6578, partition materials shall prove resistant to all chemicals tested for a period of 1 to 10 minutes and shall leave no mar or blemish on the surface when cleaned. Partition materials shall have guaranteed surface cleanability from permanent markers and shall have Non-Ghosting properties.
 - 2. Scratch Resistance Requirements: When tested in accordance with ASTM D2197, partition materials shall prove to be scratch resistant when the maximum Load Value exceeds 10 kilograms.
 - 3. Impact Resistance Requirements: When tested in accordance with ASTM D2794, partition materials shall withstand an Impact Force Value in excess of 45 inch-lbs.
 - 4. Screw Holding Strength: When tested in accordance with ASTM D1037, Direct Screw Withdrawal Test, partition materials shall withstand a direct pull force that exceeds 2,500 lbs per fastener.
 - 5. Tensile Strength: Partition materials shall have a Modulus of Elasticity of 1.55 Million PSI.
 - 6. Shear Strength: Partition materials shall have a Shear Strength of 2,000 PSI minimum.
 - 7. Compression Strength: Partition materials shall have a Compression Strength of 24,000 PSI minimum.
 - 8. Water Absorption Requirements: When tested in accordance with ASTM D570 partition materials shall have a Water Absorption Rate of less than 0.37%.

2.2 PHENOLIC-CORE UNITS

- A. <u>Basis-of-Design Product</u>: Subject to compliance with requirements, provide <u>Partition Systems</u> <u>Incorporated of South Carolina 58825</u> or comparable product by one of the following:
 - 1. <u>Bobrick Washroom Equipment, Inc</u>.
 - 2. <u>Global Steel Products Corp</u>.
 - 3. <u>Knickerbocker Partition Corporation</u>.
 - 4. <u>Metpar Corp</u>.
 - 5. <u>Rockville Partitions Incorporated</u>.
 - 6. <u>Sanymetal; a Crane Plumbing company</u>.
 - 7. <u>Shanahan's Limited</u>.
 - 8. <u>Young Group Ltd. (The)</u>; Fabricated Products Division; DesignRite Partitions.
- B. Toilet-Enclosure Style: Overhead braced.
- C. Urinal-Screen Style: Overhead braced.

- D. Door, Panel, and Pilaster Construction: Solid phenolic-core panel material with melamine facing on both sides fused to substrate during panel manufacture (not separately laminated), and with eased and polished edges. Provide minimum 3/4-inch- (19-mm-) thick doors and pilasters and minimum 1/2-inch- (13-mm-) thick panels.
- E. Pilaster Shoes: Fabricated from stainless-steel sheet, not less than 0.040-inch nominal thickness and 3 inches (76 mm) high, finished to match hardware.
- F. Urinal-Screen Post: Manufacturer's standard post design of monolithic phenolic urinal screen cut out at bottom to form a post or 1-3/4-inch- (44-mm-) square, aluminum tube with satin finish; with shoe matching that on the pilaster.
- G. Brackets (Fittings):
 - 1. Full-Height (Continuous) Type: Manufacturer's standard design; stainless steel Type 304, 14 Gauge.
- H. Phenolic-Panel Finish:
 - 1. Facing Sheet Finish: One color and pattern in each room.
 - 2. Color and Pattern: Garnet as selected by architect with manufacturer's black color core.
 - 3. On each door provide a 24" x24"+/- routed logo (Block "C" Gamecock logo). Architect to provide digital file for logo creation. Provide sample of routed logo for review.

2.3 ACCESSORIES

- A. Hardware and Accessories: Manufacturer's standard design, heavy-duty operating hardware and accessories.
 - 1. Material: Stainless steel.
 - 2. Hinges: Manufacturer's standard continuous, cam type that swings to a closed or partially open position.
 - 3. Latch and Keeper: Manufacturer's standard surface-mounted latch unit designed for emergency access and with combination rubber-faced door strike and keeper. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible.
 - 4. Coat Hook: Manufacturer's standard combination hook and rubber-tipped bumper, sized to prevent in-swinging door from hitting compartment-mounted accessories.
 - 5. Door Bumper: Manufacturer's standard rubber-tipped bumper at out-swinging doors.
 - 6. Door Pull: Manufacturer's standard unit at out-swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible.
- B. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.
- C. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel or chrome-plated steel or brass, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless steel, hot-dip galvanized steel, or other rust-resistant, protective-coated steel.

2.4 FABRICATION

- A. Overhead-Braced Units: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters to suit floor conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.
- B. Urinal-Screen Posts: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment at tops and bottoms of posts. Provide shoes at posts to conceal anchorage.
- C. Door Size and Swings: Unless otherwise indicated, provide 24-inch- (610-mm-) wide, inswinging doors for standard toilet compartments and 36-inch- (914-mm-) wide, out-swinging doors with a minimum 32-inch- (813-mm-) wide, clear opening for compartments designated as accessible.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.
 - 1. Maximum Clearances:
 - a. Pilasters and Panels: 1/2 inch (13 mm).
 - b. Panels and Walls: 1 inch (25 mm).
- B. Overhead-Braced Units: Secure pilasters to floor and level, plumb, and tighten. Set pilasters with anchors penetrating not less than 1-3/4 inches (44 mm) into structural floor unless otherwise indicated in manufacturer's written instructions. Secure continuous head rail to each pilaster with no fewer than two fasteners. Hang doors to align tops of doors with tops of panels, and adjust so tops of doors are parallel with overhead brace when doors are in closed position.
- C. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.

3.2 ADJUSTING

A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

END OF SECTION 102113

SECTION 102116 - SHOWER AND DRESSING COMPARTMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Shower compartments fabricated from solid phenolic.
 - 2. Dressing compartments fabricated from solid phenolic.
- B. Related Sections:
 - 1. Section 102800 "Toilet and Bath Accessories" for toilet tissue dispensers, grab bars, purse shelves, and similar accessories.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For shower and dressing compartments. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Show locations of cutouts for compartment-mounted accessories.
 - 2. Show locations of reinforcements for compartment-mounted grab bars.
 - 3. Show locations of centerlines of drains.
- C. Samples for Initial Selection: For each type of compartment indicated. Include Samples of hardware and accessories for material and color selection.
- D. Samples for Verification: For the following products, in manufacturer's standard sizes unless otherwise indicated:
 - 1. Each type of material, color, and finish required for compartments, prepared on 6-inch-(152-mm-) square Samples of same thickness and material indicated for the Work.
 - 2. Each type of hardware and accessory.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of shower and dressing compartment, from manufacturer.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For shower and dressing compartments to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84, or another standard acceptable to authorities having jurisdiction, by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: 75 or less.
 - 2. Smoke-Developed Index: 450 or less.
- B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1 for shower and dressing compartments designated as accessible.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls, columns, ceilings, and other construction contiguous with shower and dressing compartments by field measurements before fabrication.

1.8 WARRANTY

- A. Provide manufacturer's Twenty-Five (25) year written limited warranty on panels, pilasters and doors, against chipping, breakage, corrosion, delamination, and defects in workmanship; to be replaced without charge.
- B. Provide manufacturer's Ten (10) year written limited warranty on all cast stainless steel hardware, hinges and brackets, against defects in materials and workmanship. All other hardware shall have a one (1) year written warranty against all defects in material and workmanship.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Aluminum Castings: ASTM B 26/B 26M.
- B. Aluminum Extrusions: ASTM B 221 (ASTM B 221M).
- C. Steel Sheet: ASTM A 653/A 653M, either hot-dip galvanized or galvannealed; mill phosphatized and selected for smoothness.
- D. Stainless-Steel Sheet: ASTM A 666, Type 304, stretcher-leveled standard of flatness.

- E. Stainless-Steel Castings: ASTM A 743/A 743M.
- F. Solid Phenolic
 - 1. Graffiti Resistance Requirements: When tested in accordance with ASTM D6578, partition materials shall prove resistant to all chemicals tested for a period of 1 to 10 minutes and shall leave no mar or blemish on the surface when cleaned. Partition materials shall have guaranteed surface cleanability from permanent markers and shall have Non-Ghosting properties.
 - 2. Scratch Resistance Requirements: When tested in accordance with ASTM D2197, partition materials shall prove to be scratch resistant when the maximum Load Value exceeds 10 kilograms.
 - 3. Impact Resistance Requirements: When tested in accordance with ASTM D2794, partition materials shall withstand an Impact Force Value in excess of 45 inch-lbs.
 - 4. Screw Holding Strength: When tested in accordance with ASTM D1037, Direct Screw Withdrawal Test, partition materials shall withstand a direct pull force that exceeds 2,500 lbs per fastener.
 - 5. Tensile Strength: Partition materials shall have a Modulus of Elasticity of 1.55 Million PSI.
 - 6. Shear Strength: Partition materials shall have a Shear Strength of 2,000 PSI minimum.
 - 7. Compression Strength: Partition materials shall have a Compression Strength of 24,000 PSI minimum.
 - 8. Water Absorption Requirements: When tested in accordance with ASTM D570 partition materials shall have a Water Absorption Rate of less than 0.37%.

2.2 PHENOLIC-CORE COMPARTMENTS

- A. <u>Basis-of-Design Product</u>: Subject to compliance with requirements, provide <u>Partition Systems</u> <u>Incorporated of South Carolina</u> or comparable product by one of the following:
 - 1. <u>Bobrick Washroom Equipment, Inc</u>.
 - 2. <u>General Partitions Mfg. Corp.</u>
 - 3. <u>Global Steel Products Corp</u>.
 - 4. <u>Metpar Corp</u>.
 - 5. <u>Rockville Partitions Incorporated</u>.
 - 6. <u>Sanymetal; a Crane Plumbing company</u>.
 - 7. <u>Shanahan's Limited</u>.
 - 8. <u>Young Group Ltd. (The)</u>; Fabricated Products Division; DesignRite Partitions.
- B. Configuration: Shower and dressing compartments As shown on Drawings.
- C. Enclosure Style: Overhead braced.
- D. Panel and Pilaster Construction: Solid phenolic material consisting of solid phenolic-core panel with melamine facing on both sides fused to substrate during panel manufacture (not separately laminated) and with eased and polished edges. Provide minimum 3/4-inch- (19-mm-) thick pilasters and minimum 1/2-inch- (13-mm-) thick panels.
- E. Door Construction: Match panels; 3/4-inch (19-mm) minimum thickness.

- F. Pilaster Shoes: Formed from stainless-steel sheet, not less than 0.040-inch nominal thickness and 3 inches (76 mm) high, finished to match hardware.
- G. Brackets (Fittings):
 - 1. Full-Height (Continuous) Type: Manufacturer's standard design; stainless steel Type 304, 14 Gauge.
- H. Phenolic-Panel Finish:
 - 1. Facing Sheet Finish: One color and pattern in each room.
 - 2. Color and Pattern: Garnet as selected by architect with manufacturer's black color core.
 - 3. On each door provide a 24" x24"+/- routed logo (Block "C" Gamecock logo). Architect to provide digital file for logo creation. Provide sample of routed logo for review.

2.3 ACCESSORIES

- A. Door Hardware and Accessories: Manufacturer's standard design, heavy-duty, operating hardware and accessories.
 - 1. Material: Stainless steel.
 - 2. Hinges: Manufacturer's standard, continuous, cam type that swings to a closed or partially open position.
 - 3. Latch and Keeper: Manufacturer's standard, surface-mounted latch unit designed for emergency access and with combination rubber-faced door strike and keeper. Provide units that comply with regulatory requirements for accessibility at each compartment, accessible or not.
 - 4. Clothing Hooks: Manufacturer's standard clothing hooks in each dressing compartment; include one combination hook and rubber-tipped bumper at in-swinging doors, sized to prevent door from hitting wall panel or compartment-mounted accessories.
 - 5. Door Bumper: Manufacturer's standard, rubber-tipped bumper at out-swinging doors.
 - 6. Door Pull: Manufacturer's standard unit at out-swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible.
- B. Overhead Bracing: Manufacturer's standard, continuous, extruded-aluminum head rail or cap with antigrip profile; in manufacturer's standard finish.
- C. Head Rail with Hooks: Manufacturer's standard, continuous, extruded-aluminum head rail or cap with curtain hooks running in concealed track; with antigrip profile; in manufacturer's standard finish.
- D. Curtain Rod with Hooks: Manufacturer's standard, 1-inch- (25-mm-) diameter, stainless-steel curtain rod with matching hooks.
- E. Curtain: Flame-resistant, polyester-reinforced vinyl fabric that is stain resistant, self-sanitizing, antistatic, and antimicrobial; launderable to a temperature of not less than 90 deg F (32 deg C).

- 1. Flame Resistance: Passes NFPA 701 tests when tested by a testing and inspecting agency acceptable to authorities having jurisdiction.
- 2. Labeling: Identify fabrics with appropriate markings of applicable testing and inspecting agency.
- 3. Curtain Grommets: Two-piece, rolled-edge, rustproof, nickel-plated brass; spaced not more than 6 inches (152 mm) o.c.; machined into top hem.
- 4. Length: Where curtain extends to a floor surface, size so that bottom hem clears finished floor by not more than 1 inch (25 mm) and not less than 1/2 inch (13 mm) above floor surface. Where curtains extend to a shower-receptor curb, size so that bottom hem hangs above curb line and clears curb line by not more than 1/2 inch (13 mm).
- 5. Color and Pattern: As selected by Architect from manufacturer's full range.
- F. Seats: Manufacturer's standard, panel-mounted benches.
 - 1. Material: Solid phenolic.
 - 2. Operation: Fixed.
 - 3. Finish: As selected by Architect from manufacturer's full range.
- G. Anchorages and Fasteners: Manufacturer's standard, exposed fasteners of stainless steel, chrome-plated steel, or solid brass, finished to match the items they are securing; with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless steel, hot-dip galvanized steel, or other rust-resistant, protective-coated steel.

2.4 FABRICATION

- A. Overhead-Braced Compartments: Provide manufacturer's standard, corrosion-resistant supports, leveling method, and anchors at pilasters and walls to suit floor and wall conditions. Provide shoes at pilasters to conceal supports and leveling method.
- B. Door Sizes and Swings: Unless otherwise indicated, provide 24-inch- (610-mm-) wide, inswinging doors for standard shower and dressing compartments, and 36-inch- (914-mm-) wide, out-swinging doors with a minimum 32-inch- (813-mm-) wide, clear opening for compartments designated as accessible.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions. Install compartments rigid, straight, level, and plumb. Secure compartments in position with manufacturer's recommended anchoring devices.
 - 1. Maximum Clearances for Dressing Compartment:
 - a. Pilasters and Panels: 1/2 inch (13 mm).
 - b. Panels and Walls: 1 inch (25 mm).

- B. Overhead-Braced Compartments: Secure pilasters to floor, and level, plumb, and tighten. Set pilasters with anchors penetrating not less than 1-3/4 inches (44 mm) into structural floor unless otherwise indicated in manufacturer's written instructions. Secure continuous head rail to each pilaster with no fewer than two fasteners. Hang doors to align tops of doors with tops of panels, and adjust so tops of doors are parallel with overhead brace when doors are in closed position.
- C. Curtains: Install curtains to specified length and verify that they hang vertically without stress points or diagonal folds.

3.2 ADJUSTING

- A. Curtain Adjustment: After hanging curtains, test and adjust each track or rod to produce unencumbered, smooth operation. Steam and dress down curtains as required to produce crease- and wrinkle-free installation. Remove and replace curtains that are stained or soiled or that have stress points or diagonal folds.
- B. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

END OF SECTION 102116

SECTION 102800 – TOILET AND BATH ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Public-use washroom accessories.
 - 2. Public-use shower room accessories.
 - 3. Private-use bathroom accessories.
 - 4. Underlavatory guards.
- B. Owner-Furnished Material: See Drawings for Items furnished by Owner.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include the following:
 - 1. Construction details and dimensions.
 - 2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
 - 3. Material and finish descriptions.
 - 4. Features that will be included for Project.
 - 5. Manufacturer's warranty.
- B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
 - 1. Identify locations using room designations indicated.
 - 2. Identify products using designations indicated.

1.4 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For toilet and bath accessories to include in maintenance manuals.

TOILET, BATH, AND LAUNDRY ACCESSORIES

1.6 QUALITY ASSURANCE

- A. Source Limitations: For products listed together in the same Part 2 articles, obtain products from single source from single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.7 COORDINATION

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.
- B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.8 WARRANTY

- A. Special Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to replace mirrors that develop visible silver spoilage defects and that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Stainless Steel: ASTM A 666, Type 304, 0.031-inch (0.8-mm) minimum nominal thickness unless otherwise indicated.
- B. Brass: ASTM B 19, flat products; ASTM B 16/B 16M, rods, shapes, forgings, and flat products with finished edges; or ASTM B 30, castings.
- C. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.036inch (0.9-mm) minimum nominal thickness.
- D. Galvanized-Steel Sheet: ASTM A 653/A 653M, with G60 (Z180) hot-dip zinc coating.
- E. Galvanized-Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.
- F. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.
- G. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).

TOILET, BATH, AND LAUNDRY ACCESSORIES

H. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

2.2 PUBLIC-USE WASHROOM ACCESSORIES

- A. <u>Basis-of-Design Product</u>: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. <u>A & J Washroom Accessories, Inc</u>.
 - 2. <u>American Specialties, Inc</u>.
 - 3. <u>Bobrick Washroom Equipment, Inc</u>.
 - 4. <u>Bradley Corporation</u>.
 - 5. <u>GAMCO Specialty Accessories; a division of Bobrick Washroom Equipment, Inc.</u>
 - 6. <u>Tubular Specialties Manufacturing, Inc</u>.
- B. Grab Bar <u>GB</u>
 - 1. Basis-of-Design Product: Bobrick
 - 2. Mounting: Flanges with concealed fasteners.
 - 3. Material: Stainless steel, 0.05 inch (1.3 mm) thick.
 - a. Finish: Smooth, No. 4 finish (satin) on ends and slip-resistant texture in grip area.
 - 4. Outside Diameter: 1-1/4 inches (32 mm).
 - 5. Configuration and Length: As indicated on Drawings.
- C. Sanitary-Napkin Disposal Unit <u>ND</u>
 - 1. Basis-of-Design Product: Bobrick B-254
 - 2. Mounting: Surface mounted.
 - 3. Door or Cover: Self-closing, disposal-opening cover and hinged face panel with tumbler lockset.
 - 4. Receptacle: Removable.
 - 5. Material and Finish: Stainless steel, No. 4 finish (satin).

D. Mirror Unit <u>MI</u>

- 1. Basis-of-Design Product: Bobrick B-290 Series
- 2. Frame: Stainless-steel angle, 0.05 inch (1.3 mm) thick.
 - a. Corners: Welded and ground smooth.
- 3. Hangers: Produce rigid, tamper- and theft-resistant installation, using method indicated below.
 - a. One-piece, galvanized-steel, wall-hanger device with spring-action locking mechanism to hold mirror unit in position with no exposed screws or bolts.
- 4. No. 1 quality, ¹/₄" select float glass.
- 5. Size: As indicated on Drawings.

2.3 PUBLIC-USE SHOWER ROOM ACCESSORIES

- A. <u>Basis-of-Design Product</u>: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. <u>A & J Washroom Accessories, Inc</u>.
 - 2. <u>American Specialties, Inc</u>.
 - 3. <u>Bobrick Washroom Equipment, Inc</u>.
 - 4. <u>Bradley Corporation</u>.
 - 5. <u>GAMCO Specialty Accessories; a division of Bobrick Washroom Equipment, Inc.</u>
 - 6. <u>Tubular Specialties Manufacturing, Inc.</u>
- B. Shower Curtain Rod <u>CR</u>
 - 1. Basis-of-Design Product: **<u>Bobrick B207</u>**
 - 2. Description: 1-inch (25.4-mm) OD; fabricated from nominal 0.0375-inch- (0.95-mm-) thick stainless steel.
 - 3. Mounting Flanges: 1-3/8" (35 mm) diameter chrome plated plastic with bright polished finish over concealed aluminum mounting brackets.
 - 4. Finish: No. 4 (satin).
- C. Shower Curtain <u>C</u>
 - 1. Size: Minimum 6 inches (152 mm) wider than opening by 72 inches (1828 mm) high.
 - 2. Material: Nylon-reinforced vinyl, minimum 10 oz. (284 g) or 0.008-inch- (0.2-mm-) thick vinyl, with integral antibacterial agent.
 - 3. Color: White.
 - 4. Grommets: Corrosion resistant at minimum 6 inches (152 mm) o.c. through top hem.
 - 5. Shower Curtain Hooks: Chrome-plated or stainless-steel, spring wire curtain hooks with snap fasteners, sized to accommodate specified curtain rod. Provide one hook per curtain grommet.
- D. Folding Shower Seat <u>SS</u>
 - 1. Basis-of-Design Product: **Bobrick B-5181**
 - 2. Configuration: L-shaped seat, designed for wheelchair access.
 - 3. Seat: Phenolic or polymeric composite of slat-type or one-piece construction in color as selected by Architect.
 - 4. Mounting Mechanism: Stainless steel, No. 4 finish (satin).
 - 5. Dimensions: 33"x24"

2.4 PRIVATE-USE BATHROOM ACCESSORIES

- A. <u>Basis-of-Design Product</u>: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. <u>Basco, Inc</u>.
 - 2. <u>Bobrick Washroom Equipment, Inc</u>.
 - 3. Franklin Brass by Liberty Hardware Manufacturing Corporation; a Masco company.
 - 4. <u>GAMCO Specialty Accessories; a division of Bobrick Washroom Equipment, Inc.</u>

- 5. <u>Ginger; a Masco company</u>.
- 6. Seachrome Corporation.
- 7. <u>Tubular Specialties Manufacturing, Inc.</u>

B. Robe Hook <u>**RH**</u>

- 1. Basis-of-Design Product: **Bobrick B-76717**
- 2. Description: Single-prong unit.
- 3. Material and Finish: Stainless steel, No. 4 finish (satin).

2.5 UNDERLAVATORY GUARDS

A. Underlavatory Guard – See Plumbing

2.6 FABRICATION

- A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.
- B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
- B. Grab Bars: Install to withstand a downward load of at least 250 lbf (1112 N), when tested according to ASTM F 446.

3.2 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
- B. Remove temporary labels and protective coatings.
- C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION 102800

SECTION 104413 - FIRE EXTINGUISHER CABINETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Fire protection cabinets for the following:
 - a. Portable fire extinguishers.
- B. Related Sections:
 - 1. Section 104416 "Fire Extinguishers."

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire protection cabinets.
 - 1. Fire Protection Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.
- B. Shop Drawings: For fire protection cabinets. Include plans, elevations, sections, details, and attachments to other work.
- C. Samples for Initial Selection: For each type of fire protection cabinet indicated.
- D. Product Schedule: For fire protection cabinets. Coordinate final fire protection cabinet schedule with fire extinguisher schedule to ensure proper fit and function. Use same designations indicated on Drawings.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For fire protection cabinets to include in maintenance manuals.

1.5 COORDINATION

- A. Coordinate size of fire protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.
- B. Coordinate sizes and locations of fire protection cabinets with wall depths.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.
- B. Aluminum: Alloy and temper recommended by aluminum producer and manufacturer for type of use and finish indicated, and as follows:
 - 1. Sheet: ASTM B 209 (ASTM B 209M).
 - 2. Extruded Shapes: ASTM B 221 (ASTM B 221M).
- C. Stainless-Steel Sheet: ASTM A 666, Type 304.
- D. Tempered Float Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear).

2.2 FIRE PROTECTION CABINET FEC-R (Fully Recessed)

- A. Cabinet Type: Suitable for fire extinguisher.
 - 1. <u>Products</u>: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. <u>Fire End & Croker Corporation;</u>.
 - b. J. L. Industries, Inc., a division of Activar Construction Products Group;.
 - c. <u>Kidde Residential and Commercial Division, Subsidiary of Kidde plc;</u>
 - d. Larsen's Manufacturing Company; 2409-R2
 - e. Modern Metal Products, Division of Technico Inc.;.
 - f. <u>Potter Roemer LLC</u>;
- B. Cabinet Construction: Nonrated.
- C. Cabinet Material: Stainless-steel sheet.
 - 1. Shelf: Same metal and finish as cabinet.
- D. Recessed Cabinet: Cabinet box recessed in walls of sufficient depth to suit style of trim indicated.

- 1. Exposed Flat Trim: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).
- E. Cabinet Trim Material: Stainless-steel sheet.
- F. Door Material: Stainless-steel sheet.
- G. Door Style: Vertical duo panel with frame.
- H. Door Glazing: Tempered float glass (clear).
- I. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
 - 1. Provide recessed door pull and friction latch.
 - 2. Provide continuous hinge, of same material and finish as trim, permitting door to open 180 degrees.
- J. Accessories:
 - 1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
 - 2. Door Lock: Cam lock that allows door to be opened during emergency by pulling sharply on door handle.
 - 3. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated.
 - a. Identify fire extinguisher in fire protection cabinet with the words "FIRE EXTINGUISHER."
 - 1) Location: Applied to cabinet door.
 - 2) Application Process: Silk-screened.
 - 3) Lettering Color: White.
 - 4) Orientation: Vertical.
- K. Finishes:
 - 1. Manufacturer's standard baked-enamel paint for the following:
 - a. Interior of cabinet and door.
 - 2. Stainless Steel: No. 4.

2.3 FIRE PROTECTION CABINET FEC-S Surface

- A. Cabinet Type: Suitable for fire extinguisher.
 - 1. <u>Products</u>: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- a. <u>Fire End & Croker Corporation;</u>.
- b. J. L. Industries, Inc., a division of Activar Construction Products Group;.
- c. Kidde Residential and Commercial Division, Subsidiary of Kidde plc;.
- d. Larsen's Manufacturing Company; 2409-SM
- e. Modern Metal Products, Division of Technico Inc.;.
- f. <u>Potter Roemer LLC;</u>
- B. Cabinet Construction: Nonrated.
- C. Cabinet Material: Stainless-steel sheet.
 - 1. Shelf: Same metal and finish as cabinet.
- D. Surface-Mounted Cabinet: Cabinet box fully exposed and mounted directly on wall with no trim. Provide where walls are of insufficient depth for semirecessed cabinet installation.
- E. Cabinet Trim Material: Stainless-steel sheet.
- F. Door Material: Stainless-steel sheet.
- G. Door Style: Vertical duo panel with frame.
- H. Door Glazing: Tempered float glass (clear).
- I. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
 - 1. Provide recessed door pull and friction latch.
 - 2. Provide continuous hinge, of same material and finish as trim, permitting door to open 180 degrees.
- J. Accessories:
 - 1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
 - 2. Door Lock: Cam lock that allows door to be opened during emergency by pulling sharply on door handle.
 - 3. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated.
 - a. Identify fire extinguisher in fire protection cabinet with the words "FIRE EXTINGUISHER."
 - 1) Location: Applied to cabinet door.
 - 2) Application Process: Silk-screened.
 - 3) Lettering Color: White.
 - 4) Orientation: Vertical.
- K. Finishes:

- 1. Manufacturer's standard baked-enamel paint for the following:
 - a. Interior of cabinet and door.
- 2. Stainless Steel: No. 4.

2.4 FABRICATION

- A. Fire Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.
 - 1. Weld joints and grind smooth.
 - 2. Provide factory-drilled mounting holes.
 - 3. Prepare doors and frames to receive locks.
 - 4. Install door locks at factory.
- B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles selected.
 - 1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch (13 mm) thick.
 - 2. Miter and weld perimeter door frames.
- C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.5 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces of fire protection cabinets from damage by applying a strippable, temporary protective covering before shipping.
- C. Finish fire protection cabinets after assembly.
- D. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.6 STEEL FINISHES

- A. Surface Preparation: Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning".
- B. Factory Prime Finish: Apply manufacturer's standard, fast-curing, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.

- C. Baked-Enamel or Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils (0.05 mm).
 - 1. Color and Gloss: As selected by Architect from manufacturer's full range.

2.7 STAINLESS-STEEL FINISHES

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
- B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - 1. Run grain of directional finishes with long dimension of each piece.
 - 2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
 - 3. Directional Satin Finish: No. 4.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls and partitions for suitable framing depth and blocking where recessed and semirecessed cabinets will be installed.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare recesses for recessed and semirecessed fire protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

- A. General: Install fire protection cabinets in locations and at mounting heights indicated or, if not indicated, at heights indicated below:
 - 1. Fire Protection Cabinets: 54 inches (1372 mm) above finished floor to top of cabinet.
- B. Fire Protection Cabinets: Fasten cabinets to structure, square and plumb.
 - 1. Unless otherwise indicated, provide recessed fire protection cabinets. If wall thickness is not adequate for recessed cabinets, provide semirecessed fire protection cabinets.
 - 2. Seal perimeter of fire protection cabinets.
 - 3. Provide inside latch and lock for break-glass panels.
 - 4. Fasten mounting brackets to inside surface of fire protection cabinets, square and plumb.

C. Identification: Apply decals at locations indicated.

3.4 ADJUSTING AND CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as fire protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.
- B. Adjust fire protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.
- C. On completion of fire protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.
- D. Touch up marred finishes, or replace fire protection cabinets that cannot be restored to factoryfinished appearance. Use only materials and procedures recommended or furnished by fire protection cabinet and mounting bracket manufacturers.
- E. Replace fire protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 104413

SECTION 104416 - FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes portable, fire extinguishers and mounting brackets for fire extinguishers.
- B. Related Requirements:
 - 1. Section 104413 "Fire Protection Cabinets."

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.
- B. Product Schedule: For fire extinguishers. Coordinate final fire-extinguisher schedule with fireprotection cabinet schedule to ensure proper fit and function. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

1.6 COORDINATION

A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Failure of hydrostatic test according to NFPA 10.
 - b. Faulty operation of valves or release levers.
 - 2. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
- B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.
 - 1. Provide fire extinguishers approved, listed, and labeled by FM Global.

2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

- A. Fire Extinguishers: Type, size, and capacity for each fire-protection cabinet and mounting bracket indicated.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. <u>Badger Fire Protection</u>.
 - b. <u>Buckeye Fire Equipment Company</u>.
 - c. <u>Fire End & Croker Corporation</u>.
 - d. JL Industries, Inc.; a division of the Activar Construction Products Group.
 - e. <u>Kidde Residential and Commercial Division</u>; Subsidiary of Kidde plc.
 - f. Larsens Manufacturing Company.
 - g. <u>Nystrom Building Products</u>.
 - h. <u>Pem All Fire Extinguisher Corp</u>.
 - i. <u>Potter Roemer LLC</u>.
 - j. <u>Pyro-Chem</u>; Tyco Safety Products.
 - 2. Valves: Manufacturer's standard.
 - 3. Handles and Levers: Manufacturer's standard.

- 4. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B, and bar coding for documenting fire-extinguisher location, inspections, maintenance, and recharging.
- B. Multipurpose Dry-Chemical Type in Steel Container FE UL-rated 4-A:60-B:C, 10-lb (4.5-kg) nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.

2.3 MOUNTING BRACKETS FE-B

- A. Mounting Brackets: Manufacturer's standard steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or red baked-enamel finish.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. <u>Amerex Corporation</u>.
 - b. <u>Ansul Incorporated</u>.
 - c. <u>Badger Fire Protection</u>.
 - d. <u>Buckeye Fire Equipment Company</u>.
 - e. <u>Fire End & Croker Corporation</u>.
 - f. <u>Guardian Fire Equipment, Inc</u>.
 - g. JL Industries, Inc.; a division of the Activar Construction Products Group.
 - h. Larsens Manufacturing Company.
 - i. <u>Nystrom Building Products</u>.
 - j. <u>Potter Roemer LLC</u>.
 - k. <u>Strike First Corporation of America</u>.
- B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.
 - 1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.
 - a. Orientation: Vertical.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fire extinguishers for proper charging and tagging.
 - 1. Remove and replace damaged, defective, or undercharged fire extinguishers.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.
 - 1. Mounting Brackets: 54 inches (1372 mm) above finished floor to top of fire extinguisher.
- B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

END OF SECTION 104416

SECTION 105113 - METAL LOCKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Welded lockers.
 - 2. Locker benches.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of metal locker.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of metal locker and bench.
- B. Shop Drawings: For metal lockers.
 - 1. Include plans, elevations, sections, details, and attachments to other work.
 - 2. Show locker trim and accessories.
 - 3. Include locker identification system and numbering sequence.
- C. Samples: For each color specified, in manufacturer's standard size.
- D. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available.
- E. Samples for Verification: For the following products, in manufacturer's standard size:
 - 1. Lockers and equipment.
 - 2. Locker benches.
- F. Product Schedule: For lockers.

1.4 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For adjusting, repairing, and replacing locker doors and latching mechanisms to include in maintenance manuals.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver metal lockers until spaces to receive them are clean, dry, and ready for their installation.

1.7 FIELD CONDITIONS

A. Field Measurements: Verify actual dimensions of recessed openings by field measurements before fabrication.

1.8 COORDINATION

- A. Coordinate sizes and locations of concrete bases for metal lockers.
- B. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of work specified in other Sections to ensure that metal lockers can be supported and installed as indicated.

1.9 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of metal lockers that fail in materials or workmanship, excluding finish, within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures.
 - b. Faulty operation of latches and other door hardware.
 - 2. Damage from deliberate destruction and vandalism is excluded.
 - 3. Warranty Period for Welded Metal Lockers: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Accessibility Requirements: For lockers indicated to be accessible, comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC A117.1.
2.2 WELDED LOCKERS

- A. <u>Products</u>: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Lyon Workspace Products, LLC;
 - 2. <u>Olympus Lockers & Storage Products, Inc;</u>
 - 3. <u>Penco Products, Inc</u>; All-Welded.
 - 4. <u>Republic Storage Systems Company</u>;
- B. Doors: One piece; fabricated from 0.075-inch (1.90-mm) nominal-thickness steel sheet; formed into channel shape with double bend at vertical edges and with right-angle single bend at horizontal edges.
 - 1. Reinforcement: Manufacturer's standard reinforcing angles, channels, or stiffeners for doors more than 15 inches (381 mm) wide; welded to inner face of doors.
 - 2. Door Style: Vented panel as follows:
 - a. Louvered Vents: No fewer than six louver openings at top and bottom for singletier lockers.
- C. Body: Assembled by welding body components together. Fabricate from unperforated steel sheet with thicknesses as follows:
 - 1. Tops, Bottoms, and Sides: 0.060-inch (1.52-mm) nominal thickness.
 - 2. Backs: 0.048-inch (1.21-mm) nominal thickness.
 - 3. Shelves: 0.060-inch (1.52-mm) nominal thickness, with double bend at front and single bend at sides and back.
- D. Frames: Channel formed; fabricated from 0.060-inch (1.52-mm) nominal-thickness steel sheet; lapped and factory welded at corners; with top and bottom main frames factory welded into vertical main frames. Form continuous, integral, full-height door strikes on vertical main frames.
- E. Hinges: Welded to door and attached to door frame with no fewer than two factory-installed rivets per hinge that are completely concealed and tamper resistant when door is closed; fabricated to swing 180 degrees.
 - 1. Knuckle Hinges: Steel, full loop, five or seven knuckles, tight pin; minimum 2 inches (51 mm) high. Provide no fewer than three hinges for each door more than 42 inches (1067 mm) high.
- F. Recessed Door Handle and Latch: Stainless-steel cup with integral door pull, recessed so locking device does not protrude beyond door face; pry and vandal resistant.
 - 1. Multipoint Latching: Finger-lift latch control designed for use with built-in combination locks or padlocks; positive automatic latching and prelocking.
 - a. Latch Hooks: Equip doors 48 inches (1219 mm) and higher with three latch hooks and doors less than 48 inches (1219 mm) high with two latch hooks; fabricated

from 0.120-inch (3.04-mm) nominal-thickness steel sheet; welded to full-height door strikes; with resilient silencer on each latch hook.

- b. Latching Mechanism: Manufacturer's standard, rattle-free latching mechanism and moving components isolated to prevent metal-to-metal contact, and incorporating a prelocking device that allows locker door to be locked while door is open and then closed without unlocking or damaging lock or latching mechanism.
- G. Locks: Combination padlocks.
- H. Identification Plates: Manufacturer's standard, etched, embossed, or stamped aluminum plates, with numbers and letters at least 3/8 inch (9 mm) high.
- I. Hooks: Manufacturer's standard ball-pointed type, aluminum or steel; zinc plated.
- J. Coat Rods: Manufacturer's standard.
- K. Legs: 6 inches (152 mm) high; formed by extending vertical frame members, or fabricated from 0.075-inch (1.90-mm) nominal-thickness steel sheet; welded to bottom of locker.
 - 1. Closed Front and End Bases: Fabricated from 0.036-inch (0.91-mm) nominal-thickness steel sheet.
- L. Continuous Zee Base: Fabricated from, manufacturer's standard thickness, but not less than 0.060-inch (1.52-mm) nominal-thickness steel sheet.
 - 1. Height: 4 inches (102 mm).
- M. Continuous Sloping Tops: Fabricated from 0.048-inch (1.21-mm) nominal-thickness steel sheet, with a pitch of approximately 20 degrees.
 - 1. Closures: Vertical-end type.
- N. Filler Panels: Fabricated from 0.048-inch (1.21-mm) nominal-thickness steel sheet.
- O. Boxed End Panels: Fabricated from 0.048-inch (1.21-mm) nominal-thickness steel sheet.
- P. Materials:
 - 1. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with A60 (ZF180) zinc-iron, alloy (galvannealed) coating designation.
- Q. Finish: Baked enamel or powder coat.
 - 1. Color: As selected by Architect from manufacturer's full range.

2.3 LOCKS

A. Combination Padlocks: Provided by Owner.

2.4 LOCKER BENCHES

- A. Provide bench units with overall assembly height of 17-1/2 inches (445 mm).
- B. Bench Tops: Manufacturer's standard one-piece units, with rounded corners and edges.
 - 1. Size: Minimum 9-1/2 inches wide by 1-1/4 inches thick (241 mm wide by 32 mm thick).
 - 2. Laminated clear hardwood with one coat of clear sealer on all surfaces and one coat of clear lacquer on top and sides.
- C. Freestanding Pedestals: Manufacturer's standard supports, with predrilled fastener holes for attaching bench top, complete with fasteners, and as follows:
 - 1. Stainless Steel: 1/8-inch-thick by 3-inch-wide (3-mm-thick by 76-mm-wide) channel or 1/4-inch-thick by 3-inch-wide (6-mm-thick by 76-mm-wide) bar stock, shaped into trapezoidal form; with nonskid pads at bottom.
 - a. Finish: No. 4B.
- D. Materials:
 - 1. Stainless Steel: ASTM A 666, Type 304.

2.5 FABRICATION

- A. Fabricate metal lockers square, rigid, without warp, and with metal faces flat and free of dents or distortion. Make exposed metal edges safe to touch and free of sharp edges and burrs.
 - 1. Form body panels, doors, shelves, and accessories from one-piece steel sheet unless otherwise indicated.
 - 2. Provide fasteners, filler plates, supports, clips, and closures as required for complete installation.
- B. Fabricate each metal locker with an individual door and frame; individual top, bottom, and back; and common intermediate uprights separating compartments. Factory weld frame members of each metal locker together to form a rigid, one-piece assembly.
- C. Equipment: Provide each locker with an identification plate and the following equipment:
 - 1. Single-Tier Units: Shelf, one double-prong ceiling hook, and two single-prong wall hooks.
 - 2. Coat Rods: In lieu of ceiling hook for metal lockers 24 inches (610 mm) high or more.
- D. Welded Construction: Factory preassemble metal lockers by welding all joints, seams, and connections; with no bolts, nuts, screws, or rivets used in assembly of main locker groups. Factory weld main locker groups into one-piece structures. Grind exposed welds flush.
- E. Accessible Lockers: Fabricate as follows:

- 1. Locate bottom shelf no lower than 15 inches (381 mm) above the floor.
- 2. Where hooks, coat rods, or additional shelves are provided, locate no higher than 48 inches (1219 mm) above the floor.
- F. Continuous Base: Formed into channel or zee profile for stiffness, and fabricated in lengths as long as practical to enclose base and base ends of metal lockers; finished to match lockers.
- G. Continuous Sloping Tops: Fabricated in lengths as long as practical, without visible fasteners at splice locations; finished to match lockers.
- H. Filler Panels: Fabricated in an unequal leg angle shape; finished to match lockers. Provide slipjoint filler angle formed to receive filler panel.
- I. Boxed End Panels: Fabricated with 1-inch- (25-mm-) wide edge dimension, and designed for concealing fasteners and holes at exposed ends of nonrecessed metal lockers; finished to match lockers.
 - 1. Provide one-piece panels for double-row (back-to-back) locker ends.
- J. Finished End Panels: Designed for concealing unused penetrations and fasteners, except for perimeter fasteners, at exposed ends of nonrecessed metal lockers; finished to match lockers.
 - 1. Provide one-piece panels for double-row (back-to-back) locker ends.

2.6 ACCESSORIES

- A. Fasteners: Zinc- or nickel-plated steel, slotless-type, exposed bolt heads; with self-locking nuts or lock washers for nuts on moving parts.
- B. Anchors: Material, type, and size required for secure anchorage to each substrate.
 - 1. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls, and elsewhere as indicated, for corrosion resistance.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls, floors, and support bases, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install lockers level, plumb, and true; shim as required, using concealed shims.
 - 1. Anchor locker runs at ends and at intervals recommended by manufacturer, but not more than 36 inches (910 mm) o.c. Using concealed fasteners, install anchors through backup reinforcing plates, channels, or blocking as required to prevent metal distortion.
 - 2. Anchor single rows of metal lockers to walls near top and bottom of lockers.
 - 3. Anchor back-to-back metal lockers to floor.
- B. Welded Lockers: Connect groups together with standard fasteners, with no exposed fasteners on face frames.
- C. Equipment:
 - 1. Attach hooks with at least two fasteners.
 - 2. Attach door locks on doors using security-type fasteners.
 - 3. Identification Plates: Identify metal lockers with identification indicated on Drawings.
 - a. Attach plates to each locker door, near top, centered, with at least two aluminum rivets.
- D. Trim: Fit exposed connections of trim, fillers, and closures accurately together to form tight, hairline joints, with concealed fasteners and splice plates.
 - 1. Attach recess trim to recessed metal lockers with concealed clips.
 - 2. Attach filler panels with concealed fasteners. Locate filler panels where indicated on Drawings.
 - 3. Attach sloping-top units to metal lockers, with closures at exposed ends.
 - 4. Attach boxed end panels using concealed fasteners to conceal exposed ends of nonrecessed metal lockers.
 - 5. Attach finished end panels using fasteners only at perimeter to conceal exposed ends of nonrecessed metal lockers.
- E. Freestanding Locker Benches: Place benches in locations indicated on Drawings.

3.3 ADJUSTING

A. Clean, lubricate, and adjust hardware. Adjust doors and latches to operate easily without binding.

3.4 **PROTECTION**

A. Protect metal lockers from damage, abuse, dust, dirt, stain, or paint. Do not permit use during construction.

B. Touch up marred finishes, or replace metal lockers that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by locker manufacturer.

END OF SECTION 105113

SECTION 10 73 00 - ALUMINUM WALKWAY COVERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Related Sections include the following: Design, fabrication, and installation of welded extruded aluminum walkway cover systems. Walkway and Canopy System notation is used interchangeably in the documents. Locations: Visitor Side concourse level and Home side lower level at Batting Cage.
- B. Products Furnished but not Installed Under this Section: Column sleeves (styrofoam blockouts) or anchor bolts (if required)

1.3 REFERENCES

- A. The Aluminum Association (AA):
 1. The Aluminum Design Manual 2005, Specifications & Guidelines for Aluminum Structures.
- B. American Architectural Manufacturers Association (AAMA):
 1. AAMA 611, Voluntary Specification for Anodized Architectural Aluminum.
- C. American Society of Civil Engineers (ASCE):
 1. ASCE 7, Minimum Design Loads for Buildings and Other Structures.
- D. American Society for Testing and Materials (ASTM):
 - 1. ASTM B 209, Specification for Aluminum and Aluminum- Alloy Sheet and Plate.
 - 2. ASTM B 221, Specification for Aluminum and Aluminum- Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
 - 3. ASTM C 150, Specification for Portland Cement.
 - 4. ASTM C 404, Specification for Aggregates for Masonry Grout.
- E. American Welding Society (AWS):
 - 1. ANSI/AWS D1.2, Structural Welding Code Aluminum.

1.4 PERFORMANCE REQUIREMENTS

A. Design Requirements:

- 1. Design Walkways and canopies in accordance with The Aluminum Design Manual 2010.
- 2. Comply with the wind requirements of 2009 International Building Code (IBC) and ASCE 7-02.
- 3. Provide an all welded extruded aluminum system complete with internal drainage. Non-welded systems are not acceptable.
- 4. Provide expansion joints to accommodate temperature changes of 120 degrees F. Provide expansion joints with no metal to metal contact.
- B. General: Provide aluminum-framed systems, including anchorage, capable of withstanding, without failure, the effects of the following:
 - 1. Structural loads.
 - 2. Thermal movements.
 - 3. Movements of supporting structure indicated on Drawings including, but not limited to, story drift and deflection from uniformly distributed and concentrated live loads.
 - 4. Dimensional tolerances of building frame and other adjacent construction.
 - 5. Failure includes the following:
 - a. Deflection exceeding specified limits.
 - b. Thermal stresses transferred to building structure.
 - c. Framing members transferring stresses, including those caused by thermal and structural movements, to glazing.
 - d. Noise or vibration created by wind and thermal and structural movements.
 - e. Loosening or weakening of fasteners, attachments, and other components.
 - f. Sealant failure.
- C. Structural Loads:
 - 1. Wind Load Criteria: As indicated on Drawings.
 - 2. Seismic Load Criteria: As indicated on Drawings.
 - 3. Structure shall be capable of supporting a concentrated load, such as being walked upon.
- D. Grout: Compressive strength of 3000 psi, minimum.

1.5 SUBMITTALS

- A. Product Data: Manufacturer's product information, specifications, and installation instructions for walkway cover components and accessories.
- B. Shop Drawings: Include plan dimensions, elevations, details, and reactions for foundation design.
- C. Samples:
 - 1. 3-inch-square samples of each finish selected on the substrate specified.
 - 2. Sample of each type of exposed welding (beam to column and end caps) for aesthetic visual appearance, minimum of 3" long.
 - 3. Sample of touch-up paint process at exposed welded structural connections.

D. Design Data: Design calculations bearing the seal of a Registered Professional Engineer, licensed in South Carolina. Design calculations shall state that the walkway cover system and canopies design complies with the wind and seismic requirements of 2009 IBC and ASCE 7-02, the stability criteria of applicable building code, and all other governing criteria.

1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of structural supports for aluminum-framed systems by field measurements before fabrication and indicate measurements on Shop Drawings.
 - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating aluminum-framed systems without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: At least ten years experience in the design, fabrication, and erection of extruded aluminum walkway cover systems.
- B. Installer Qualifications: Capable of assuming engineering responsibility and performing work of this Section and who is acceptable to manufacturer.
 - 1. Engineering Responsibility: Preparation of data for aluminum-framed systems including Shop Drawings based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project and submission of reports of tests performed on manufacturer's standard assemblies.
 - 2. Walkway covers shall be installed by the manufacturer; third party installation is not acceptable
- C. Product Options: Information on Drawings and in Specifications establishes requirements for systems' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.
 - 1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.
- D. Welding: Qualify procedures and personnel according to AWS D1.2, "Structural Welding Code--Aluminum."
- E. Testing Agency Qualifications: Minimum ICC certified.

F. DELIVERY AND STORAGE

1. Deliver and store all items in protected areas. Keep free of any damage. Replace any damaged items or parts at no cost to the Owner.

1.8 WARRANTY

- A. Special Assembly Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of aluminum-framed systems that do not comply with requirements or that deteriorate as defined in this Section within specified warranty period. Intention of Warranty is the manufacturer will come to the job site and do all necessary to remedy deficiencies.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including, but not limited to, excessive deflection.
 - b. Deterioration of metals and other materials beyond normal weathering.
 - c. Adhesive or cohesive sealant failures.
 - d. Water leakage through roof system.
 - e. Failure of operating components to function properly.
 - 2. Warranty Period: 2 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide **Peachtree Protective Covers, Inc.**, or comparable products by one of the following:
 - 1. Dittmer Architectural Aluminum.
 - 2. E.L. Burns Company.
 - 3. Mason Corporation.
 - 4. Perfection Architectural Systems, Inc.
 - 5. Tennessee Valley Metals, Inc.
- B. Substitutions: Subject to compliance with requirements, provide products by one of the listed manufacturers, or comparable products by other manufacturers submitted for acceptance within the bidding period and approved in accordance with Division 00 Section 00900 "Submittal of Substitutions.

2.2 MATERIALS

- A. Aluminum Members: Extruded aluminum, ASTM B 221, 6063 alloy, T6 temper.
- B. Fasteners: Aluminum, 18-8 stainless steel, or 300 series stainless steel. (rivets not permitted in deck)

- C. Protective Coating for Aluminum Columns Embedded in Concrete: Clear acrylic.
- D. Grout:
 - 1. Portland Cement: ASTM C 150, Type I.
 - 2. Sand: ASTM C 404.
 - 3. Water: Potable.
- E. Gaskets: Dry seal santoprene pressure type.
- F. Aluminum Flashing: ASTM B 209, Type 3003 H14, 0.040 inch, minimum.

2.3 MIXES

A. Grout: Minimum 2000 psi compressive strength of 1 part Portland Cement to 3 parts sand, add water to produce a pouring consistency.

2.4 FABRICATION

A. General:

- 1. Shop Assembly: Assemble components in shop to greatest extent possible to minimize field assembly.
- 2. Welding: In accordance with ANSI/AWS D1.2.
- 3. Bent Construction: Factory weld beams to columns with neatly mitered corners to form one-piece rigid bents. Make welds smooth and uniform using an inert gas shielded arc. Perform suitable edge preparation to assure 100% penetration. Grind welds only where interfering with adjoining structure to allow for flush connection. Field welding is not permitted. Rigid mechanical joints may be used only if fully welded bents cannot be shipped on local, state, or federal highways without a special permit from the department of transportation.
- 4. Deck Construction: Fabricate from extruded modules that interlock in a self-flashing manner. Positively fasten interlocking joints at 8 inches on center creating a monolithic structural unit capable of developing the full strength of the sections. The fastenings must have minimum shear strength of 350 pounds each. Assemble deck with sufficient camber to offset dead load deflection.
- 5. Exposed welded structural connections shall be painted subsequent to the welding. Using air-dry touch up paint to cover these locations is not acceptable. A sample shall be submitted prior to proceeding with touch-up paint.
- 6. All exposed fasteners shall match adjacent finish. Exposed fasteners and/or exposed fastener plates shall not be located on the vertical plane of the fascia, beams, or columns. Exposed fasteners shall be limited to minimal locations such as the bottom and top of the fascia elements. Location of all exposed fasteners shall be approved by the Architect.
- 7. Corner fascia Construction: Where the canopy fascia is exposed on two or more adjacent corners corners shall be constructed with a clean, hairline miter joint in the profile of the fascia, or a corner cover trim piece (minimum of 6" length in each direction) shall be installed with fasteners only visible on the top and bottom horizontal planes (no fasteners permitted on the fascia). The trim piece shall follow the profile of the fascia.

- 8. Exposed ends of beams, columns or structural elements: All exposed ends of beams columns or structural elements shall be capped with an endplate welded on all sides and finished to match adjacent surfaces.
- B. Columns: Provide radius-cornered tubular extrusions with cutout and internal diverter for drainage. Coordinate invert elevations for drain cutouts assuring positive drainage for tie-in to underground storm drainage system. Circular downspout opening in column not acceptable.
- C. Beams: Provide open-top tubular extrusion, top edges thickened for strength and designed to receive deck members in self-flashing manner. Provide structural ties in tops of all beams.
- D. Deck: Extruded self-flashing sections interlocking into a composite unit. Provide welded plate closures at deck ends.
- E. Fascia: Manufacturer's standard shape. Provide fascia splices where continuous runs of fascia are jointed. Locate splices to be in line with bents and fasten in place on hidden or non-vertical surfaces.

2.5 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions: Verify that all concrete, masonry, and roofing work in the vicinity is complete and cleaned.

3.2 ERECTION

- A. Erect protective cover true to line, level, and plumb. Protect aluminum columns embedded in concrete or earth with clear acrylic. Fill downspout columns with grout to the discharge level to prevent standing water. Assure that grout fills all voids and "keys" to columns. Coordinate the work with other trades and set column drainage cutouts at proper elevation for connection with underground storm drainage piping. Install weep holes at top of concrete in non-draining columns to remove condensation.
- B. Install roof deck sections, accessories and related flashing in accordance with manufacturer's instructions. Provide roof slope for positive storm water drainage without ponding water. Align and anchor roof deck units to structural support frames.
 - 1. Roof fasteners shall be evenly spaced and aligned in straight lines.
- C. Provide hairline miters and fitted joints.

- D. Install sealant at all penetrations in deck, beam or columns of canopy system to maintain watertight system.
- E. Structural members and anchors shall be anchored to CMU grouted solid. Elements and supports shall not anchor to brick veneer.

3.3 CLEANING AND PROTECTION

- A. Damaged Units: Replace roof deck panels and other components of the work which have been damaged or have deteriorated beyond successful minor repair.
- B. Cleaning: Remove protective coverings at time in project sequence which will afford greatest protection of work. Clean finish surfaces as recommended by manufacturer. Maintain in a clean condition during construction.
- C. Protect materials during and after installation.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Testing Services: Testing and inspecting of representative areas to determine compliance of installed systems with specified requirements shall take place as follows and in successive stages. Do not proceed with installation of the next area until test results for previously completed areas show compliance with requirements. Inspect Work for conformance of canopy structure, connections and roof deck connections with the approved shop drawings.
- C. Repair or remove work where test results and inspections indicate that it does not comply with specified requirements.
- D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- E. Testing includes soils and concrete footings.

END OF SECTION 10 73 00

SECTION 107500 - FLAGPOLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes ground-mounted flagpoles made from aluminum.
- B. Owner-Furnished Material: Flags.

1.3 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Flagpole assemblies, including anchorages and supports, shall withstand the effects of gravity loads, and the following loads and stresses within limits and under conditions indicated according to the following design criteria:
 - 1. Seismic Loads: as indicated on drawings.
 - 2. Wind Loads: as indicated on drawings.
 - 3. Base flagpole design on polyester flags of maximum standard size suitable for use with flagpole or flag size indicated, whichever is more stringent.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, operating characteristics, fittings, accessories, and finishes for flagpoles.
 - 1. Include section, and details of foundation system for ground-mounted flagpoles.
- B. Delegated-Design Submittal: For flagpole assemblies indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified professional engineer.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For flagpoles to include in operation and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of flagpole as complete unit, including fittings, accessories, bases, and anchorage devices, from single source from single manufacturer.

1.8 DELIVERY, STORAGE, AND HANDLING

A. General: Spiral wrap flagpoles with heavy paper and enclose in a hard fiber tube or other protective container.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. <u>Manufacturers</u>: Subject to compliance with requirements, provide products by one of the following:
 - 1. <u>American Flagpole; a Kearney-National Inc. company</u>.
 - 2. <u>Atlantic Fiberglass Products, Inc</u>.
 - 3. <u>Baartol Company</u>.
 - 4. <u>Concord Industries, Inc</u>.
 - 5. Eder Flag Manufacturing Company, Inc.
 - 6. <u>Ewing Flagpoles</u>.
 - 7. Lingo Inc.; Acme Flagpole Company Division.
 - 8. Millerbernd Manufacturing Company.
 - 9. <u>Morgan-Francis; Division of Original Tractor Cab Co., Inc</u>.
 - 10. <u>PLP Composite Technologies, Inc</u>.
 - 11. <u>Pole-Tech Company Inc</u>.
 - 12. <u>U.S. Flag & Flagpole Supply, LP</u>.
 - 13. <u>USS Manufacturing Inc</u>.

2.2 FLAGPOLES

- A. Flagpole Construction, General: Construct flagpoles in one piece if possible. If more than one piece is necessary, comply with the following:
 - 1. Fabricate shop and field joints without using fasteners, screw collars, or lead calking.
 - 2. Provide self-aligning, snug-fitting joints.
- B. Exposed Height: 25 feet (7.5 m) and 30 feet (9 m).

- C. Aluminum Flagpoles: Provide cone-tapered flagpoles fabricated from seamless extruded tubing complying with ASTM B 241/B 241M, Alloy 6063, with a minimum wall thickness of 3/16 inch (4.8 mm).
- D. Sleeve for Aluminum Flagpole: Fiberglass or PVC pipe foundation sleeve, made to fit flagpole, for casting into concrete foundation.
 - 1. Provide flashing collar of same material and finish as flagpole.

2.3 FITTINGS

- A. Finial Ball: Manufacturer's standard flush-seam ball, sized as indicated or, if not indicated, to match flagpole-butt diameter.
 - 1. 0.063-inch (1.6-mm) spun aluminum, finished to match flagpole.
- B. External Halyard: Ball-bearing, nonfouling, revolving truck assembly of cast metal with continuous 5/16-inch- (8-mm-) diameter, braided polypropylene halyard and 9-inch (228-mm) cast-metal cleats with fasteners. Finish exposed metal surfaces to match flagpole.
 - 1. Provide one halyard and one cleat at each flagpole.
 - 2. Halyard Flag Snaps: Provide two chromium-plated bronze swivel snap hooks per halyard.
 - a. Provide with neoprene or vinyl covers.

2.4 MISCELLANEOUS MATERIALS

- A. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107.
- B. Drainage Material: Crushed stone, or crushed or uncrushed gravel; coarse aggregate.
- C. Sand: ASTM C 33, fine aggregate.
- D. Elastomeric Joint Sealant: Multicomponent nonsag urethane joint sealant complying with requirements in Section 079200 "Joint Sealants" for Use NT (nontraffic) and for Use M, G, A, and, as applicable to joint substrates indicated, for Use O.
- E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.5 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.6 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

2.7 STEEL FINISHES

- A. Flagpole Interior Finish: Apply one coat of bituminous paint on interior of flagpole or otherwise treat to prevent corrosion.
- B. Galvanized Finish: Hot-dip galvanize after fabrication to comply with ASTM A 123/A 123M.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, including foundation; accurate placement, pattern, orientation of anchor bolts, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare uncoated metal flagpoles that are set in foundation tubes by painting below-grade portions with a heavy coat of bituminous paint.
- B. Foundation Excavation: Excavate to neat clean lines in undisturbed soil. Remove loose soil and foreign matter from excavation and moisten earth before placing concrete. Place and compact drainage material at excavation bottom.
- C. Provide forms where required due to unstable soil conditions and for perimeter of flagpole base at grade. Secure and brace forms to prevent displacement during concreting.
- D. Place concrete, as specified in Section 033000 "Cast-in-Place Concrete." Compact concrete in place by using vibrators. Moist-cure exposed concrete for not less than seven days or use nonstaining curing compound.
- E. Trowel exposed concrete surfaces to a smooth, dense finish, free of trowel marks, and uniform in texture and appearance. Provide positive slope for water runoff to perimeter of concrete base.

3.3 FLAGPOLE INSTALLATION

- A. General: Install flagpoles where shown and according to Shop Drawings and manufacturer's written instructions.
- B. Ground Set: Place sleeve, center, and brace to prevent displacement during concreting. Place concrete. Plumb and level sleeve and allow concrete to cure. Install flagpole, plumb, in sleeve.
 - 1. Foundation Tube: Place tube seated on bottom plate between steel centering wedges and install hardwood wedges to secure flagpole in place. Place and compact sand in foundation tube and remove hardwood wedges. Seal top of foundation tube with a 2-inch (50-mm) layer of elastomeric joint sealant and cover with flashing collar.

END OF SECTION 107500

SECTION 113200 SOFTBALL FACILITY SOUND SYSTEM

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. Provide a performance grade, full range, multi-zone, 2-way sound system, with field devices (loudspeakers, wiring, interface) permanently installed, setup and secure at the venue, along with an equipment rack (head end) with all equipment as described herein and as shown on associated drawings.
- B. Systems to be capable of providing sound reinforcement of dynamic musical and vocal sources along with interfacing with other audio systems and ancillary audio equipment. The sound system shall consistently provide intelligible and natural sound reinforcement of voice and music throughout the seating and outer listening areas.
- C. The sound system installation will be provided by the Electrical Contractor with the assistance of the subcontracted Sound System Contractor. The Sound System Contractor will provide all headend terminations, system setup, digital signal processor programming, testing, calibration and user training.
- D. Equipment to include wired and wireless microphones (handheld and headworn microphones), AM/FM tuner, mixer, analog and digital signal processors (equalization, compression, limiting, time alignment, feedback reduction filters, etc.), amplifiers, loudspeaker systems, all associated cabling, equipment and hardware and/or all other equipment as listed herein or as needed for optimum performance and functionality. The sound system will also feature a wireless remote interface for iPods ands other portable music devices.
- E. Installation to include mounting of loudspeakers as shown on plans and as directed by electrical engineer. Install all speakers as shown on the Drawings and generally as described below. Install two speakers on the side of pressbox above concourse roof level facing out toward and the seating behind and beyond the dugouts. Install 4 speakers to the side of the pressbox out toward the seating bowl. Install 4 speakers to the underside of the pressbox facing in toward the concourse area. Install one speaker on the side of the pressbox facing the "bridge" from the promenade. Install a speaker on both the first and third base light poles (adjacent to the ball pens) facing toward future seating in left field and right field beyond the outfield fencing. Install additional speakers as shown on the attached block diagram. All wiring to be protected per the NEC, including rigid galvanized conduit and waterproof splice boxes and covers at each loudspeaker location.

1.2 REFERENCE STANDARDS

A. All equipment to comply with the latest applicable requirements and standards of the National Electrical Code (NEC), the Electronics Industries Association (EIA), the Federal Communications Commission (FCC), and the Audio Engineering Society (AES).

1.3 PERFORMANCE SPECIFICATIONS

- A. The sound system shall be designed and installed to produce a clear and undistorted SPL of 85dB throughout the full bandwidth between 250Hz and 5kHz without exceeding or being below 3dB of the reference level at all frequencies throughout the primary listening areas.
- B. Reproduction of sound will be controlled utilizing a CPU based automatic mixer / digital signal processor (DSP). The DSP unit will be custom configured and programmed by the Sound System Contractor to provide the optimum fidelity and to insure system protection from excessive volume. Precise adjustments will be made to time alignment between each of the eight loudspeaker zones utilizing advance acoustical analysis tools such as SIA SmaartLive software and calibrated testing hardware.
- C. The loudspeakers will be configured to provide articulate and full range sound reproduction for the spectator and playing field areas only and will be positioned to provide a minimum amount of acoustical interaction outside of the event grounds. All loudspeakers will be weather resistant and will not require removal for precipitation or extreme temperature conditions.

1.4 SOUND SYSTEM CONTRACTOR QUALIFICATION

- A. The sound system equipment shall be furnished by and installed under the direction of a qualified professional Sound System Contractor experienced in the installation, testing and adjustment of sound systems similar to the systems specified herein.
- B. Said Sound System Contractor is to be a certified member of at least three of the following professional audio organizations:
 - 1. Audio Engineering Association (AES)
 - 2. InfoComm (formerly International Communications Industries Association)
 - 3. National Academy of Recording Arts & Sciences (NARAS)
 - 4. National Systems Contractor Association (NSCA)
- C. Said Sound System Contractor is to have received factory authorized training for analog and digital audio signal processing from at least three of the following professional audio equipment manufacturer's:
 - 1. Ashly Audio
 - 2. Bose Professional
 - 3. Digidesign
 - 4. Peavey Electronics
 - 5. QSC Audio
 - 6. Sennheiser
 - 7. Shure
- D. Said Sound System Contractor shall employ a team of personnel highly trained and experienced in the fields of audio engineering. The team leader should have at least 10 (ten) years experience as an audio engineer and should, at a minimum, posses a CTS (Certified Technology Specialist) certification from InfoComm.
- E. Said Sound System Contractor may be required to provide references from previous customers and authorization from equipment manufacturers.

1.5 WARRANTY & SERVICE

- A. To maintain certain manufacturer's warranties, equipment must be installed, aligned and serviced by those installers authorized by said manufacturer to perform those duties. The Sound System Contractor will include a statement of warranty on the entire system and on the individual pieces of equipment. The system warranty will be one year from the date of system acceptance by the Owner. This warranty shall obligate the Sound System Contractor to provide equipment, material, and labor if required, at no charge to the Owner, during the warranty period, in the event of system or equipment malfunction.
- B. Sound System Contractor to maintain a dedicated service representative and point of contact for future support, and maintain an inventory of spare parts capable of providing future service.
- C. Response for service and/or operational assistance shall be within 24 hours of receiving such service call and will be provided during normal working hours Monday through Friday.

1.6 SUBMITTALS

- A. The Sound System Contractor shall provide multiple copies (10 total) of the following submittals:
 - 1. Product Data: Manufacturer's descriptive literature for each type of device or piece of equipment, and wire/cable to be used on the project, indicating compliance with specified requirements.
 - 2. Shop Drawings: Complete description and wiring riser diagram layout of sound system, clearly indicating all devices, equipment, etc.
 - 3. Users Guides: Manufacturer's operational manuals for each type of device or piece of equipment requiring manual operation.
 - 4. Operations / Maintenance Manual: Basic system operation instructions with any/all asbuilt changes in wiring or configuration included in updated drawings.

1.7 SCOPE OF WORK BY SOUND CONTRACTOR:

- A. Provide electronic copies of submittal and close-out documentation.
- B. Provide and setup all equipment as listed below.
- C. Provide internal terminations and soldered field terminations.
- D. Integrate school's existing equipment where applicable.
- E. Provide guidance for E.C.'s installation of field devices.
- F. Provide guidance for E.C.'s mounting/aiming of loudspeakers.
- G. Provide programming of wireless devises and digital signal processor.
- H. Test and tune system utilizing calibrated computer analysis.
- I. Coordinate with and provide operational and maintenance training to school staff.

1.8 SCOPE OF WORK BY OTHERS (ELECTRICALCONTRACTOR):

- A. Provide power to rack location (two dedicated 20 amp. Circuits to quad outlet).
- B. Installation of loudspeakers and associated mounts as provided.
- C. Installation of antenna's and associated wiring as provided by sound contractor.
- D. Provision and installation of all field wiring (speaker) and associated raceways.
- E. Receive equipment, coordinate installation and training schedules.

PART 2 - PRODUCTS

2.1 EQUIPMENT

A. Equipment listed is not intended to be restricted to specific manufacturers but provide a minimum technical feature set and performance specifications on which the entire system's design is based.

REF	QTY	MODEL / PART #	MANUFACTURER / DESCRIPTION
1	2	DS-7E	Atlas desktop mic stand
2	1	TEB-E	Atlas tripod w/ boom mic stand
3	16	D6	Community ceiling speaker system
4	1	dSPEC-226	Community digital loudspeaker processor
5	2	PMB-1RR	Community pole mount kit (outfield)
6	2	PMB-BAND	Community pole band kit (outfield)
7	1	R.25.94TZ	Community weatherproof loudspeaker (entrance)
8	4	R.5HP	Community weatherproof loudspeaker (baselines &
9	4	W2-218W	Community weatherproof loudspeaker (concourse)
10	4	W2-2W8W	Community weatherproof loudspeaker (under
11	2	PL PRO-DMC	Furman power distro sys
12	3	100LVC-DW	Lowell 100w volume control
13	5	50LVC-DW	Lowell 50w volume control
14	10	BL-1	MiddleAtlantic blank panel
15	2	D2LK	MiddleAtlantic locking storage drawer
16	1	НМ	MiddleAtlantic premium rack screws (100)
17	1	SR-40-22	MiddleAtlantic wall rack
18	1	VFD-40	MiddleAtlantic locking vented front door
19	4	VT-1	MiddleAlantic vent panel
20	1	CX-602V	QSC 2x440w at 70v amplifier
21	1	CX-702	QSC 2x700w at 4 ohms amplifier
22	3	CX-1102	QSC 2x110w at 4 ohms amplifier
23	2	RG9913F-50	Sennheiser antenna cable
24	2	WM1	Sennheiser antenna mount kit
25	2	A2003-UHF	Sennheiser directional antenna
26	2	e845S	Sennheiser handheld mic w/switch

27	1	EW345G3-A	Sennheiser wireless handheld mic system
28	1	SKP100G3-A	Sennheiser wireless plug-on transmitter
29	1	EM300G3-A	Sennheiser wireless receiver
30	1	DFR-22	Shure 2x2 digital signal processor
31	1	SCM-810	Shure 9x1 mixer
32	1	UA-221	Shure dual 2x1 antenna splitters
33	1	CD-200i	Tascam CD player w/ iPod dock
34	1	DA-2	Whirlwind 2 x 8 distribution amplifier
35	1	WPX1B/2FD-MIC 3, 4	Whirlwind heavy duty mic jack wall plate
36	1	WPX1B/1FD-MIC 5	Whirlwind heavy duty mic jack wall plate
37	1	WPX1B/1FD-MIC 6	Whirlwind heavy duty mic jack wall plate
38	1	WPX1B/1FD-MIC 7	Whirlwind heavy duty mic jack wall plate
39	1	WPX1B/1MD-PA FEED 3	Whirlwind heavy duty output jack wall plate
40	1	WPX1B/2MD-PA FEED 4, 5	Whirlwind heavy duty output jack wall plate
41	1	WPX1B/2MD-PA FEED 6, 7	Whirlwind heavy duty output jack wall plate
42	1	WPX1B/1MD-PRESS FEED 8	Whirlwind heavy duty output jack wall plate
43	1	1RU/2RCA-AUX IN/2MD-PA FEED 1, 2	Whirlwind I/O panel
44	1	MST2R10	Whirlwind portable adapter cable
45	1	PodDI	Whirlwind portable transformer
46	4	MK420NP	Whirlwind portable microphone cable
47	10	MK402NP	Whirlwind XLR jumper cable
48	1	LOT-1	Misc. hardware, wiring & connectors as req'd
49	1	FREIGHT-1	TBD shipping & handling
50		LABOR-1	Admin - PM, Design & Engineering
51		LABOR-2	Tech - In Shop Prep & Travel
52		LABOR-3	Tech - On Site Install (Rack Build & Terminations)
53		LABOR-4	Tech - Commissioning (Tuning, Training)
54		MISC-1	Installation & Travel Expenses

ASSISTIVE LISTENING SYSTEM ADD / ALT:

REF	QTY	MODEL / PART #	MANUFACTURER / DESCRIPTION
57	1	LT-800-072	Listen ALS rack mounted transmitter
58	1	LA-326	Listen ALS rack kit
59	1	LA-122	Listen ALS antenna kit
60	16	LR-400-072	Listen ALS beltpack receiver
61	16	LA-362	Listen ALS rechargeable batteries
62	12	LA-165	Listen ALS beltpack headphones
63	4	LA-166	Listen ALS beltpack neckloop
64	1	LA-325-01	Listen ALS storage/charging case
65	1	LOT-3	Misc. hardware, wiring & connectors as req'd
66	1	FREIGHT-1	TBD shipping & handling
67		LABOR-6	Admin - PM, Design & Engineering
68		LABOR-7	Tech - In Shop Prep & Travel
69		LABOR-8	Tech - On Site Install (Rack Build & Terminations)
70		LABOR-9	Tech - Commissioning (Tuning, Training)
71		MISC-2	Installation & Travel Expenses

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation shall include delivery, unloading, setting in place, and inter-connecting wiring of system components, equipment alignment and adjustment and programming, and all other work whether or not expressly required herein which is necessary to result in complete operational systems. THE INSTALLATION OF ALL FIELD DEVICES, ALONG WITH THE INSTALLATION AND PROVISION OF ALL FIELD WIRING, RACEWAYS, BACKBOXES AND ASSOCIATED HARDWARE SHALL BE PROVIDED BY A LICENSED, ELECTRICAL CONTRACTOR EXPERIENCED WITH THE INSTALLATION OF PERFORMANCE SOUND SYSTEMS.
- B. All installation practices shall be in accordance with, but not limited to, this specification. Installation shall be performed in accordance with the applicable standards, requirements, and recommendations of National, State, and Local authorities having jurisdiction.
- C. During installation, and up to the date of System Acceptance, the Electrical Contractor shall be under obligation to protect the Sound System Contractor's finished and unfinished work against damage and loss. In the event of such damage or loss, the Electrical Contractor shall replace or repair such work at no cost to the Sound System Contractor.

3.2 SYSTEM ACCEPTANCE

- A. A physical inventory will be taken of all equipment on site and will be compared to equipment lists in the contract documents.
- B. The operation of all system equipment shall be demonstrated by the Sound System Contractor.
- C. All final "as built" drawings, cut sheets, manuals, and other required documentation shall be delivered in duplicate to Owner at this time.

3.3 TRAINING

A. The Sound System Contractor will provide on-the-job training by a qualified instructor, to instruct the Owner in the operation and maintenance of system. Owner is advised to provide system operators with basic sound system knowledge to be present at time of training. There shall be a minimum of two hours total training provided. This training may take place before, during and/or after System Acceptance.

END OF SECTION

SECTION 114000 - FOODSERVICE EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Fabricated equipment (stainless steel counter and wall shelf)
 - 2. Air Curtains (OWNER FURNISHED, CONTRACTOR INSTALLED)
 - 3. Utility distribution systems.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include the following:
 - 1. Manufacturer's model number.
 - 2. Accessories and components that will be included for Project.
 - 3. Clearance requirements for access and maintenance.
 - 4. Utility service connections for water, drainage, power, and fuel; include roughing-in dimensions.
- B. Shop Drawings: For fabricated equipment. Include plans, elevations, sections, roughing-in dimensions, fabrication details, utility service requirements, and attachments to other work.

1.4 INFORMATIONAL SUBMITTALS

A. Warranty: Samples of special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For foodservice equipment to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. NSF Standards: Provide equipment that bears NSF Certification Mark or UL Classification Mark certifying compliance with applicable NSF standards.

B. UL Certification: Provide electric and fuel-burning equipment and components that are evaluated by UL for fire, electric shock, and casualty hazards according to applicable safety standards, and that are UL certified for compliance and labeled for intended use.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of construction contiguous with foodservice equipment by field measurements before fabrication. Indicate measurements on Coordination Drawings.

1.8 COORDINATION

- A. Coordinate foodservice equipment layout and installation with other work, including layout and installation of lighting fixtures, HVAC equipment, and fire-suppression system components.
- B. Coordinate locations and requirements of utility service connections.
- C. Coordinate sizes, locations, and requirements of the following:
 - 1. Floor areas with positive slopes to drains.
 - 2. Floor sinks and drains serving foodservice equipment.

PART 2 - PRODUCTS

2.1 FABRICATED EQUIPMENT

- A. Stainless-Steel Shelf Units:
 - 1. Description: Wall mounted. Fabricate units of stainless steel, Type 304, 0.050 inch (1.27 mm) thick.
 - 2. Stainless-Steel Finish: Directional satin finish, No. 4.
 - 3. Location: Above 3 compartment sink. Match length of sink.
- B. Stainless-Steel Countertop
 - 1. Description: Flat-countertop.
 - a. Tops: Stainless steel, Type 316, 0.078 inch (1.98 mm) thick, reinforced and sound deadened.
 - 1) Edge: straight with hemmed edges.
 - b. Crossbracing and counter support: Metallic-coated steel tubing, bolted to wall.
 - c. Accessories: Stainless steel Grommets with finished edges (3)
 - 2. Stainless-Steel Finish: Directional satin finish, No. 4.

2.2 AIR CURTAINS (OWNER FURNISHED, CONTRACTOR INSTALLED)

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Berner International Corp. Drive-Thru Unit Air Door Model DTU1018AA or comparable product submitted prior to bidding.
- B. Description: Unheated 18" wide maximum with 1/12 HP motor with bracket. Powder coat extruded aluminum exterior cabinet.
- C. Location: 5 units at Concession.
- D. Units shall be wired with overhead coiling door and turn on when the door is opened.

2.3 UTILITY DISTRIBUTION SYSTEMS

- A. Utility Distribution Systems:
 - 1. Description: Overhead and Wall-mounted system.
 - 2. Accessories: 4" PVC piping for soda drink tubing mounted to wall and routed above ceiling. See plan for locations.

2.4 MISCELLANEOUS MATERIALS

- A. Installation Accessories, General: NSF certified for end-use application indicated.
- B. Elastomeric Joint Sealant: ASTM C 920; silicone. Type S (single component), Grade NS (nonsag), Class 25, Use NT (nontraffic) related to exposure, and Use M, G, A, or O as applicable to joint substrates indicated.
 - 1. Public Health and Safety Requirements:
 - a. Sealant is certified for compliance with NSF standards for end-use application indicated.
 - b. Washed and cured sealant complies with the FDA's regulations for use in areas that come in contact with food.
 - 2. Cylindrical Sealant Backing: ASTM C 1330, Type C, closed-cell polyethylene, in diameter greater than joint width.

2.5 FINISHES

- A. Stainless-Steel Finishes:
 - 1. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
 - 2. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - a. Run grain of directional finishes with long dimension of each piece.

- b. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
- B. Powder-Coat Finishes: Immediately after cleaning and pretreating, electrostatically apply manufacturer's standard, baked-polymer, thermosetting powder finish. Comply with resin manufacturer's written instructions for application, baking, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install foodservice equipment level and plumb, according to manufacturer's written instructions.
 - 1. Connect equipment to utilities.
 - 2. Provide cutouts in equipment, neatly formed, where required to run service lines through equipment to make final connections.
- B. Complete equipment assembly where field assembly is required.
 - 1. Provide closed butt and contact joints that do not require a filler.
 - 2. Grind field welds on stainless-steel equipment until smooth and polish to match adjacent finish.
- C. Install cabinets and similar equipment on bases in a bed of sealant.
- D. Install joint sealant in joints between equipment and abutting surfaces with continuous joint backing unless otherwise indicated. Produce airtight, watertight, vermin-proof, sanitary joints.

3.2 CLEANING AND PROTECTING

- A. After completing installation of equipment, repair damaged finishes.
- B. Clean and adjust equipment as required to produce ready-for-use condition.
- C. Protect equipment from damage during remainder of the construction period.

END OF SECTION 114000

SECTION 116660 SPORTS EQUIPMENT

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Provide equipment and materials, and do work necessary to construct or provide the following, as indicated on the Drawings and as specified. Work shall include but shall not be limited to:
 - 1. Softball Equipment
 - a. Backstop and Dugout Net Fabric
 - b. Vertical and Horizontal Backstop Cabling and Connections
 - c. Batting Tunnel / Cage netting system
 - d. Dugout Rail Padding
 - e. Wall Padding

1.2 SUBMITTALS

- A. Shop Drawings:
 - 1. Show application to project
 - 2. Show fabrication and installation of backstop assembly. Include plans, elevations, component details, and attachments to other Work.
- B. Provide sealed structural drawings by the qualified professional engineer, registered in the state of the project, for backstops.
- C. Product Data: Submit manufacturer's product data and samples as noted for the following:
 - 1. Backstop and Dugout Fabric Netting
 - a. 3 samples of netting one square ft each
 - b. Vertical and horizontal backstop cabling and connections
 - 2. Batting Tunnel Net Fabric
 - a. 3 samples of netting one square ft each
 - b. Tunnel cabling and connections
 - 3. Dugout Rail Padding
 - 4. Field Wall Padding

1.3 PERFORMANCE REQUIREMENTS

- A. Backstop System: Backstop support system shall be capable of supporting installed netting.
 - 1. Contractor to submit sealed shop drawings by State of South Carolina licensed engineer

1.4 QUALITY ASSURANCE

- A. Installer of outdoor sports equipment the playing field shall be the same Contractor.
- B. Backstop Installer Qualifications (Netting and cable system): An experienced installer who has completed backstop systems similar in material, design, and extent to that indicated for this Project and whose work has resulted in backstop installations with a record of successful in-service performance.
 - 1. Installers responsibilities: Installation of backstop assembly, including the following:
 - a. Cablings
 - b. Fittings
 - c. Netting
 - d. Re-Stretching If necessary 60 days after substantial completion
- C. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code-Steel," and AWS D1.3, "Structural Welding Code – Sheet Steel."

1.5 WARRANTY

- A. General Warranty: Special warranties specified in this Section shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
- B. Special Warranties:
 - 1. Equipment: Written warranties, executed by the manufacturer of each piece of equipment specified agreeing to repair or replace equipment or components that fail in materials or workmanship with specified warranty period.
 - 2. Backstop Netting: Installed netting shall prevent passage of batted or thrown ball. If netting fails to do so, installer shall adjust netting to appropriate tension.
 - a. Warranty Period: 3-years from Date of Substantial Completion.
 - 3. Batting Tunnel: Installed netting shall prevent passage of batted or thrown ball. If netting fails to do so, installer shall adjust netting to appropriate tension.
 - a. Warranty Period: 3-years from Date of Substantial Completion.
 - 4. Wall & Rail Padding:
 - a. Warranty period: 5-years from date of substantial completion.
 - b. Color fastness should be warrantied for five years from date of substantial completion.

PART 2 - PRODUCTS

2.1 SOFTBALL EQUIPMENT

- A. Backstop and Dugout Net Fabric
 - 1. Provide 1-3/4 inch square mesh netting that complies with the following:
 - a. Yarn Type: Dyneema or #18 Spectra Backstop Netting
 - b. Weight: #18 (0.0625 inches)
 - c. Minimum Strength: 350 pounds
 - d. Weather Treatment: Provide UV, weather treated, black netting and cord
 - e. Edge/Border Treatment: Dyneema Rope 12s, spliced and or woven to the edge. Provide net manufacturers standard cord for lacing netting to supports.
 - 2. Suppliers:
 - a. Burbank Sports Nets, (866) 349-0057, www.burbanksportsnets.com
 - b. West Coast Netting, Inc., www.westcoastnetting.com (888) 631-6387
 - c. Apex Screens and Netting, (888) 549-4344, www.apexsports.us
 - d. Carron Net, (800) 558-7768, www.carronnet.com
 - e. US Netting, www.usnetting.com
 - f. Approved Equal
- B. Vertical Backstop Cabling and Connections
 - 1. Provide the following materials and accessories:
 - a. Top and Vertical Cables: Dyneema Rope 12s.
 - b. Bottom Horizontal Cables: Stainless steel aircraft cable, 5/16" 7 x 19 strand.
 - c. Fittings: Stainless Steel.
 - d. Miscellaneous connection plates: ASTM A 36 steel, galvanized in accordance with ASTM A 153.
 - 2. Suppliers
 - a. Burbank Sports Nets, (866) 349-0057, www.burbanksportsnets.com
 - b. West Coast Netting, Inc., www.westcoastnetting.com (888) 631-6387
 - c. Apex Screens and Netting, (888) 549-4344, www.apexsports.us
 - d. Carron Net, (800) 558-7768, www.carronnet.com
 - e. US Netting, www.usnetting.com
 - f. Approved Equal

SPORTS EQUIPMENT

- C. Batting Tunnel / Cage Fabric Netting
 - 1. Provide the following:
 - a. 60' L x 14'H x 14'W. Knotted nylon, #60 heavy duty grade. One piece construction. Separation divider panel required in each cage. Three cages required.
 - b. Knotted Nylon Netting, Heavy duty grade, All Weather, UV and Weather Treated. Heavy duty 3/8" poly ropes sewn around the top perimeter, down the top center length to minimize sag, and down all 4 corner seams. "Pro Wrap" type doors and dividers
 - c. Requires Hardware kit for connections to batting tunnel cabels and Netting attachment clips. Three cables per cage, entire length of Building \pm 70'. Re: drawings for tunnel/fence/frame design. Nominal fastening height shall be 15'.
 - d. Each batting tunnel shall have a removable divider net at the mid-point of the 60'L tunnel.
 - e. Suppliers:
 - 1) Burbank Sports Net, (866) 349-0057, www.burbanksportsnets.com
 - 2) "Collegiate Series", Mid America Sports Advantage (800) 264-4519, www.masa.com
 - 3) Apex Screens and Netting, (888) 549-4344, www.apexsports.us
 - 4) Carron Net, (800) 558-7768, www.carronnet.com
 - 5) C and H Baseball (941) 727-1533, (www.chbaseball.com)
 - 6) Approved equal
 - 2. Provide the following:
 - a. Cage Net: Burbank Sport Nets Company or approved equal Weather resistant, Black #60 nylon cage 14 feet height by 14 feet wide by 60 feet long.
 - Cage Accessories: Burbank Sport Net Company or approved equal ¼" S.S. T304, 7 x 19 strand aircraft cable and hardware kit, galvanized shackles, turn-buckler and connections as required at all attachment points. 3" spring snaps and fasteners for manual sliding on cable system
 - c. Netting system as shown on drawings complete with pulleys, pull strings, connectors, cleats, etc per recommendations of the manufacturer.
 - d. Suppliers:
 - 1) Burbank Sports Nets, Dyneema Netting, (866) 349-0057, www.burbanksportsnets.com

- 2) Carron Net, (800) 558-7768, www.carronnet.com
- 3) Apex Screens and Netting, (888) 549-4344, www.apexsports.us
- 4) C and H Baseball (941) 727-1533, (www.chbaseball.com)
- 5) Approved equal
- D. Dugout Rail Padding
 - 1. 18oz. vinyl covered, 1" thick, 2-1/4" I.D., Brass Grommets every 6 inches. Color "garnet" (custom color to match architect's sample).
 - 2. Product:
 - a. Beacon Rail Padding Kit, Beacon
 - b. Model GRP-8, CH Baseball
 - c. Approved equal
 - 3. Supplier:
 - a. Beacon Ballfields, (800) 747-5985
 - b. Sportsfield Specialties, Inc (www.sportsfieldspecialties.com)
 - c. C and H Baseball (941) 727-1533, (www.chbaseball.com)
 - d. Mid America Sports Advantage (800) 264-4519, (www.masa.com)
 - e. Approved Equal.

E. Field Wall Padding

- 1. Vinyl Covering: 18 oz High UV Laminated Vinyl. Color "black".
- 2. Padding: density polyurethane, 3" thick high
- 3. Backer Board: 1/2 inch Moisture Resistant Composite Wood
- 4. Wall padding height shall be as noted on the drawings.
- 5. Attachment: Z clips for wall pads.
- 6. Hardware: Stainless Steel
- 7. Products:
 - a. Basezone, Sportsfield Specialties
 - b. Model PWPZ100, C&H Baseball
 - c. Burbank Sports Nets
 - d. Approved equal
- 8. Suppliers:
 - a. Sportsfield Specialties, Inc (www.sportsfieldspecialties.com)
 - b. Approved equal

SPORTS EQUIPMENT

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install in accordance with manufacturers recommendations and approved shop drawings.
- B. Softball Equipment
 - 1. Backstop and Dugout Netting:
 - a. Install cable and fittings as indicated on the Drawings
 - b. Install backstop fabric netting and appurtenances as per the recommendations of the manufacturer and approved shop drawings.
 - c. Lace net to all perimeter and interior backstop cabling from the center out to the edges and from the top down. Install net after backstop cabling has been tightened in place.
 - 1) Re-stretch netting six weeks after initial installation.
 - d. Netting shall be installed by an installer acceptable to the manufacturer.
 - e. Tension of installed netting shall be as recommended by the manufacturer to prevent passage of batted or thrown ball.
 - 1) Tension of vertical netting shall be such that balls do not become trapped in netting system.
 - 2) Tension of vertical netting shall be such to protect spectators in first row.
 - f. Do not attach netting to rigid structural pipe supports.
 - g. Contractor to return after 60 days to retighten netting as required.
 - 2. Batting Tunnel/Cage Netting:
 - a. Fasten netting system to support cables.
 - 1) Netting to be fastened so that it is a minimum of 18" clear from all vertical posts. Do not attach netting to rigid vertical pipe supports.
 - b. Install system and hardware per manufacturer's recommendations.
 - c. Contractor to return after 60 days to retighten netting as required.
 - 3. Wall & Rail Padding:
 - a. Fasten wall pads securely with Z clips as shown on plans. Each pad section shall abut the adjoining pad with no gaps.
b.

Rail pads shall fasten securely to rails with hidden Velcro strips, zip ties or other exposed fasteners are NOT acceptable. Each pad segment abut the adjacent segment tightly with no gaps.

END OF SECTION



Project Manual

University of South Carolina Softball Stadium Construction

Columbia, SC

Architect's Project Number: 11.122.00 State Project Number: H27-6088-MJ

BID SET

03.16.12

Volume 2

Quackenbusharchitects.com

SECTION 00 01 00 - TABLE OF CONTENTS

The complete Project Manual for this project consists of this entire bound volume which is not to be separated for any reason. The Architect and Owner will not be responsible for any assumptions made by a Contractor or Subcontractor who does not receive a complete bound Project Manual containing all sections and documents listed in the Table of Contents.

The following listed documents comprise the Project Manual for University of South Carolina Softball Stadium Construction. Where numerical sequence of Sections or Divisions is interrupted, such interruptions are intentional.

PROJECT NUMB	ER: H27-6088-MJ	
Section No.	Section Title	Number of Pages

VOLUME 1

DIVISION 00 – BIDDING AND CONTRACT REQUIREMENTS

INTRODUCTO	RY INFORMATION	
	Cover Page	1
	Project Directory	1
	Seals Pages	4
	Project Manual Table of Contents	6
BIDDING REQ	UIREMENTS	
	Invitation to Bids (Request for Advertisement SE-310)	1
	Instructions to Bidders (AIA Document A701 – 1997 Edition) 00201-OSE Standard Supplementary Instructions to Bidders (2011 Ed)	1 10
	Bid Bond (AIA Document A301)	1
	Standard Bid Form (SE-330-2011 Edition)	6
CONTRACTIN	G REQUIREMENTS	
	Standard Form of Agreement between Owner and Contractor (AIA	
	Document A101-2007 Edition)	1
	00501-OSE Standard Modifications to Agreement Between Owner and	
	Contractor AIA A101-201 (2011 Edition)	3
	General Conditions of the Contract for Construction	
	(AIA Document A201-2007 Edition)	1
	00811 – Standard Supplementary Conditions (2011 Edition)	
	(Supplement to AIA Document A201-2007 Edition General Conditions	
	of the Contract)	25
	USC Supplemental General Conditions for Construction Projects	3
	Performance Bond (SE-355-2011 Edition)	2
	Labor and Material Payment Bond (SE-357-2011 Edition)	2
	Construction Change Order (SE-480 2011 Edition)	1
	Contractor's One Year Guarantee	1

Contractor's One Year Guarantee

00 01 15	List of Drawing Sheets	4
00 31 32	Geotechnical Data	1
	GS2 Report Dated October 31, 2011	49
DIVISION 1	CENEDAL DECHIDEMENTS	
	GENERAL REQUIREMENTS	11
01 21 00	Allowances	11
01 21 00 01 23 00	Altornates	3
01 25 00	Substitution Procedures	2
01 25 00	Contract Modification Procedures	4
01 20 00	Payment Procedures	5
01 29 00	Project Management and Coordination	10
01 32 00	Construction Progress Documentation	10
01 32 00	Submittal Procedures	12
01 55 00	Request for Electronic Drawing Files	12
01 40 00	Quality Paquiroments	1
01 40 00	Quanty Requirements Solomic Doquirements - Quality Assurance Dian	9 1
	Seisinic Requirements – Quanty Assurance Fran Contractor's Statement of Posponsibility Solismic Quality Assurance	1
	Statement of Spacial Inspections	1
01 42 00	Pafaranaaa	ے 15
01 42 00	Temperary Escilities and Controls	13
01 50 00	Product Poquirements	5
01 00 00	Field Engineering	J 1
01 71 23	Execution	1
01 73 00	Closeout Procedures	10
01 77 00	Closeour Flocedures Operation and Maintenance Data	0
01 78 20	Droiget Record Documents	1
01 78 39	Demonstration and Training	4
01 /9 00	Demonstration and Training	4
DIVISION 2	– EXISTING CONDITIONS	
02 41 16	Structure Demolition	7
	Hazardous Material Test Reports	16
DIVISION 3	- CONCRETE	
03 30 00	Cast-In-Place Concrete	17
03 30 05	Cast-In-Place Concrete for Sitework	16
DIVISION 4	MASONDV	
04 20 00	Unit Masonry	20
$04\ 20\ 00$	Cast Stone Masonry	20
04 72 00	Cast Stone Wasoni y	7
DIVISION 5	– METALS	
05 21 00	Structural Steel	9
05 31 00	Steel Deck	4
05 40 00	Cold Formed Metal Framing	3
05 50 00	Metal Fabrications	10
05 51 00	Metal Stairs	8
05 52 13	Pipe and Tube Railings	10
57 00 00	Decorative Metal	10

DIVISION 6 -	WOOD & PLASTICS	
06 10 53	Miscellaneous Rough Carpentry	5
06 16 00	Sheathing	6
06 41 13	Wood-Veneer-Faced Architectural Cabinets	8
DIVISION 7 –	THERMAL & MOISTURE PROTECTION	
07 11 13	Bituminous Dampproofing	3
07 13 26	Self-Adhering Sheet Waterproofing	6
07 13 26.1	Self-Adhering Sheet Waterproofing (Walls)	6
07 19 00	Concrete Sealers and Water Repellents	4
07 21 00	Thermal Insulation	6
07 24 13	Polymer-Based Exterior Finish System (DEFS)	7
07 25 00	Weather Barriers	3
07 26 00	Under Slab Vapor Barrier	3
07 41 13.16	Standing Seam Metal Roof Panels	12
07 42 13.23	Metal Composite Material Wall Panels	9
07 52 16	Styrene-Butadiene-Styrene (SBS) Modified Bituminous Membrane Roofing	13
07 54 19	Polyvinyl-chloride (PVC) Roofing	10
07 62 00	Sheet Metal Flashing and Trim	12
07 81 00	Applied Fireproofing	6
07 84 46	Fire-Resistive Joint Systems	6
07 92 00	Joint Sealants	11
DIVISION 8 -	DOORS & WINDOWS	
08 11 13	Hollow Metal Doors and Frames	10
08 14 16	Flush Wood Doors	7
08 31 13	Access Doors and Frames	4
08 33 13	Coiling Counter Doors	5
08 33 23	Overhead Coiling Doors	9
08 36 13	Sectional Doors	10
08 43 13	Aluminum-Framed Entrances and Storefront	11
08 51 13`	Aluminum Windows	6
08 56 00	Ticket Windows	6
08 71 00	Door Hardware	28
08 80 00	Glazing	13
08 90 00	Louvers and Vents	8
DIVISION 9 –	FINISHES	
09 21 16.23	Gypsum Board Shaft Wall Assemblies	4
09 22 16	Non-Structural Metal Framing	6
09 29 00	Gypsum Board	8
09 30 00	Tiling	11
09 51 13	Acoustical Panel Ceilings	9
09 65 13	Resilient Base and Accessories	6
09 91 13	Exterior Painting	9
09 91 23	Interior Painting	9

DIVISION 1	0 – SPECIALTIES	
10 11 00	Visual Display Surfaces	6
10 21 13	Toilet Compartments	5
10 21 16	Shower and Dressing Compartments	6
10 28 00	Toilet and Bath Accessories	5
10 44 13	Fire Extinguisher Cabinets	7
10 44 16	Fire Extinguishers	4
10 51 13	Metal Lockers	8
10 73 00	Aluminum Walkway Covers	7
10 75 00	Flagpoles	5
DIVISION 1	1 – EQUIPMENT	
113200	Softball Facility Sound System	6
114000	Food Service Equipment	4
116660	Sports Equipment	7
VOLUME	2	
DIVISION 12	2 – FURNISHINGS	
12 24 13	Roller Window Shades	5
12 36 61	Simulated Stone Countertops	3
12 63 00	Stadium Seating	7
DIVISION 1	3 – SPECIAL CONSTRUCTION	
13 34 19	Metal Building Systems	16
DIVISION 14	4 – CONVEYING SYSTEMS	
14 24 00	Hydraulic Elevators	11
DIVISION 2	1 – FIRE SUPPRESSION	
21 13 13	Fire Protection Sprinkler System	13
	Fire Sprinkler Specification Sheet	1
DIVISION 2	2 – PLUMBING	
22 05 13	Common Motor Requirements for Plumbing Equipment	3
22 05 17	Sleeves and Seals for Plumbing Piping	4
22 05 18	Escutcheons for Plumbing Piping	2
22 05 19	Meters and Gages for Plumbing Piping	6
22 05 23	General-Duty Valves for Plumbing Piping	11
22 05 29	Hangers and Supports for Plumbing Piping	12
22 05 33	Heat Tracing for Plumbing Piping	4
22 05 48	Vibration and Seismic Controls for Plumbing Piping and Equipment	11
22 05 53	Identification for Plumbing Piping and Equipment	6
22 07 16	Plumbing Equipment Insulation	24
22 07 19	Plumbing Piping Insulation	23
22 11 16	Domestic Water Piping	15
22 11 19	Domestic Water Piping Specialties	16
22 11 23	Domestic Water Pumps	5
22 13 16	Sanitary Waste and Vent Piping	14

University of South Carolina Softball Stadium Construction BID SET		Architect's Project No. 11.122.00 State Project No. H27-6088-MJ 03/16/12	
22 13 19	Sanitary Waste Piping Specialties		14
22 14 13	Facility Storm Drainage Piping		12
22 14 23	Storm Drainage Piping Specialties		5
22 33 00	Electrical. Domestic-Water Heaters		6
22 40 00	Plumbing Fixtures		19
DIVISION 23 – H	EATING VENTING AND AIR CONDITIONING	G (HVAC)	
23 05 00	Mechanical and Electrical General Provisions		21
23 05 13	Common Motor Requirements for HVAC Equipme	ent	3
23 05 29	Hangers and Supports for HVAC Piping and Equip	ment	6
23 05 48	Vibration and Seismic Controls for HVAC Piping a	and Equipment	10
23 05 53	Identification for HVAC Piping and Equipment		6
23 05 93	Testing, Adjusting, and Balancing for HVAC Syste	ems	15
23 07 13	Duct Insulation		20
23 09 10	Automatic Temperature Control Instrumentation		24
23 23 00	Refrigerant Piping		8
23 31 13	Metal Ducts		19
23 33 00	Air Duct Accessories		19
23 34 23	HVAC Power Ventilators		7
23 37 13	Diffusers, Registers, and Grilles		6
23 81 26	Heating and Air Conditioning Equipment		15
23 82 39	Unit Heaters		7
DIVISION 26 – El	LECTRICAL		
26 05 19	Low-Voltage Electrical Power Conductors and Cab	bles	4
26 05 26	Grounding and Bonding for Electrical Systems		3
26 05 29	Hangers and Supports for Electrical Systems		5
26 05 33	Raceway and Boxes for Electrical Systems		8
26 05 43	Underground Ducts and Raceways for Electrical Sy	vstems	8
26 05 48	Vibration and Seismic Controls for Electrical Syste	ms	7
26 05 53	Identification for Electrical Systems		10
26 05 73	Overcurrent Protective Device Coordination Study		7
26 22 00	Low-Voltage Transformers		5
26 24 13	Switchboards		10
26 24 16	Panelboards		7
26 27 26	Wiring Devices		6
26 28 13	Fuses		4
26 28 16	Enclosed Switches and Circuit Breakers		6
26 36 00	Transfer Switches		2
26 51 00	Interior Lighting		9
26 56 00	Exterior Lighting		7
26 56 10	Softball Field Lighting System		12
DIVISION 27 – C	OMMUNICATIONS		
27 05 36	Cable Trays for Communication Systems		6
DIVISION 28 – El	LECTRONIC SAFETY AND SECURITY		
28 31 11	Digital, Addressable Fire-Alarm System		15

DIVISION 31 – EARTHWORK

31 11 00	Clearing and Grubbing	1
31 22 00	Site Grading	7
31 22 00.1	Playing Field Earthwork	5
31 23 16.16	Excavating, Backfilling for Structures	8
31 23 33	Trenching, Backfilling for Utilities	8
31 25 13	Erosion and Sediment Control	3
31 31 16	Termite Control	4
DIVISION 32 -	- EXTERIOR IMPROVEMENTS	
32 11 23	Stone Base Course	4
32 11 25	Synthetic Turf Base Course	5
32 31 13.25	Color Chain Link Fence System	6
32 31 19	Decorative Metal Fences and Gates	4
32 92 13	Grassing	4
32 92 30	Synthetic Turf	10
32 92 31	Playing Field Materials and Mixtures	4

DIVISION 33 – UTILITIES

33 01 00	Sewers: Sanitary, Gravity	7
33 11 00	Water Distribution System	11
33 41 00	Sewers: Storm Drainage	8

END OF SECTION

SECTION 122413 - ROLLER WINDOW SHADES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Manually operated roller shades with single rollers.
- B. Related Requirements:
 - 1. Section 061053 "Miscellaneous Rough Carpentry" for wood blocking and grounds for mounting roller shades and accessories.
 - 2. Section 079200 "Joint Sealants" for sealing the perimeters of installation accessories for light-blocking shades with a sealant.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include styles, material descriptions, construction details, dimensions of individual components and profiles, features, finishes, and operating instructions for roller shades.
- B. Shop Drawings: Show fabrication and installation details for roller shades, including shadeband materials, their orientation to rollers, and their seam and batten locations.
- C. Samples for Initial Selection: For each type and color of shadeband material.
 - 1. Include Samples of accessories involving color selection.
- D. Samples for Verification: For each type of roller shade.
 - 1. Shadeband Material: Not less than 3 inches (76 mm) square. Mark inside face of material if applicable.
- E. Roller-Shade Schedule: Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Certificates: For each type of shadeband material, signed by product manufacturer.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roller shades to include in maintenance manuals.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver roller shades in factory packages, marked with manufacturer, product name, and location of installation using same designations indicated on Drawings.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not install roller shades until construction and finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operating hardware of operable glazed units through entire operating range. Notify Architect of installation conditions that vary from Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. <u>Basis-of-Design Product</u>: Subject to compliance with requirements, provide **MechoShade Systems, Inc.** or comparable product by one of the following:
 - 1. <u>Draper Inc</u>.
 - 2. <u>Hunter Douglas Contract</u>.
 - 3. <u>Nysan Solar Control Inc.; Hunter Douglas Company</u>.
- B. Source Limitations: Obtain roller shades from single source from single manufacturer.

2.2 MANUALLY OPERATED SHADES WITH SINGLE ROLLERS

A. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.

- 1. Bead Chains: Stainless steel.
 - a. Loop Length: Full length of roller shade.
 - b. Limit Stops: Provide upper and lower ball stops.
 - c. Chain-Retainer Type: Clip, jamb mount.
- B. Spring Operating Mechanisms: Roller contains spring sized to accommodate shade size indicated. Provide with positive locking mechanism that can stop shade movement at each half-turn of roller and with manufacturer's standard pull.
 - 1. Pole: Manufacturer's standard type in length required to make operation convenient from floor level and with hook for engaging pull.
- C. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.
 - 1. Roller Drive-End Location: Right side of inside face of shade or Left side of inside face of shade.
 - 2. Direction of Shadeband Roll: Regular, from back of roller.
 - 3. Shadeband-to-Roller Attachment: Removable spline fitting integral channel in tube.
- D. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.
- E. Shadebands:
 - 1. Shadeband Material: Light-filtering fabric.
 - 2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.
 - a. Type: Enclosed in sealed pocket of shadeband material.
- F. Installation Accessories:
 - 1. Exposed Headbox: Rectangular, extruded-aluminum enclosure including front fascia, top and back covers, endcaps, and removable bottom closure.
 - a. Height: Manufacturer's standard height required to enclose roller and shadeband when shade is fully open, but not less than 4 inches (102 mm).
 - 2. Endcap Covers: To cover exposed endcaps.
 - 3. Installation Accessories Color and Finish: As selected from manufacturer's full range.

2.3 SHADEBAND MATERIALS

A. Shadeband Material Flame-Resistance Rating: Comply with NFPA 701. Testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

- B. Light-Filtering Fabric: Woven fabric, stain and fade resistant.
 - 1. Source: Roller-shade manufacturer.
 - 2. Type: TPO fabric, non-PVC (TPO for both core yarn and jacket, single thickness, non-raveling
 - 3. Weave: Basketweave.
 - 4. Thickness: 0.030 inch
 - 5. Orientation on Shadeband: Up the bolt.
 - 6. Openness Factor: 3 percent.
 - 7. Color: EcoVeil 1570 Shadow Grey

2.4 ROLLER-SHADE FABRICATION

- A. Product Safety Standard: Fabricate roller shades to comply with WCMA A 100.1, including requirements for flexible, chain-loop devices; lead content of components; and warning labels.
- B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F (23 deg C):
 - 1. Outside of Jamb Installation: Width and length as indicated, with terminations between shades of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.
- C. Shadeband Fabrication: Fabricate shadebands without battens or seams to extent possible except as follows:
 - 1. Vertical Shades: Where width-to-length ratio of shadeband is equal to or greater than 1:4, provide battens and seams at uniform spacings along shadeband length to ensure shadeband tracking and alignment through its full range of movement without distortion of the material.
 - 2. Railroaded Materials: Railroad material where material roll width is less than the required width of shadeband and where indicated. Provide battens and seams as required by railroaded material to produce shadebands with full roll-width panel(s) plus, if required, one partial roll-width panel located at top of shadeband.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ROLLER-SHADE INSTALLATION

- A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions.
 - 1. Opaque Shadebands: Located so shadeband is not closer than 2 inches (51 mm) to interior face of glass. Allow clearances for window operation hardware.

3.3 ADJUSTING

A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.4 CLEANING AND PROTECTION

- A. Clean roller-shade surfaces after installation, according to manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that roller shades are without damage or deterioration at time of Substantial Completion.
- C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

END OF SECTION 122413

SECTION 123661 - SIMULATED STONE COUNTERTOPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:1. Solid-surface-material countertops and backsplashes.
- B. Related Sections:
 - 1. Section 064113 "Wood-Veneer-Faced Architectural Cabinets" and Section 064116 "Plastic-Laminate-Faced Architectural Cabinets" for base cabinets to receive simulated stone countertops.

1.3 ACTION SUBMITTALS

- A. Product Data: For countertop materials.
- B. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.
- C. Samples for Initial Selection: For each type of material exposed to view.
- D. Samples for Verification: For the following products:
 - 1. Countertop material, <u>6 inches</u> (150 mm) square.
 - 2. One full-size solid-surface-material countertop, with front edge, 8 by 10 inches (200 by 250 mm), of construction and in configuration specified.

1.4 **PROJECT CONDITIONS**

A. Field Measurements: Verify dimensions of countertops by field measurements after base cabinets are installed but before countertop fabrication is complete.

1.5 COORDINATION

A. Coordinate locations of utilities that will penetrate countertops or backsplashes.

PART 2 - PRODUCTS

2.1 SOLID-SURFACE-MATERIAL COUNTERTOPS

- A. Configuration: Provide countertops with the following front and backsplash style:
 - 1. Front: Straight, slightly eased at top.
 - 2. Backsplash: Straight, slightly eased at corner.
 - 3. Endsplash: Matching backsplash.
- B. Countertops: 1/2-inch- (12.7-mm-) thick, solid surface material with front edge built up with same material.
- C. Backsplashes: 1/2-inch- (12.7-mm-) thick, solid surface material.
- D. Fabrication: Fabricate tops in one piece with shop-applied edges unless otherwise indicated. Comply with solid-surface-material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.
 - 1. Fabricate with loose backsplashes for field assembly.

2.2 SOLID-SURFACE-MATERIAL WINDOW SILLS

- A. Configuration: Provide window sills as detailed in the A7 series.
 - 1. Front: Straight, slightly eased at top.
- B. Window Sills: 1/2-inch- (12.7-mm-) thick, solid surface material.
- C. Fabrication: Fabricate tops in one piece with shop-applied edges unless otherwise indicated. Comply with solid-surface-material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.

2.3 COUNTERTOP MATERIALS

- A. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.
- B. Solid Surface Material: Homogeneous solid sheets of filled plastic resin complying with ANSI SS1.
 - 1. <u>Manufacturers</u>: Subject to compliance with requirements, provide products by one of the following:
 - a. <u>E. I. du Pont de Nemours and Company</u>.
 - b. <u>Formica Corporation</u>.
 - c. <u>Wilsonart International</u>.
 - 2. Type: Provide Standard Type unless Special Purpose Type is indicated.

3. Colors and Patterns: As indicated by manufacturer's designations.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install countertops level to a tolerance of 1/8 inch in 8 feet (3 mm in 2.4 m).
- B. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Pre-drill holes for screws as recommended by manufacturer. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
 - 1. Install backsplashes and endsplashes to comply with manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.

END OF SECTION 123661

SECTION 126300 – STADIUM SEATING

PART 1 GENERAL

1.1 SUMMARY

- A. Work includes the following:
 - 1. Fixed Chair Seating: Furnish and install fixed chairs as specified, floor and riser mounted, with self-lifting seat that rises to a uniform 3/4 safety fold position. Refer to Sheet A1.2A for quantities required.
 - 2. Extruded Aluminum Plank Seating: Furnish and install fixed plank seating as specified, riser mounted with brackets. Refer to Alternate No.1.
- B. Related Sections:
 - 1. Section 012300, ALTERNATES; Description of alternates.

1.2 SUBMITTALS

- A. Product data for each chair and plank model specified to include construction details, material descriptions and finish options
- B. Seating layout (shop drawings) developed from the contract drawings that show aisle widths, chair and plank spacing for each row, row-lettering and chair-numbering scheme, chair dimensions and back pitch. Layout drawings to also include locations for accessories, accessibility provisions and attachments to other work.
- C. Samples for verification & finish selection to include:
 - 1. Chairs:
 - a. Initial finish selections to be made from custom color.
 - b. Final powder coat selection to be approved from samples not less than 1 in. x 3 in.
 - c. Final plastic color selection to be approved from samples not less than 2 in. x 3 in.
 - d. Full size chair sample to be provided for final selection by Owner
 - 2. Planks:
 - a. 12 in. long by full width sample, showing specified finish.
- D. Maintenance instructions and inspection guidelines furnished for each chair and plank model specified.
- E. Manufacturers standard warranty.

1.3 QUALITY ASSURANCE

- A. Source Limitations:
 - 1. Obtain each type of fixed seating required, including accessories and mounting components, from a single manufacturer for each type.

1.4 PROJECT CONDITIONS

A. Field Measurements: Take field measurements to verify or supplement dimensions indicated on contract drawings prior to manufacturing.

1.5 PROJECT COORDINATION:

- A. Do not deliver or install seating until space is free of lifts and/or scaffolding used by other trades which may interfere with installation and/or damage seating.
- B. Coordinate concrete requirements needed for proper installation.

1.6 WARRANTY:

- A. Provide a manufacturer's warranty covering the material and workmanship for the specified warranty period from date of final acceptance.
- B. Chair Warranty Periods:
 - 1. Structural Components: one year.
 - 2. Operating Mechanisms: one year.
 - 3. Plastic and Painted Components: one year.
- C. Plank Warranty Periods:
 - 1. One year.

PART 2 PRODUCTS

2.1 CHAIR MATERIALS AND FINISHES:

- A. Cast Iron shall meet requirements for ASTM A 48/A 48M, Class 30, gray iron castings free of blow holes and hot checks with parting lines ground smooth.
- B. Prior to powder coating, metal and cast iron parts shall be treated with a zinc phosphate cleaning process for superior finish adhesion. All cast iron and steel parts shall be coated with a corrosion inhibiting primer to a minimum thickness of 1 mil. The hybrid thermosetting powder coat finish shall be applied by electrostatic means to a thickness of 2 5 mils. After coating, parts shall be oven baked to create a durable finish that meets the following test standards for weathering and corrosion:
 - 1. No blistering, cracking, de-lamination or chalking

- 2. 5 Year South Florida or 10 Year South Florida (2800MJ EMMAQUA)
- 3. Delta $E \le 5$ when tested per ASTM D2244
- 4. Loss of Gloss at a minimum of:
 - 40% for 5 Year South Florida Powders when tested to ASTM D523
 - 50% for 10 Year South Florida Powders when tested to ASTM D523
- 5. No greater than a No. 8 rating for colors and a No. 6 rating for whites per ASTM D4214, test method A
- 6. Cross Hatch Adhesion of 5B (No Loss) per ASTM D3359B
- 7. Pencil Hardness with a minimum rating of 2H per ASTM D3363
- 8. Front impact of at least 80in-lbs when tested per ASTM D2794
- 9. No more than 5% rust after 1500 hours tested per ASTM B117

9.1. Any perceived blistering, cracking, or de-lamination at no less than a scribe rating of 7 (1/16" or 2mm maximum creep) per ASTM D1654

Color shall be custom color to match Architect's sample.

- C. Molded Plastics:
 - 1. Structural components shall be mar and dent resistant high density glass-filled polypropylene with UV stabilizers.
 - 2. Decorative components shall be mar and dent resistant high density polyethylene (HDPE) with UV stabilizers.
 - 3. Plastic components color shall be custom color to match Architect's sample.

2.2 FIXED STADIUM CHAIR SEATING

- A. Permanent arrangement of fixed audience seating as shown on seating layout drawings.
 - 1. Approved manufacturers subject to compliance with requirements outlined herein.
 - 2. Basis-of-design for fixed audience seating is 39B.47S.35 Senator Chair as manufactured by Irwin Seating, or approved equal product by one of the following:
 - a. American Seating
 - b. Camatic Seating.
 - c. Hussey Seating.
 - d. Irwin Seating.
- B. Anchor Bolts: Chair manufacturer shall provide stainless steel expansion or chemical anchor bolts for mounting chairs. Provide all materials required for a complete seating installation.
- C. Plastic Components: Plastic seat and back components shall be double-wall construction, high-density polyethylene plastic formulated with ultra-violet inhibitors to minimize chalking and fading of finish colors. Surface finish shall be a custom color matching Architect's sample.

- D. Standards shall be one-piece Class 30 cast gray iron standards, featuring a gently curved, contemporary closed-loop design. Standards shall be cast to provide exceptional strength and to maintain proper height and angle for seats and backs and to provide proper clearance of the riser face. Standards shall be cast with integral blocks for back and seat attachment. Armrests shall also be an integral part of the standards castings, providing a comfortably wide, scrolled arm support.
 - 1. Standards: Provide standards riser mounted unless floor mounted required. Provide manufacturer's standard "low riser" unit if required to accommodate concrete substrate.
 - a. Provide manufacturer's standard cast iron or cast aluminum design.
 - b. If required, provide steel transfer plate to accommodate concrete substrate anchorage.
 - c. Provide custom logo inserts at end of row standards. Logo shall match "Gamecocks" team logo in raised, three dimensional pattern; right and left hand applications.
- E. Hinge Mechanism: Provide automatic lifting of the seat to a ³/₄ fold position, allowing for manually lifting the seat to a full fold position. Hinge mechanism shall perform to the requirements of ASTM F851.
- F. Chair width shall vary between 19-inches and 22-inches to accommodate sightlines and row lengths. Maximize the quantity of 21-inch chairs in each row. Install as many chairs as possible, but no less than the quantity indicated on the Architectural drawings.
- G. Back pitch shall be fixed as shown on seating layout drawings.
- H. A numbering system shall be provided for identification of all chairs. Number and letter plates shall be furnished as shown on the approved seating layout, and shall be 1-3/4 in. x 2-3/4 in. elliptical-shaped anodized aluminum. Number plates shall be located in a molded recess in the upper corner of the back, while row letters shall be located on a raised land on the side of the aisle standards. Number and letter plates shall be attached with bright-plated matching hardware.
- I. Cupholders shall be provided and attached to the rear of each chair in locations detailed on the seating layout drawings and shall be HDPE molded plastic. Provide no cupholders on backs of back row. Provide armrest mounted cupholders at front row seats and at accessible seats. Upper opening diameter of the molded cupholder shall be 3-3/4 in., with a bottom restriction to accommodate a variety of container sizes.
- J. Accessible Seating:
 - 1. Shall be designated on the seating layout drawings and designed to allow an individual to transfer from a wheelchair to the theatre chair. The aisle standard shall be equipped with an armrest capable of lifting to a position parallel with the chair back, opening sideways access to the seat. Aisle standards so equipped shall be provided with a label, displaying an easily recognizable "handicapped" symbol. Decorative requirements of aisle standards are waived for the handicapped access standards.

- 2. Easy Access Chairs: Provide end standard with hinged armrest to allow access to the chair from the side. Armrest height shall match fixed stadium chairs. Provide quantity equal to one percent of overall seating capacity, evenly distributed throughout the seating bowl. Aisle standards so equipped shall be provided with a label, displaying an easily recognizable "handicapped" symbol. Decorative requirements of aisle standards are waived for the handicapped access standards.
- K. Extra Stock: Furnish extra materials from the same production run that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Seats and Backs: Furnish complete seat and back assemblies equal to 2% of amount installed for each type and size of chair seat and back.
 - 2. Center Standards: Furnish center standards equal to 2% of amount installed for each type of center standard.
 - 3. End Standards: Furnish end standards equal to 2% of amount installed for each type of end standaerd.
 - 4. Cupholders: Furnish cupholders equal to 2% of amount installed for each type of cupholder.
 - 5. Hinge Components: Furnish hinge components equal to 2% of amount installed for each type of hinge component.
 - 6. Fasteners and Mounting Hardware: Furnish fasteners and mounting hardware equal to 10% of amount installed for each type of fastener and mounting hardware.
 - 7. Easy Access Armrests: Furnish easy access armrests equal to 2% of amount installed for each type of easy access armrest.
 - 8. Row Identification Plates: Furnish row identification plates equal to 5 each for each type of row identification plates.
 - 9. Seat Identification Plates: Furnish seat identification plates equal to 5 each for each type of seat identification plates.

2.3 CHAIR FABRICATION

- A. Fabricate floor attachment plates to conform to floor slope, if any, so that standards are plumb and chairs are maintained at same angular relationship to vertical throughout project.
- B. Fabricate riser attachment plates to conform to riser heights so that standards are plumb and chairs are maintained at same angular relationship to vertical throughout project.

2.4 EXTRUDED ALUMINUM BENCH SEATING

- A. Provide extruded aluminum bench seating planks from one of the following, or approved equal:
 - 1. Aluminum Seating, Inc.
 - 2. Dant Clayton.
 - 3. Southern Bleacher Company.

- B. Plank Seats, Basis of Design: Provide Model No. 2x12RS-13315 seat plank with Die No. 7969 aluminum back-rest, as manufactured by Southern Bleacher Company, or approved equal from another specified manufacturer. Seat benches shall be 6063-T6 extruded aluminum with a fluted surface matching the model specified. The size of seatboard is 2 in. x 12 in. (nom.). Back-rest shall be 2 in. x 6 in. with a 5-1/2 in. height. Aluminum shall be cleaned, pre-treated and powder coated in custom color selected by Architect.
- C. Seat benches shall be attached to concrete steps by use of manufacturer's standard "L" mounting brackets which are made of hot-dip galvanized structural steel, fully welded and powder coated in custom color selected by Architect. Tread mounted "Z" brackets are not acceptable and strictly prohibited. "L" mounting brackets shall be attached to vertical rise with stainless steel expansion or chemical anchors.
- D. Seat Numbers: Provide seat numbers at all bench seating. Coordinate numbering with Owner's seating plan. Provide as follows:
 - 1. Decals with black lettering on aluminum field.
 - 2. Rows: Numerals or alphabetical letters as directed by Owner.
 - 3. Seat Numbers: Numerals.
- E. Finishes: Provide as follows:
 - 1. Aluminum Components: Manufacturer's standard clear anodized finish.
 - 2. Steel Brackets: Powder-coated with manufacturer's standard powder-coat finish in custom color selected by Architect. Powder coat finish shall be electrostatically applied to minimum 3-4 mils thickness.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Prior to layout and installation examine floors, risers, and other adjacent work and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the work including, but not limited to, plumb of riser faces and concrete conditions.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CHAIR INSTALLATION

- A. Install seating in locations indicated and fastened securely to substrates according to manufacturer's written installation instructions.
- B. Use installation methods and fasteners that produce fixed audience seating assemblies with individual chairs capable of supporting an evenly distributed 600-lb static load applied 3" from front edge of the seat without failure or other conditions that might impair the chair's usefulness.
- C. Install seating with chair end standards aligned from first to last row and with backs and seats varied in width and spacing to optimize sightlines.

- D. Install riser-mounted attachments to maintain uniform chair heights above floor..
- E. Install seating so moving components operate smoothly and quietly.
- 3.3 PLANK BENCH INSTALLATION
 - A. Follow manufacturer's printed instructions for installation.
 - B. Standards: Anchored with not less than two anchoring devices.
 - C. Install plank benches and back-rests using manufacturer's recommended hardware and fasteners.

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Prepare test and inspection reports.

3.5 ADJUSTING

- A. Adjust chair backs so that they are properly aligned with each other.
- B. Adjust self-rising seat mechanisms so seats in each row are aligned when in upright position.
- C. Verify that all components and devices are operating properly.
- D. Repair minor abrasions and imperfections in finishes with coating that matches factoryapplied finish.
- E. Repair minor abrasions and imperfections in painted finishes with a coating that matches the factory-applied finish.
- F. Replace benches damaged during installation.

END OF SECTION

SECTION 133419 - METAL BUILDING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Structural-steel framing.
 - 2. Thermal insulation.

B. Related Sections:

- 1. Section 074113.16 "Standing-Seam Metal Roof Panels".
- 2. Section 083323 "Overhead Coiling Doors."
- 3. Section 083613 "Sectional Doors."

1.3 DEFINITIONS

A. Terminology Standard: See MBMA's "Metal Building Systems Manual" for definitions of terms for metal building system construction not otherwise defined in this Section or in referenced standards.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of metal building system component. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
 - 1. Structural-steel-framing system.
 - 2. Insulation and vapor retarder facings.
 - 3. Accessories.
- B. Shop Drawings: For the following metal building system components. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Anchor-Bolt Plans: Submit anchor-bolt plans and templates before foundation work begins. Include location, diameter, and projection of anchor bolts required to attach metal building to foundation. Indicate column reactions at each location.

- Structural-Framing Drawings: Show complete fabrication of primary and secondary framing; include provisions for openings. Indicate welds and bolted connections, distinguishing between shop and field applications. Include transverse cross-sections.
 a. Show provisions for attaching ceiling hung equipment and lighting.
- 3. Insulation Drawings: Indicate locations of connections and attachments, general details, anchorages and method of anchorage and installation.
- C. Samples for Verification: For each type of exposed finish required, prepared on Samples of sizes indicated below:
 - 1. Vapor-Retarder Facings: Nominal 6-inch- (150-mm-) square Samples.
- D. Delegated-Design Submittal: For metal building systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified erector and manufacturer.
- B. Manufacturer Accreditation: Statement that metal building system and components were designed and produced by a manufacturer accredited according to the International Accreditation Service's AC472.
- C. Welding certificates.
- D. Metal Building System Certificates: For each type of metal building system, from manufacturer.
 - 1. Letter of Design Certification: Signed and sealed by a qualified professional engineer. Include the following:
 - a. Name and location of Project.
 - b. Order number.
 - c. Name of manufacturer.
 - d. Name of Contractor.
 - e. Building dimensions including width, length, height, and roof slope.
 - f. Indicate compliance with AISC standards for hot-rolled steel and AISI standards for cold-rolled steel, including edition dates of each standard.
 - g. Governing building code and year of edition.
 - h. Design Loads: Include dead load, roof live load, collateral loads, roof snow load, deflection, wind loads/speeds and exposure, seismic design category or effective peak velocity-related acceleration/peak acceleration, and auxiliary loads (cranes).
 - i. Load Combinations: Indicate that loads were applied acting simultaneously with concentrated loads, according to governing building code.
 - j. Building-Use Category: Indicate category of building use and its effect on load importance factors.
- E. Erector Certificates: For each product, from manufacturer.

- F. Manufacturer Certificates: For each product, from manufacturer.
- G. Material Test Reports: For each of the following products:
 - 1. Structural steel including chemical and physical properties.
 - 2. Bolts, nuts, and washers including mechanical properties and chemical analysis.
 - 3. Tension-control, high-strength, bolt-nut-washer assemblies.
 - 4. Shop primers.
 - 5. Nonshrink grout.
- H. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for insulation and vapor-retarder facings. Include reports for thermal resistance, fire-test-response characteristics, water-vapor transmission, and water absorption.
- I. Source quality-control reports.
- J. Field quality-control reports.
- K. Warranties: Sample of special warranties.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer and member of MBMA.
 - 1. Accreditation: According to the International Accreditation Service's AC472.
 - 2. Engineering Responsibility: Preparation of comprehensive engineering analysis and Shop Drawings by a professional engineer who is legally qualified to practice in jurisdiction where Project is located.
- B. Erector Qualifications: An experienced erector who specializes in erecting and installing work similar in material, design, and extent to that indicated for this Project and who is acceptable to manufacturer.
- C. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.
- D. Source Limitations: Obtain metal building system components, including primary and secondary framing and metal panel assemblies, from single source from single manufacturer.
- E. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code Steel."
 - 2. AWS D1.3, "Structural Welding Code Sheet Steel."
- F. Structural Steel: Comply with AISC 360, "Specification for Structural Steel Buildings," for design requirements and allowable stresses.
- G. Cold-Formed Steel: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" for design requirements and allowable stresses.

- H. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review methods and procedures related to metal building systems including, but not limited to, the following:
 - a. Condition of foundations and other preparatory work performed by other trades.
 - b. Structural load limitations.
 - c. Construction schedule. Verify availability of materials and erector's personnel, equipment, and facilities needed to make progress and avoid delays.
 - d. Required tests, inspections, and certifications.
 - e. Unfavorable weather and forecasted weather conditions.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, sheets, panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.
- B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Protect insulation as follows:
 - 1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.
 - 2. Protect against ignition at all times. Do not deliver insulation materials to Project site before installation time.
 - 3. Complete installation and concealment of materials as rapidly as possible in each area of construction.

1.8 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when weather conditions permit metal panels to be installed according to manufacturers' written instructions and warranty requirements.
- B. Field Measurements:
 - 1. Established Dimensions for Foundations: Comply with established dimensions on approved anchor-bolt plans, establishing foundation dimensions and proceeding with fabricating structural framing without field measurements. Coordinate anchor-bolt installation to ensure that actual anchorage dimensions correspond to established dimensions.

1.9 COORDINATION

A. Coordinate sizes and locations of concrete foundations and casting of anchor-bolt inserts into foundation walls and footings. Concrete, reinforcement, and formwork requirements are specified in Section 033000 "Cast-in-Place Concrete."

1.10 WARRANTY

A. Insulation system components to include a ten-year limited material warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. American Steel Building Co., Inc.
 - 2. Butler Manufacturing Company; a BlueScope Steel company.
 - 3. Ceco Building Systems; Division of NCI Building Systems, L.P.
 - 4. Chief Buildings; Division of Chief Industries, Inc.
 - 5. Metallic Building Company; Division of NCI Building Systems, L.P.
 - 6. Nucor Building Systems.
 - 7. USA, Inc.
 - 8. VP Buildings; a United Dominion company.
 - 9. Vulcan Steel Structures, Inc.

2.2 METAL BUILDING SYSTEMS

- A. Description: Provide a complete, integrated set of mutually dependent components and assemblies that form a metal building system capable of withstanding structural and other loads, thermally induced movement, and exposure to weather without failure or infiltration of water into building interior.
 - 1. Provide metal building system of size and with bay spacings, roof slopes, and spans indicated.
- B. Primary-Frame Type:
 - 1. Rigid Clear Span: Solid-member, structural-framing system without interior columns.
- C. End-Wall Framing: Manufacturer's standard, for buildings not required to be expandable, consisting of load-bearing end-wall and corner columns and rafters.
- D. Secondary-Frame Type: Manufacturer's standard purlins and joists and girts.
- E. Eave Height: As indicated by nominal height on Drawings.

- F. Bay Spacing: As indicated on Drawings
- G. Roof Slope: 1 inch per 12 inches (1:12).
- H. Roof System: See Section 074113.16 "Standing-Seam Metal Roof Panels" for roof system.
- I. Exterior Wall System: Brick, masonry and composite panel as shown in details.

2.3 METAL BUILDING SYSTEM PERFORMANCE

- A. Delegated Design: Design metal building system, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Metal building systems shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated according to procedures in MBMA's "Metal Building Systems Manual."
 - 1. Design Loads: As indicated on Drawings.
 - 2. Deflection Limits: Design metal building system assemblies to withstand design loads with deflections no greater than the following:
 - a. Purlins and Rafters: Vertical deflection of 1/180 of the span.
 - b. Girts: Horizontal deflection of 1/240 of the span.
 - c. Metal Roof Panels: Vertical deflection of 1/180 of the span.
 - d. Metal Wall Panels: Horizontal deflection of 1/180 of the span.
 - e. Design secondary-framing system to accommodate deflection of primary framing and construction tolerances, and to maintain clearances at openings.
 - 3. Drift Limits: Engineer building structure to withstand design loads with drift limits no greater than the following:
 - a. Lateral Drift: Maximum of 1/400 of the building height.
 - 4. Metal panel assemblies shall withstand the effects of gravity loads and loads and stresses within limits and under conditions indicated according to ASTM E 1592.
- C. Seismic Performance: Metal building systems shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- D. Thermal Movements: Allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.4 STRUCTURAL-STEEL FRAMING

- A. Primary Framing: Manufacturer's standard primary-framing system, designed to withstand required loads and specified requirements. Primary framing includes transverse and lean-to frames; rafter, rake; sidewall, intermediate, end-wall, and corner columns; and wind bracing.
 - 1. General: Provide frames with attachment plates, bearing plates, and splice members. Factory drill for field-bolted assembly. Provide frame span and spacing indicated.
 - a. Slight variations in span and spacing may be acceptable if necessary to comply with manufacturer's standard, as approved by Architect.
 - 2. Rigid Clear-Span Frames: I-shaped frame sections fabricated from shop-welded, built-up steel plates or structural-steel shapes. Interior columns are not permitted.
 - 3. Rigid Modular Frames: I-shaped frame sections fabricated from shop-welded, built-up steel plates or structural-steel shapes.
 - 4. Frame Configuration: One-directional sloped.
 - 5. Exterior Column Type: Tapered.
 - 6. Rafter Type: Uniform depth.
- B. End-Wall Framing: Manufacturer's standard primary end-wall framing fabricated for fieldbolted assembly to comply with the following:
 - 1. End-Wall and Corner Columns: I-shaped sections fabricated from structural-steel shapes; shop-welded, built-up steel plates; or C-shaped, cold-formed, structural-steel sheet.
 - 2. End-Wall Rafters: C-shaped, cold-formed, structural-steel sheet; or I-shaped sections fabricated from shop-welded, built-up steel plates or structural-steel shapes.
- C. Secondary Framing: Manufacturer's standard secondary framing, including purlins, girts, eave struts, flange bracing, base members, gable angles, clips, headers, jambs, and other miscellaneous structural members. Unless otherwise indicated, fabricate framing from either cold-formed, structural-steel sheet or roll-formed, metallic-coated steel sheet, prepainted with coil coating, to comply with the following:
 - 1. Purlins: C- or Z-shaped sections; fabricated from built-up steel plates, steel sheet, or structural-steel shapes; minimum 2-1/2-inch- (64-mm-) wide flanges.
 - a. Depth: As needed to comply with system performance requirements (including insulation thickness).
 - 2. Purlins: Steel joists of depths indicated.
 - 3. Girts: C- or Z-shaped sections; fabricated from built-up steel plates, steel sheet, or structural-steel shapes. Form ends of Z-sections with stiffening lips angled 40 to 50 degrees from flange, with minimum 2-1/2-inch- (64-mm-) wide flanges.
 - a. Depth: As indicated and As required to comply with system performance requirements.
 - 4. Eave Struts: Unequal-flange, C-shaped sections; fabricated from built-up steel plates, steel sheet, or structural-steel shapes; to provide adequate backup for metal panels.

- 5. Flange Bracing: Minimum 2-by-2-by-1/8-inch (51-by-51-by-3-mm) structural-steel angles or 1-inch- (25-mm-) diameter, cold-formed structural tubing to stiffen primary-frame flanges.
- 6. Sag Bracing: Minimum 1-by-1-by-1/8-inch (25-by-25-by-3-mm) structural-steel angles.
- 7. Base or Sill Angles: Minimum 3-by-2-inch (76-by-51-mm) zinc-coated (galvanized) steel sheet.
- 8. Purlin and Girt Clips: Manufacturer's standard clips fabricated from steel sheet. Provide galvanized clips where clips are connected to galvanized framing members.
- 9. Secondary End-Wall Framing: Manufacturer's standard sections fabricated from zinccoated (galvanized) steel sheet.
- 10. Framing for Openings: Channel shapes; fabricated from cold-formed, structural-steel sheet or structural-steel shapes. Frame head and jamb of door openings and head, jamb, and sill of other openings.
- 11. Miscellaneous Structural Members: Manufacturer's standard sections fabricated from cold-formed, structural-steel sheet; built-up steel plates; or zinc-coated (galvanized) steel sheet; designed to withstand required loads.
- D. Bracing: Provide adjustable wind bracing as follows:
 - 1. Rods: ASTM A 36/A 36M; ASTM A 572/A 572M, Grade 50 (345); or ASTM A 529/A 529M, Grade 50 (345); minimum 1/2-inch- (13-mm-) diameter steel; threaded full length or threaded a minimum of 6 inches (152 mm) at each end.
 - 2. Rigid Portal Frames: Fabricated from shop-welded, built-up steel plates or structuralsteel shapes to match primary framing; of size required to withstand design loads.
- E. Bolts: Provide plain-finish bolts for structural-framing components that are primed or finish painted. Provide hot-dip galvanized bolts for structural-framing components that are galvanized.
- F. Materials:
 - 1. W-Shapes: ASTM A 992/A 992M; ASTM A 572/A 572M, Grade 50 or 55 (345 or 380); or ASTM A 529/A 529M, Grade 50 or 55 (345 or 380).
 - 2. Channels, Angles, M-Shapes, and S-Shapes: ASTM A 36/A 36M; ASTM A 572/A 572M, Grade 50 or 55 (345 or 380); or ASTM A 529/A 529M, Grade 50 or 55 (345 or 380).
 - 3. Plate and Bar: ASTM A 36/A 36M; ASTM A 572/A 572M, Grade 50 or 55 (345 or 380); or ASTM A 529/A 529M, Grade 50 or 55 (345 or 380).
 - 4. Structural-Steel Sheet: Hot-rolled, ASTM A 1011/A 1011M, Structural Steel (SS), Grades 30 through 55 (205 through 380), or High-Strength Low-Alloy Steel (HSLAS), Grades 45 through 70 (310 through 480); or cold-rolled, ASTM A 1008/A 1008M, Structural Steel (SS), Grades 25 through 80 (170 through 550), or High-Strength Low-Alloy Steel (HSLAS), Grades 45 through 70 (310 through 480).
 - 5. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grades 33 through 80 (230 through 550,) or High-Strength Low-Alloy Steel (HSLAS), Grades 50 through 80 (340 through 550); with G60 (Z180) coating designation; mill phosphatized.
 - 6. Metallic-Coated Steel Sheet Prepainted with Coil Coating: Steel sheet, metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
- a. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grades 33 through 80 (230 through 550,) or High-Strength Low-Alloy Steel (HSLAS), Grades 50 through 80 (340 through 550); with G90 (Z275) coating designation.
- b. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, Structural Steel (SS), Grade 50 or 80 (340 or 550); with Class AZ50 (AZM150) coating.
- 7. Joist Girders: Manufactured according to "Standard Specifications for Joist Girders," in SJI's "Standard Specifications and Load Tables for Steel Joists and Joist Girders"; with steel-angle, top- and bottom-chord members, and end- and top-chord arrangements as indicated and required for primary framing.
- 8. Non-High-Strength Bolts, Nuts, and Washers: ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6), carbon-steel, hex-head bolts; ASTM A 563 (ASTM A 563M) carbon-steel hex nuts; and ASTM F 844 plain (flat) steel washers.
 a. Finish: Hot-dip zinc coating, ASTM A 153/A 153M, Class C.
- High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy-hex steel structural bolts; ASTM A 563 (ASTM A 563M) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M) hardened carbon-steel washers.
 a. Finish: Hot-dip zinc coating, ASTM A 153/A 153M, Class C.
- 10. High-Strength Bolts, Nuts, and Washers: ASTM A 490 (ASTM A 490M), Type 1, heavy-hex steel structural bolts; ASTM A 563 (ASTM A 563M) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M) hardened carbon-steel washers, plain.
- 11. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, heavy-hex-head steel structural bolts with spline ends.
 - a. Finish: Mechanically deposited zinc coating, ASTM B 695, Class 50.
- 12. Unheaded Anchor Rods: ASTM A 36/A 36M.
 - a. Configuration: Straight.
 - b. Nuts: ASTM A 563 (ASTM A 563M) heavy-hex carbon steel.
 - c. Plate Washers: ASTM A 36/A 36M carbon steel.
 - d. Washers: ASTM F 436 (ASTM F 436M) hardened carbon steel.
 - e. Finish: Hot-dip zinc coating, ASTM A 153/A 153M, Class C.
- 13. Headed Anchor Rods: ASTM F 1554, Grade 36.
 - a. Configuration: Straight.
 - b. Nuts: ASTM A 563 (ASTM A 563M) heavy-hex carbon steel.
 - c. Plate Washers: ASTM A 36/A 36M carbon steel.
 - d. Washers: ASTM F 436 (ASTM F 436M) hardened carbon steel.
 - e. Finish: Hot-dip zinc coating, ASTM A 153/A 153M, Class C.
- 14. Threaded Rods: ASTM A 36/A 36M.
 - a. Nuts: ASTM A 563 (ASTM A 563M) heavy-hex carbon steel.
 - b. Washers: ASTM A 36/A 36M carbon steel.
 - c. Finish: Hot-dip zinc coating, ASTM A 153/A 153M, Class C.

- G. Finish: Factory primed. Apply specified primer immediately after cleaning and pretreating.
 - 1. Apply primer to primary and secondary framing to a minimum dry film thickness of 1 mil (0.025 mm).
 - a. Prime secondary framing formed from uncoated steel sheet to a minimum dry film thickness of 0.5 mil (0.013 mm) on each side.
 - 2. Prime galvanized members with specified primer after phosphoric acid pretreatment.
 - 3. Primer: SSPC-Paint 15, Type I, red oxide.

2.5 THERMAL INSULATION

- A. Basis-of-Design Product: Subject to compliance with requirements, provide <u>Thermal Design</u>, <u>Inc. Simple Saver System</u> or comparable product by one of the following:
 - 1. Rhino pro-Value
 - 2. Sealed "N" Safe
- B. System shall have an installed total roof insulation R-value of R-30 and an average installed thickness of 9-inches. Roof system shall be a double-layer system. A thermal block shall be applied where there is no existing thermal break between metal panel and metal structure. System shall include a ten-year warranty.
- C. System Components:
 - 1. Steel Strap: 100 KSI minimum yield high tensile strength steel, galvanized, primed and then painted white on the exposed side with a clear coat primer on unexposed side.
 - a. Traverse strap pattern shall in include one strap six (6) inches away from each rafter flange with the remaining space between rafters divided into equal spaces not to exceed five (5) feet.
 - b. Longitudinal straps shall be nominally thirty (30) inches on-center, with two adjacent straps at the ridge line.
 - 2. Fasteners: $\#12 \ge 3/4^{"}$, plated self-drilling screws with sealing washers painted to match the specified color for fastening to light gauge steel (up to 12 GA purlins) or $\#12 \ge 11/4^{"}$ plated self-drilling screws with sealing washers, painted to match the specified color for heavier gauge steel (up to $3/8^{"}$ purlins/bar joist).
 - 3. Fabric: Syseal Fabric or equal. Shall be woven reinforced high-density polyethylene yarns coated on both sides with a continuous white film. The fabric grade for the roof shall be (select one): Syseal® FP (White), The fabric shall comply with UL/ULC 723 or ASTM E84, and be Class A compliant with a low flame spread index of 25 or less based on ASTM E84 test standards. This material shall be manufactured in large custom pieces by extrusion welding from roll goods. Pieces shall be fabricated to substantially fit the large defined building areas with minimum practical sealing to be done on job site. Fabric shall be folded to allow for rapid pull-out on the strap support system. The fabric shall be: liner fabric shall not function as a vapor barrier but shall be perforated with 3/16″ minimum holes space not more than four inches apart in each direction.
 - 4. Sealants: Shall be Simple Saver System G524 high tack solvent-based vapor barrier sealant for sealing vapor barrier laps and/or Syseal® Tape (double-sided bonding tape) 3/4" wide by 1/32" thick extruded vapor barrier sealant by Thermal Design or equal.

- 5. Insulation: Shall be formaldehyde-free fiberglass blanket or batt insulation meeting ASTM C991 Type 1, ASTM E136 and ASTM E84.
- 6. Thermal break: Thermal break shall be 3/8" Snap-R thermal block or equal.
- D. Retainer Strips: 0.025-inch (0.64-mm) nominal-thickness, formed, metallic-coated steel or PVC retainer clips colored to match insulation facing.
- E. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.

2.6 DOORS AND FRAMES

A. Swinging Personnel Doors and Frames: As specified in Section 081113 "Hollow Metal Doors and Frames."

2.7 SOURCE QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to evaluate product.
- B. Special Inspector: Owner will engage a qualified special inspector to perform the following tests and inspections and to submit reports. Special inspector will verify that manufacturer maintains detailed fabrication and quality-control procedures and will review the completeness and adequacy of those procedures to perform the Work.
 - 1. Special inspections will not be required if fabrication is performed by manufacturer registered and approved by authorities having jurisdiction to perform such Work without special inspection.
 - a. After fabrication, submit copy of certificate of compliance to authorities having jurisdiction, certifying that Work was performed according to Contract requirements.
- C. Testing: Test and inspect shop connections for metal buildings according to the following:
 - 1. Bolted Connections: Shop-bolted connections shall be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
 - 2. Welded Connections: In addition to visual inspection, shop-welded connections shall be tested and inspected according to AWS D1.1/D1.1M and the following inspection procedures, at inspector's option:
 - a. Liquid Penetrant Inspection: ASTM E 165.
 - b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
 - c. Ultrasonic Inspection: ASTM E 164.
 - d. Radiographic Inspection: ASTM E 94.
- D. Product will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

2.8 FABRICATION

- A. General: Design components and field connections required for erection to permit easy assembly.
 - 1. Mark each piece and part of the assembly to correspond with previously prepared erection drawings, diagrams, and instruction manuals.
 - 2. Fabricate structural framing to produce clean, smooth cuts and bends. Punch holes of proper size, shape, and location. Members shall be free of cracks, tears, and ruptures.
- B. Tolerances: Comply with MBMA's "Metal Building Systems Manual" for fabrication and erection tolerances.
- C. Primary Framing: Shop fabricate framing components to indicated size and section, with baseplates, bearing plates, stiffeners, and other items required for erection welded into place. Cut, form, punch, drill, and weld framing for bolted field assembly.
 - 1. Make shop connections by welding or by using high-strength bolts.
 - 2. Join flanges to webs of built-up members by a continuous, submerged arc-welding process.
 - 3. Brace compression flange of primary framing with steel angles or cold-formed structural tubing between frame web and purlin web or girt web, so flange compressive strength is within allowable limits for any combination of loadings.
 - 4. Weld clips to frames for attaching secondary framing.
 - 5. Shop Priming: Prepare surfaces for shop priming according to SSPC-SP 2. Shop prime primary framing with specified primer after fabrication.
- D. Secondary Framing: Shop fabricate framing components to indicated size and section by rollforming or break-forming, with baseplates, bearing plates, stiffeners, and other plates required for erection welded into place. Cut, form, punch, drill, and weld secondary framing for bolted field connections to primary framing.
 - 1. Make shop connections by welding or by using non-high-strength bolts.
 - 2. Shop Priming: Prepare uncoated surfaces for shop priming according to SSPC-SP 2. Shop prime uncoated secondary framing with specified primer after fabrication.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with erector present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Before erection proceeds, survey elevations and locations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments to receive

structural framing, with erector present, for compliance with requirements and metal building system manufacturer's tolerances.

C. Proceed with erection only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition.
- B. Provide temporary shores, guys, braces, and other supports during erection to keep structural framing secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural framing, connections, and bracing are in place unless otherwise indicated.

3.3 ERECTION OF STRUCTURAL FRAMING

- A. Erect metal building system according to manufacturer's written erection instructions and erection drawings.
- B. Do not field cut, drill, or alter structural members without written approval from metal building system manufacturer's professional engineer.
- C. Set structural framing accurately in locations and to elevations indicated, according to AISC specifications referenced in this Section. Maintain structural stability of frame during erection.
- D. Base Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
 - 1. Set plates for structural members on wedges, shims, or setting nuts as required.
 - 2. Tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
 - 3. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- E. Align and adjust structural framing before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with framing. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 - 1. Level and plumb individual members of structure.
 - 2. Make allowances for difference between temperature at time of erection and mean temperature when structure will be completed and in service.
- F. Primary Framing and End Walls: Erect framing level, plumb, rigid, secure, and true to line. Level baseplates to a true even plane with full bearing to supporting structures, set with double-

nutted anchor bolts. Use grout to obtain uniform bearing and to maintain a level base-line elevation. Moist-cure grout for not less than seven days after placement.

- 1. Make field connections using high-strength bolts installed according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for bolt type and joint type specified.
 - a. Joint Type: Snug tightened or pretensioned.
- G. Secondary Framing: Erect framing level, plumb, rigid, secure, and true to line. Field bolt secondary framing to clips attached to primary framing.
 - 1. Provide rake or gable purlins with tight-fitting closure channels and fasciae.
 - 2. Locate and space wall girts to suit openings such as doors and windows.
 - 3. Provide supplemental framing at entire perimeter of openings, including doors, windows, louvers, ventilators, and other penetrations of roof and walls.
- H. Bracing: Install bracing in roof and sidewalls where indicated on erection drawings.
 - 1. Tighten rod and cable bracing to avoid sag.
 - 2. Locate interior end-bay bracing only where indicated.
- I. Framing for Openings: Provide shapes of proper design and size to reinforce openings and to carry loads and vibrations imposed, including equipment furnished under mechanical and electrical work. Securely attach to structural framing.
- J. Erection Tolerances: Maintain erection tolerances of structural framing within AISC 303.

3.4 THERMAL INSULATION INSTALLATION

- A. EXAMINATION
 - 1. Verify that building structure including all bracing and any concealed building systems are completed and approved prior to installing liner system and insulation in the structure.
 - 2. Correct any unsatisfactory conditions before proceeding.
 - 3. If conditions are the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

B. INSTALLATION - GENERAL

- 1. Install pre-engineered building insulation system in accordance with manufacturer's installation instructions and the approved shop drawings.
- 2. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- 3. Install in exterior spaces without gaps or voids. Do not compress insulation.

- 4. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.
- 5. Fit insulation tight in spaces and tight to exterior side of the sealed liner fabric and around mechanical and electrical services within plane of insulation.

C. ROOF INSULATION INSTALLATION

- 1. Straps:
 - a. Cut straps to length and install in the pattern and spacings indicated on shop drawings.
 - b. Tension straps to required value.
- 2. Vapor Barrier Fabric:
 - a. Install vapor barrier fabric in large one-piece custom fabricated pieces to substantially fit defined building areas with minimum practicable job site sealing.
 - b. Position pre-folded fabric on the strap platform along one eave purlin.
 - c. Clamp the two bottom corners at the eave and also centered on the bay.
 - d. Pull the other end of the pleat-folded fabric across the building width on the strap platform, pausing only at the ridge to fasten the straps and fabric in position where plane of roof changes and to release temporary fasteners on the opposite ridge purlins.
 - e. Once positioned, install fasteners from the bottom side at each strap/purlins intersection.
 - f. Trim edges and seal along the rafters.
 - g. All seams must be completely sealed and stapled seams not acceptable.
- 3. Insulation:
 - a. Unpack, and shake to a thickness exceeding the specified thickness.
 - b. Ensure that cavities are filled completely with insulation.
 - c. Place on the vapor barrier liner fabric without voids or gaps.
 - d. Place top layer of insulation over and perpendicular to the purlins without voids or gaps, as roof sheathing is applied.
 - e. Place thermal block on top of purlins or bottom of purlins for retrofit work, if no other thermal break exists.
 - f. Place new insulation between purlins at the required thickness for the R-value specified.
 - g. Seal vapor barrier fabric to the wall fabric and elsewhere as required to provide a continuous vapor barrier.
- 4. CLEANING
 - a. Clean dirt or exposed sealant from the exposed vapor barrier fabric.
 - b. Remove scraps and debris from the site.
- 5. PROTECTION
 - a. Protect system products until completion of installation.
 - b. Repair or replace damaged products before completion of insulation system installation.

3.5 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
 - 1. Inspection of fabricators.
 - 2. Steel construction.
- B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- C. Tests and Inspections:
 - 1. High-Strength, Field-Bolted Connections: Connections shall be tested and inspected during installation according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
 - 2. Welded Connections: In addition to visual inspection, field-welded connections shall be tested and inspected according to AWS D1.1/D1.1M and the following inspection procedures, at inspector's option:
 - a. Liquid Penetrant Inspection: ASTM E 165.
 - b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
 - c. Ultrasonic Inspection: ASTM E 164.
 - d. Radiographic Inspection: ASTM E 94.
- D. Product will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.6 CLEANING AND PROTECTION

- A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.
- C. Touchup Painting: After erection, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted structural framing and accessories.
 - 1. Clean and prepare surfaces by SSPC-SP 2, "Hand Tool Cleaning," or by SSPC-SP 3, "Power Tool Cleaning."
 - 2. Apply a compatible primer of same type as shop primer used on adjacent surfaces.

END OF SECTION 133419

SECTION 142400 - HYDRAULIC ELEVATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes hydraulic passenger elevators.
- B. Related Requirements:
 - 1. Section 015000 "Temporary Facilities and Controls" for temporary use of elevators for construction purposes.
 - 2. Section 033000 "Cast-in-Place Concrete" for setting sleeves, inserts, and anchoring devices in concrete.
 - 3. Section 042000 "Unit Masonry" for setting sleeves, inserts, and anchoring devices in masonry and for grouting elevator entrance frames installed in masonry walls.
 - 4. Section 055000 "Metal Fabrications" and structural drawings for the following:
 - a. Hoist beams.
 - b. Structural-steel shapes for subsills.
 - c. Pit ladders.
 - 5. Division 9 and finish schedule for finish flooring in elevator cars.

1.3 DEFINITIONS

A. Definitions in ASME A17.1/CSA B44 apply to work of this Section.

1.4 ACTION SUBMITTALS

- A. Product Data: Include capacities, sizes, performances, operations, safety features, finishes, and similar information. Include product data for car enclosures, hoistway entrances, and operation, control, and signal systems.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, and large-scale details indicating service at each landing, machine room layout, coordination with building structure, relationships with other construction, and locations of equipment.
 - 2. Include large-scale layout of car-control station and standby power operation control panel.

- 3. Indicate maximum dynamic and static loads imposed on building structure at points of support, and maximum and average power demands.
- C. Samples for Initial Selection: For finishes involving color selection.
- D. Samples for Verification: For exposed car, hoistway door and frame, and signal equipment finishes; 3-inch- (75-mm-) square Samples of sheet materials.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Seismic Qualification Certificates: For elevator equipment, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Manufacturer Certificates: Signed by elevator manufacturer certifying that hoistway, pit, and machine room layout and dimensions, as shown on Drawings, and electrical service including standby power generator, as shown and specified, are adequate for elevator system being provided.
- D. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For elevators to include in emergency, operation, and maintenance manuals.
- B. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted elevator use.
- C. Continuing Maintenance Proposal: Submit a continuing maintenance proposal from Installer to Owner, in the form of a standard one-year maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Elevator manufacturer or an authorized representative who is trained and approved by manufacturer.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle materials, components and equipment in manufacturer's protective packaging. Store materials, components, and equipment off of ground, under cover, and in a dry location.

1.9 COORDINATION

- A. Coordinate installation of sleeves, block outs, elevator equipment with integral anchors, and other items that are embedded in concrete or masonry for elevator equipment. Furnish templates, sleeves, elevator equipment with integral anchors, and installation instructions and deliver to Project site in time for installation.
- B. Coordinate locations and dimensions of other work relating to hydraulic elevators including pit ladders; sumps and floor drains in pits; entrance subsills; electrical service; and electrical outlets, lights, and switches in hoistways, pits, and machine rooms.

1.10 WARRANTY

- A. Manufacturer's Special Warranty: Manufacturer agrees to repair, restore, or replace elevator work that fails in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, operation or control system failure, including excessive malfunctions; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.
 - 2. Warranty Period: One (1) year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. <u>Basis-of-Design Product</u>: Subject to compliance with requirements, provide ThyssenKrupp Elevator AMEE 35 HLS or comparable product by one of the following:
 - 1. KONE Inc.
 - 2. <u>Otis Elevator Co</u>.
 - 3. <u>Schindler Elevator Corp</u>.
 - 4. <u>ThyssenKrupp Elevator</u>.
- B. Source Limitations: Obtain elevators from single manufacturer.
 - 1. Major elevator components, including pump-and-tank units, plunger-cylinder assemblies, controllers, signal fixtures, door operators, car frames, cars, and entrances, shall be manufactured by single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with ASME A17.1/CSA B44.
- B. Accessibility Requirements: Comply with Section 407 in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and with ICC A117.1.
- C. Seismic Performance: Elevator system shall withstand the effects of earthquake motions determined according to ASCE/SEI 7 and shall comply with elevator safety requirements for seismic risk Zone 2 or greater in ASME A17.1/CSA B44.
 - 1. The term "withstand" means "the system will remain in place without separation of any parts when subjected to the seismic forces specified."
 - 2. Affected peak velocity acceleration (Av) for Project's location is less than 0.10 (seismic risk Zones 0 and 1).
 - 3. Provide earthquake equipment required by ASME A17.1/CSA B44.
 - 4. Design earthquake spectral response acceleration short period (Sds) for Project is .438
 - 5. Project's Seismic Design Category: C.
 - 6. Elevator Component Importance Factor: 1.0.

2.3 ELEVATORS

- A. Elevator System, General: Manufacturer's standard elevator systems. Unless otherwise indicated, manufacturers' standard components shall be used, as included in standard elevator systems and as required for complete system.
- B. Elevator Description:
 - 1. Emergency Elevator Number(s): 1
 - 2. Type: Holeless, beside-the-car, telescoping, dual cylinder.
 - 3. Rated Load: 3500 lb (1589 kg).
 - 4. Rated Speed: 150 fpm (0.76 m/s).
 - 5. Operation System: Single automatic.
 - 6. Auxiliary Operations:
 - a. Standby power operation.
 - b. Automatic dispatching of loaded car.
 - 7. Security Features: Keyswitch operation.
 - 8. Car Enclosures:
 - a. Inside Width: 80 inches (2032 mm) from side wall to side wall.
 - b. Inside Depth: 65 inches (1651 mm) from back wall to front wall (return panels).
 - c. Inside Height: 88 inches (2235 mm) to underside of ceiling.
 - d. Front Walls (Return Panels): Satin stainless steel, No. 4 finish with integral car door frames.
 - e. Car Fixtures: Satin stainless steel, No. 4 finish.
 - f. Side and Rear Wall Panels: Textured stainless steel.
 - g. Door Faces (Interior): Satin stainless steel, No. 4 finish.

- h. Door Sills: Aluminum, mill finish.
- i. Ceiling: Luminous ceiling.
- j. Handrails: 1-1/2 inches (38 mm) round satin stainless steel, No. 4 finish, at sides & rear of car.
- k. Floor prepared to receive resilient flooring (specified in Division 9).
- 9. Hoistway Entrances:
 - a. Width: 42 inches (1067 mm).
 - b. Height: 84 inches (2134 mm).
 - c. Type: Single-speed side sliding.
 - d. Frames: Satin stainless steel, No. 4 finish.
 - e. Doors: Satin stainless steel, No. 4 finish.
 - f. Sills: Aluminum, mill finish.
- 10. Hall Fixtures: Satin stainless steel, No. 4 finish.
- 11. Additional Requirements:
 - a. Provide inspection certificate in each car, mounted under acrylic cover with frame made from satin stainless steel, No. 4 finish.
 - b. Provide hooks for protective pads and one complete set(s) of full-height protective pads.

2.4 SYSTEMS AND COMPONENTS

- A. Pump Units: Positive-displacement type with a maximum of 10 percent variation between no load and full load and with minimum pulsations.
 - 1. Pump shall be submersible type with submersible squirrel-cage induction motor, and shall be suspended inside oil tank from vibration isolation mounts or shall be tank-top-mounted type with fan-cooled, squirrel-cage induction motor, and shall be mounted on oil tank with vibration isolation mounts and enclosed in prime-painted steel enclosure lined with 1-inch- (25-mm-) thick, glass-fiber insulation board.
 - 2. Motor shall have solid-state starting.
 - 3. Motor shall have variable-voltage, variable-frequency control.
- B. Hydraulic Silencers: System shall have hydraulic silencer containing pulsation-absorbing material in blowout-proof housing at pump unit.
- C. Piping: Size, type, and weight of piping as recommended by elevator manufacturer, with flexible connectors to minimize sound and vibration transmissions from power unit.
 - 1. Cylinder units shall be connected with dielectric couplings.
 - 2. Casing for Underground Piping: Schedule 40 PVC pipe complying with ASTM D 1785, joined with PVC fittings complying with ASTM D 2466 and solvent cement complying with ASTM D 2564.

- D. Hydraulic Fluid: Elevator manufacturer's standard fire-resistant fluid with additives as needed to prevent oxidation of fluid, corrosion of cylinder and other components, and other adverse effects.
- E. Inserts: Furnish required concrete and masonry inserts and similar anchorage devices for installing guide rails, machinery, and other components of elevator work. Device installation is specified in another Section.
- F. Protective Cylinder Casing: PVC or HDPE pipe casing complying with ASME A17.1/CSA B44, of sufficient size to provide not less than 1-inch (25-mm) clearance from cylinder and extending above pit floor. Casing shall have means of monitoring effectiveness to comply with ASME A17.1/CSA B44.
- G. Corrosion-Protective Filler: A nontoxic, petroleum-based gel formulated for filling the space between hydraulic cylinder and protective casing. Filler shall be electrically nonconductive, displace or absorb water, and gel or solidify at temperatures below 60 deg F (16 deg C).
- H. Car Frame and Platform: Welded or bolted steel units.
- I. Guides: Roller guides; polymer-coated, nonlubricated sliding guides; or sliding guides with guide-rail lubricators. Provide guides at top and bottom of car and counterweight frames.
- J. <u>Provide manufacturer's standard oil cooler system.</u>

2.5 OPERATION SYSTEMS

- A. General: Provide manufacturer's standard microprocessor operation system as required to provide type of operation indicated.
- B. Auxiliary Operations: In addition to primary operation system features, provide the following operational features for elevators where indicated:
 - 1. Single-Car Standby Power Operation: On activation of standby power, car is returned to a designated floor and parked with doors open. Car can be manually put in service on standby power, either for return operation or for regular operation, by switches in control panel located at main lobby. Manual operation causes automatic operation to cease.
 - 2. Automatic Dispatching of Loaded Car: When car load exceeds 80 percent of rated capacity, doors start closing.
- C. Security Features: Provide the following security features, where indicated. Security features shall not affect emergency firefighters' service.
 - 1. Keyswitch Operation: Push buttons are activated and deactivated by security keyswitches at car-control stations. Key is removable in either position.
 - 2. Car-to-Lobby Feature: Feature, activated by keyswitch at main lobby, that causes car to return immediately to lobby and open doors for inspection. On deactivation by keyswitch, calls registered before keyswitch activation are completed and normal operation is resumed.

3. Provide necessary infrastructure for Owner installed security camera.

2.6 DOOR REOPENING DEVICES

- A. Infrared Array: Provide door reopening device with uniform array of 36 or more microprocessor-controlled, infrared light beams projecting across car entrance. Interruption of one or more light beams shall cause doors to stop and reopen.
- B. Nudging Feature: After car doors are prevented from closing for predetermined adjustable time, through activating door reopening device, a loud buzzer shall sound and doors shall begin to close at reduced kinetic energy.

2.7 CAR ENCLOSURES

- A. General: Provide steel-framed car enclosures with nonremovable wall panels, with car roof, access doors, power door operators, and ventilation.
 - 1. Provide standard railings complying with ASME A17.1/CSA B44 on car tops where required by ASME A17.1/CSA B44.
- B. Materials and Finishes: Manufacturer's standards, but not less than the following:
 - 1. Subfloor: Exterior, underlayment grade plywood, not less than 5/8-inch (15.9-mm) nominal thickness.
 - 2. Floor Finish: Division 9 and finish schedule. (resilient flooring)
 - 3. Stainless-Steel Wall Panels: Flush, hollow-metal construction; fabricated from stainlesssteel sheet.
 - 4. Fabricate car with recesses and cutouts for signal equipment.
 - 5. Fabricate car door frame integrally with front wall of car.
 - 6. Stainless-Steel Doors: Flush, hollow-metal construction; fabricated from stainless-steel sheet or by laminating stainless-steel sheet to exposed faces and edges of enameled cold-rolled steel doors using adhesive that fully bonds metal to metal without telegraphing or oil-canning.
 - 7. Sight Guards: Provide sight guards on car doors.
 - 8. Sills: Extruded metal, with grooved surface, 1/4 inch (6.4 mm) thick.
 - 9. Luminous Ceiling: Fluorescent light fixtures and ceiling panels of translucent acrylic or other permanent rigid plastic.
 - 10. Handrails: Manufacturer's standard handrails, of shape, metal, and finish indicated.

2.8 HOISTWAY ENTRANCES

- A. Hoistway Entrance Assemblies: Manufacturer's standard horizontal-sliding, door-and-frame hoistway entrances complete with track systems, hardware, sills, and accessories. Frame size and profile shall accommodate hoistway wall construction.
- B. Fire-Rated Hoistway Entrance Assemblies: Door and frame assemblies shall comply with NFPA 80 and be listed and labeled by a testing and inspecting agency acceptable to authorities

having jurisdiction based on testing at as close-to-neutral pressure as possible according to NFPA 252 or UL 10B.

- 1. Fire-Protection Rating: 1 hour with 30-minute temperature rise of 450 deg F (250 deg C).
- C. Materials and Fabrication: Manufacturer's standards, but not less than the following:
 - 1. Stainless-Steel Frames: Formed from stainless-steel sheet.
 - 2. Star of Life Symbol: Identify emergency elevators with star of life symbol, not less than 3 inches (76 mm) high, on both inside surfaces of hoistway door frames.
 - 3. Stainless-Steel Doors: Flush, hollow-metal construction; fabricated from stainless-steel sheet or by laminating stainless-steel sheet to exposed faces and edges of enameled cold-rolled steel doors using adhesive that fully bonds metal to metal without telegraphing or oil-canning.
 - 4. Sight Guards: Provide sight guards on doors matching door edges.
 - 5. Sills: Extruded metal, with grooved surface, 1/4 inch (6.4 mm) thick.
 - 6. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M.

2.9 SIGNAL EQUIPMENT

- A. General: Provide hall-call and car-call buttons that light when activated and remain lit until call has been fulfilled. Fabricate lighted elements with long-life lamps and acrylic or other permanent, non-yellowing translucent plastic diffusers or LEDs.
- B. Car-Control Stations: Provide manufacturer's standard recessed car-control stations. Mount in return panel adjacent to car door unless otherwise indicated.
 - 1. Mark buttons and switches for required use or function. Use both tactile symbols and Braille.
 - 2. Provide "No Smoking" sign matching car-control station, either integral with car-control station or mounted adjacent to it, with text and graphics as required by authorities having jurisdiction.
- C. Swing-Return Car-Control Stations: Provide car-control stations mounted on rear of hinged return panel adjacent to car door and with buttons, switches, controls, and indicator lights projecting through return panel but substantially flush with face of return panel.
 - 1. Mark buttons and switches for function. Use both tactile symbols and Braille.
 - 2. Provide "No Smoking" sign matching car-control station, either integral with car-control station or mounted adjacent to it, with text and graphics as required by authorities having jurisdiction.
- D. Emergency Communication System: Two-way voice communication system, with visible signal, which dials preprogrammed number of monitoring station and does not require handset use. System is contained in flush-mounted cabinet, with identification, instructions for use, and battery backup power supply.
- E. Hall Push-Button Stations: Provide one hall push-button station at each landing.

- 1. Provide manufacturer's standard wall-mounted units with flat faceplate for mounting with body of unit recessed in wall.
- 2. Equip units with buttons for calling elevator and for indicating applicable direction of travel.
- F. Hall Lanterns: Units with illuminated arrows; but provide single arrow at terminal landings. Provide one of the following:
 - 1. Manufacturer's standard wall-mounted units, for mounting above entrance frames.
 - 2. Units mounted in both jambs of entrance frame.
 - 3. Units mounted in both car door jambs.
- G. Hall Annunciator: With each hall lantern, provide audible signals indicating car arrival and direction of travel. Signals sound once for up and twice for down.
 - 1. At manufacturer's option, audible signals may be placed on cars.
- H. Standby Power Elevator Selector Switches: Provide switches, as required by ASME A17.1/CSA B44, where indicated. Adjacent to switches, provide illuminated signal that indicates when normal power supply has failed.
- I. Emergency Pictorial Signs: Fabricate from materials matching hall push-button stations, with text and graphics as required by authorities having jurisdiction, indicating that in case of fire elevators are out of service and exits should be used instead. Provide one sign at each hall push-button station unless otherwise indicated. (stainless steel)

2.10 FINISH MATERIALS

- A. General: Provide the following materials for exposed parts of elevator car enclosures, car doors, hoistway entrance doors and frames, and signal equipment as indicated.
- B. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, commercial steel, Type B, exposed, matte finish.
- C. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, commercial steel, Type B, pickled.
- D. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304. (Type 316 at exterior)
- E. Textured Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304 with embossed texture rolled into exposed surface.
 - 1. Product: Subject to compliance with requirements, provide rigidized stainless steel.
 - 2. Metal surface is satin polished after texturing.
- F. Stainless-Steel Bars: ASTM A 276, Type 304.
- G. Stainless-Steel Tubing: ASTM A 554, Grade MT 304.
- H. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elevator areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work. Verify critical dimensions and examine supporting structure and other conditions under which elevator work is to be installed.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install cylinder plumb and accurately centered for elevator car position and travel. Anchor securely in place, supported at pit floor and braced at intervals as needed to maintain alignment. Anchor cylinder guides at spacing needed to maintain alignment and avoid overstressing guides.
- B. Welded Construction: Provide welded connections for installing elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS workmanship and welding operator qualification standards.
- C. Sound Isolation: Mount rotating and vibrating equipment on vibration-isolating mounts to minimize vibration transmission to structure and structure-borne noise due to elevator system.
- D. Install piping above the floor, where possible. Install underground piping in casing.
- E. Lubricate operating parts of systems as recommended by manufacturers.
- F. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with car. Where possible, delay installation of sills and frames until car is operable in shaft. Reduce clearances to minimum, safe, workable dimension at each landing.
- G. Leveling Tolerance: 1/4 inch (6 mm), up or down, regardless of load and travel direction.
- H. Set sills flush with finished floor surface at landing. Fill space under sill solidly with nonshrink, nonmetallic grout.
- I. Locate hall signal equipment for elevators as follows, unless otherwise indicated:
 - 1. Place hall lanterns either above or beside each hoistway entrance.
 - 2. Mount hall lanterns at a minimum of 72 inches (1829 mm) above finished floor.
- J. Telephone line connection

- 1. Elevator installer required to extend phone line from outside room to connection inside machine room and connect to equipment.
- 2. Owner will provide phone line to junction box outside of machine room.

3.3 FIELD QUALITY CONTROL

- A. Acceptance Testing: On completion of elevator installation and before permitting elevator use (either temporary or permanent), perform acceptance tests as required and recommended by ASME A17.1/CSA B44 and by governing regulations and agencies.
- B. Advise Owner, Architect, and authorities having jurisdiction in advance of dates and times that tests are to be performed on elevators.

3.4 **PROTECTION**

- A. Temporary Use: Comply with the following requirements for elevator used for construction purposes:
 - 1. Provide car with temporary enclosure, either within finished car or in place of finished car, to protect finishes from damage.
 - 2. Provide strippable protective film on entrance and car doors and frames.
 - 3. Provide padded wood bumpers on entrance door frames covering jambs and frame faces.
 - 4. Provide other protective coverings, barriers, devices, signs, and procedures as needed to protect elevator and elevator equipment.
 - 5. Do not load elevators beyond their rated weight capacity.
 - 6. Engage elevator Installer to provide full maintenance service. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleanup, and adjustment as necessary for proper elevator operation at rated speed and capacity. Provide parts and supplies same as those used in the manufacture and installation of original equipment.
 - 7. Engage elevator Installer to restore damaged work, if any, so no evidence remains of correction. Return items that cannot be refinished in the field to the shop, make required repairs and refinish entire unit, or provide new units as required.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate elevator(s).
- B. Check operation of elevator with Owner's personnel present before date of Substantial Completion and again not more than one month before end of warranty period. Determine that operation systems and devices are functioning properly.

END OF SECTION 142400

SECTION 211313 – FIRE PROTECTION SPRINKLER SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including General and Supplementary Conditions and General Requirements, apply to the work specified in this section.

1.2 GENERAL DESCRIPTION

- A. Provide the hydraulic design, all materials, equipment, and labor, including all required drilling for the addition of an automatic sprinkler system in the USC Softball Stadium to include an automatic dry-pipe system on portions of the Lower Level, Concourse Level and Upper Level and manual standpipe systems in the four exit stairs.
- B. A new four (4) inch fire service will be brought to the building by Division 33.
- C. Secure all required permits, inspections and approvals.
- D. Submit all required drawings and calculations necessary to secure approvals from the AHJ.
- E. All work must be performed in accordance with these specifications and referenced documents.
- F. Contractors shall field verify installation conditions and shall be solely responsible for design and installation of the systems.

1.3 INTENT OF SPECIFICATIONS

A. The work performed shall be complete in every respect in accordance with the adopted codes, standards, Manufacturer's recommendations and Underwriters Laboratories, Inc. (UL) listings.

1.4 SCOPE

- A. Provide new automatic sprinkler protection throughout the area of work in accordance with the adopted editions of NFPA Standards except as made more stringent herein.
- B. Provide sprinkler system supervisory switches and water flow indicators as required. All electrical work related shall be provided under Division 28.
- C. Provide all required drains and inspector test connections, connected and ready to use.
- D. Prepare and submit shop drawings, record drawings, and other submittals required herein.
- E. Test each new and/or modified sprinkler system.

- F. Guarantee all new equipment, systems, and modifications during installation for a one (1) year period after final acceptance of the work by the Engineer.
- G. Provide all required drilling, cutting and coring for sprinkler and water supply pipe.
- H. Pipe sizes shall be as required by NFPA Standards but in no case less than those shown on the drawings. For the Contractor's information, fire flow test data is hereinafter included.
- I. Sprinkler heads shall be provided as required by NFPA Standards. Sprinkler head locations shall be coordinated with the ceiling plans. Sprinkler shop drawings shall indicate the ceiling, lighting fixtures, smoke detectors, air devices, etc.
- J. Provide specialty heads, shut-off valves with tamper switches on sprinkler pipes serving special use areas, such as elevator shafts, elevator machine rooms, electric rooms, etc. as required by local code and the authority having jurisdiction.
- K. All requirements of the State of South Carolina, the State Fire Marshal's Office, and local AHJ shall apply to this specification.
- L. The sprinkler contractor shall provide all required construction coordination as specified in other Divisions. All coordination issues and conflicts shall be resolved by the Contractor(s) at no additional cost to the Owner. Resolutions may include, but not be limited to, moving pipe mains, sprinkler heads, drain and test piping, valves, etc.

1.5 RELATED WORK SPECIFIED ELSEWHERE

- A. Fire alarm wiring is by Division 28.
- B. Power wiring is by Division 26.
- C. Underground piping to a point five feet outside the building footprint is by Division 33.

1.6 WORKING CONDITIONS

- A. It shall be the Contractor's responsibility to inspect the job site and become familiar with the conditions under which the work will be performed.
- B. Coordinate working hours with the Owner.

1.7 CODES AND STANDARDS

- A. All work shall conform to the requirements of the applicable portions of the National Fire Protection Association (NFPA) Standards and documents referenced herein.
 - 1. NFPA 13 (2010) "Standard for the Installation of Sprinkler Systems"
 - 2. NFPA 14 (2010) "Standard for the Installation of Standpipes and Hose Systems"
 - 3. NFPA 24 (2010) "Standard for the Installation of Private Service Mains and Their Appurtenances".
 - 4. NFPA 25 (2008) "Recommended Practice for the Inspection, Testing, and Maintenance

FIRE PROTECTION SPRINKLER SYSTEM

of Sprinkler Systems"

- 5. NFPA 70 (2008) "National Electrical Code"
- 6. NFPA 72 (2010) "Standard for the Installation, Maintenance, and Use of Local Protective Signaling Systems"
- 7. NFPA 101 (2009) "Standard Code for Life Safety from Fire in Buildings and Structures"
- 8. ICC IBC (2009)
- 9. ICC IFC (2009)
- 10. The Fire Protection Sprinkler Systems Act, South Carolina Code of laws Title 40 Chapter 10.
- B. All work and materials shall conform to all Federal, State, and local codes and regulations governing this installation.
- C. If there is a known conflict between the referenced NFPA Standards, Federal, State or local codes and this specification, it shall be the Contractor's responsibility to bring the conflict to the attention of the Engineer for resolution.
- D. The Contractor shall be responsible for paying all fees and securing all permits, inspections, and approvals necessary for conducting this work.
- E. All devices, systems, equipment, and materials furnished and installed shall be of types or models acceptable to the AHJ, and listed by Underwriters Laboratories for use in systems and occupancies of this type.

1.8 QUALIFICATIONS OF CONTRACTOR

- A. The Contractor shall hold all licenses necessary to perform work of this type.
- B. The Contractor shall have experience in installation of systems of this type and be familiar with all applicable local, State, and Federal laws and regulations.
- C. The Contractor shall be regularly engaged in the design, installation, testing, and servicing of automatic sprinkler systems.
- D. The Contractor shall provide a job site supervisor who shall be present at all times that work is actively in progress.

1.9 SUBMITTALS

- A. General:
 - 1. Fire sprinkler shop drawings may be submitted electronically or in hard copy of sufficient quantity. If submitted electronically, provide product data and calculations in .pdf file format. Provide shop drawings in .dwf format only.
 - 2. Shop drawings shall bear the company name, qualifying signature and license number of the fire sprinkler contractor licensed in South Carolina who prepared them.
 - 3. The Engineer will review all submittals for compliance. Upon determining compliance, the Engineer will forward submittals to the State Fire Marshal.

- 4. If the Contractor's submittals are non-compliant, the Contractor shall be required to resubmit with modifications, within seven (7) working days of notification.
- B. Product Data:
 - 1. The Contractor shall submit Manufacturer's Data showing the type and model of all equipment or material proposed. This information shall include as a minimum the following items:
 - a. Pipe
 - b. Hangers
 - c. Valves
 - d. Pipe fittings/joining methods
 - e. Sprinklers
 - f. Water flow devices
 - g. Supervisory devices
 - h. Notification devices
 - i. Air compressor
 - j. Fire Department connections, escutcheons, and signage
 - 2. When a Data Sheet shows more than one product, the specific proposed product shall be clearly indicated by arrows or other suitable means.
 - 3. Provide all electrical wiring diagrams of air compressor, flow switches, notification, and supervising equipment for coordination with Division 28.
- C. Hydraulic Calculations
- D. Seismic Restraint Calculations
- E. Shop Drawings:
 - 1. Shop drawings shall show light fixtures, ducts, mechanical equipment, structural elements, and all other items which may affect the layout of sprinkler heads and piping. Scale shall be not less than 1/8 inch per foot.
 - a. Shop drawings shall be insufficient detail to show compliance with adopted codes.
 - b. Shop drawings shall show locations of pipe supports, seismic braces and end-ofline pipe restraints in plan view. Shop drawings shall also detail pipe supports, seismic braces and end-of-line restraints.
 - c. The shop drawings shall indicate all areas to be sprinklered, locations and sizes of water supply pipe, major drains and tests, alarm check valve and alarm bell/gong, risers and other main piping and valves, and the location of fire department connections. Complete riser diagrams shall also be submitted. The drawings shall locate by dimension all fire protection piping and sprinkler heads.
- F. Operation and Maintenance Manual
 - 1. Refer to Division 1 for additional requirements of operation and maintenance manuals. The Contractor shall provide the Engineer with a loose-leaf manual containing the

following data:

- a. A detailed description of the new sprinkler system(s), including the provisions for system expansion.
- b. A detailed description of routine maintenance required or recommended including a maintenance schedule and detailed maintenance instructions for each type of device installed.
- c. Manufacturer's data sheets and installation manuals/instructions for all equipment installed.
- d. A list of recommended spare parts.
- e. Service directory for all components in the system.
- f. Eleven (11) inches by seventeen (17) inches reduced copies of the as-built drawings.
- G. Record Drawings:
 - 1. The Contractor shall provide and maintain on the site an up-to-date record set of approved shop drawing prints which shall be marked to show each and every change made to the sprinkler system from the original approved shop drawings. This shall not be construed as authorization to deviate from or make changes to the shop drawings approved without written instruction in each case. This set of drawings shall be used only as a record set.
 - 2. Upon completion of the work, the record set of prints shall be used to prepare complete, accurate final record drawings (CAD) reflecting any and all changes and deviations made to the sprinkler system.
 - 3. Upon completion of the work, two sets of black line record drawings shall be submitted to the Engineer for review and approval.
 - 4. The approved version of record drawings shall be submitted with closeout documentation in accordance with Division 01.

1.10 GUARANTEE PERIOD

A. The Contractor shall guarantee all materials and workmanship for a period of one (1) year beginning with the date of substantial completion acceptance by the Owner and Engineer. The Contractor shall be responsible during the design, installation, testing, and guarantee periods for any damage caused by him or his subcontractors or by defects in his or his subcontractors' work, materials, or equipment.

1.11 TRAINING

- A. The Contractor shall conduct one training session of up to four (4) hours to familiarize the Owner's personnel with the features, operation, and maintenance of the sprinkler system(s). Training sessions shall be scheduled by the Contractor at a time mutually agreeable to the Owner and Engineer.
- B. The proposed training agenda shall include, but not be limited to, the following items:
 - 1. Overview of system operation

- 2. Overview of system equipment and device locations
- 3. Detailed operation guidelines
- 4. Detailed maintenance procedures
- 5. Periodic testing procedures

1.12 SPARE PARTS AND SPECIAL TOOLS

A. Spare Parts: Provide spare sprinklers and wrenches in cabinet(s) of sufficient quantity to comply with adopted codes.

1.13 FINAL APPROVAL AND ACCEPTANCE

- A. Final approval and acceptance of the work will be given when the following occurs:
 - 1. The complete sprinkler system(s) have been inspected, tested, and approved by the AHJ.
 - 2. Required submittals, system operation and maintenance manuals, record drawings, spare parts, special tools, and training have been provided, reviewed, and accepted by the Owner and Architect/Engineer.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All equipment and system components furnished and installed shall be new and of first quality, and be listed by Underwriters Laboratories Inc. (UL) or approved by Factory mutual (FM) for their intended use. All such equipment and system components shall be installed within the limitations of the respective UL listings or FM approvals.
- B. Each item of equipment shall be capable of performing its function over an extended period of time with a minimum of attention and maintenance. All equipment shall be constructed using new materials designed and built in accordance with the best practices of the industry. Each major item of equipment shall bear the manufacturer's name or trademark; serial number; UL label; operating instructions and hydraulic temperature characteristic conditions, etc., if applicable.

2.2 ABOVEGROUND PIPING

- A. Fire protection system piping shall meet the requirements of NFPA Standard 13 and the following:
 - 1. No plastic piping will be permitted.
 - 2. Welded Piping
 - a. Schedule 10 ASTM A-135 or A-795 Sizes 2 ¹/₂ through 6-inch.
 - 3. Grooved Pipe:

- a. Schedule 10 ASTM A-135, Sizes 2 ¹/₂ through 5 inch.
- b. Schedule 40 sizes 2 inch and smaller.
- c. Pipe 6-inch shall not have a wall thickness less than 0.134 inch.
- 4. Threaded Pipe:
 - a. Schedule 40 Sizes 2-inch and smaller.
 - b. Black cast iron ANSI B16.4 Class 250 screwed couplings and fittings.
- 5. Pressure ratings of all fittings shall meet or exceed the maximum working pressure available within the system.
- 6. All piping and hangers where exposed to the weather or installed in a corrosive atmosphere shall be protected against corrosion. No wet piping shall be subject to freezing.
- B. If mechanical couplings are used, all coupling and pipe fittings (not including valves and specialties) shall be provided by one manufacturer and shall be part of a UL/FM approved assembly.

2.3 UNDERGROUND PIPING

- A. Pipe shall be ductile iron manufactured in accordance with the requirements of ANSI/AWWA C151/A21.51.
- B. Mechanical joints shall be in accordance with ANSI/AWWA C111/A21.11.
- C. Fittings shall be ductile iron and in accordance with the requirements of ANSI/AWWA C153/A21.53 for compact fittings or ANSI/AWWA C110/A21.10 for standard fittings.
- D. Pipe and fittings shall have cement mortar lining and seal coating in accordance with ANSI/AWWA C104/A21.4.

2.4 CONTROL AND DRAIN VALVES

- A. Fire Protection system control valves shall be the following types:
 - 1. Gate Valves 2 inch and under shall be UL listed, 175 pounds per square inch (psi) water working pressure (WWP), OS&Y with bronze body and screwed end equal to Stockham Fig. B-133.
- B. Riser control valves shall be of the OS&Y gate type with valve supervisory switch.
- C. All valves must be UL listed or FM approved for their intended use.
- D. All water supply control valves and drain valves shall be permanently marked to show their function and sprinkler system zone which they serve.
- E. Pressure ratings of all valves shall meet or exceed maximum working pressure available within the system.

F. Provide inspector's test and drain assemblies.

2.5 DRY PIPE SYSTEM

- A. The dry pipe valve assembly shall be a latching differential type and shall be complete with trim piping, valves, fittings, pressure gauges, priming water fill cup, velocity drip check, drip cup, and other ancillary components as required for proper operation.
- B. Provide an air supply system in accordance with NFPA 13. The connection from the air compressor shall not be less than 1/2 inch and shall enter the system above the priming water level of the dry pipe valve. Install a check valve in the system supply air piping from the compressor. A shutoff valve of the renewable disc type shall be installed upstream of this check valve. The air supply system shall besized to pressurize the sprinkler system to 40 psi within 20 minutes.
- C. Air compressor shall be single stage oil-free type, air-cooled, electric-motor driven, equipped with a check valve, shutoff valve and pressure switch for automatic starting and stopping. Pressure switch shall be factory set to start the compressor at 30 psi and stop it at 40 psi. A safety relief valve, set to operate at 65 psi, shall be provided.
- D. Air pressure maintenance device shall be a pressure regulator that automatically reduces supply air to provide the pressure required to be maintained in the piping system. The device shall have a cast bronze body and valve housing complete with diaphragm assembly, spring, filter, ball check to prevent backflow, restriction to prevent rapid pressurization of the system, and adjustment screw. The device shall be capable of reducing an inlet pressure of up to 100 psig to a fixed outlet pressure adjustable to 10 psig.
- E. The dry pipe valve trim shall be provided with an alarm device consisting of a metal enclosure containing an alarm horn or bell, silence switch, green power-on light, red low-air alarm light and amber trouble light. Activate the alarm device by the low air pressure switch. Upon reduction of sprinkler system pressure to 10 psig above the dry valve trip point pressure, the low air pressure switch shall actuate the audible alarm device and a red low-air alarm light. Restoration of system pressure shall cause the low-air alarm light to be extinguished and the audible alarm to be silenced. An alarm silence switch shall be provided to silence the audible alarm. An amber trouble light shall be provided which will illuminate upon operation of the silence switch and shall be extinguished upon return to its normal position.
- F. Low air pressure supervisory switch shall supervise the air pressure in system and shall be set to activate at 10 psi above the dry pipe valve trip point pressure. The switch shall have an adjustable range between 5 and 80 psi. The switch shall have screw terminal connection and shall be capable of being wired for normally open or normally closed circuit.

2.6 AUTOMATIC SPRINKLERS

- A. Sprinklers shall be listed by Underwriter's Laboratories and only new sprinklers shall be used. Any sprinkler that incurs damage, is painted, or is sprayed with any fire retardant or obstructive material shall be replaced at no cost to the Owner.
- B. The correct temperature rating of every sprinkler head shall be used according to the maximum

ceiling temperature rating and requirements in NFPA Standard 13. All sprinklers with the exception of specified decorative types and bulb-types shall have their frame arms colored at the factory in accordance with the standard table in NFPA Standard 13. High temperature heads shall be used where required by NFPA Standard 13 and the Authority Having Jurisdiction.

- C. Sprinklers that may be subject to mechanical damage due to their location (under stairwells, or low hanging sprinklers in corridors, storage rooms or under ducts) shall be provided with approved guards (Reliable Model MA or equivalent).
- D. Automatic sprinklers shall be of the following types:
 - 1. Standard pendant or sidewall residential or light hazard sprinklers.
 - 2. All sprinklers within a space shall be from the same manufacturer and have the same heat response element, including temperature rating and response characteristics.
 - 3. All sprinklers in spaces with finished ceilings shall be recessed type with white covers.
 - 4. Sprinklers located on exterior piping systems, or located in corrosive atmospheres shall be corrosion resistant.

2.7 SUPERVISORY AND ALARM EQUIPMENT

- A. Vane-type waterflow indicators with adjustable pneumatic retard (0-90 seconds) shall be used to indicate waterflow in each new sprinkler system zone.
- B. Valve supervisory switches shall be provided for all new valves controlling the water supply to the sprinkler system(s).
- C. Valve supervisory switches shall be the yoke mounted type. Contractor shall not use remote mounted, wire loop type switches.
- D. All electrical wiring of flow switches and valve tamper switches into the fire alarm system shall be provided under Division 28. The sprinkler contractor is responsible for providing, installing, and adjusting the devices as necessary for proper operation.
- E. All valves controlling water supply shall be electrically supervised in accordance with requirements of NFPA Standards. The switches shall be a single circuit limit switch mounted to the piping so that when the valve is fully opened the limit switch actuator holds the contacts open. If the valve is closed to a point where the stem has reached a distance of 1/5 of total travel to the closed position, the limit switch actuator shall close to the switch contacts.

2.8 HANGERS

A. Provide hangers, seismic bracing and supports for fire sprinkler piping from the building structure. All pipe supports and seismic braces shall be of UL listed components.

2.9 FLOW SWITCHES

A. Flow switches (Viking Model VRS, VS, or equivalents) shall be installed where indicated. Conductors shall be provided under the Electric Division to provide fire alarm and University of South Carolina Softball Stadium Construction BID SET

annunciation. Activation of the sprinkler system by one (1) sprinkler or equivalent test shall cause the fire alarm system to activate and the appropriate lamp(s) to activate on the annunciator. An approved test shall be provided for each water flow switch.

PART 3 - EXECUTION

3.1 HYDRAULIC DESIGN CRITERIA

A. Hydraulically calculated wet-pipe and dry-pipe sprinkler systems shall be designed to produce uniform discharge over the design area. Refer to the FSSSS for water supply and design criteria information.

3.2 INSTALLATION

- A. General:
 - 1. Installation shall comply with adopted codes.
 - 2. Coordination of trades, professional workmanship, and cleanliness are primary considerations when installing sprinklers and sprinkler piping. Any facet of sprinkler installation that does not meet with the Owner's, Engineer's, or AHJ's approval shall be changed by the Contractor to the objecting party's satisfaction at no expense to the Owner.
 - 3. All holes made by the Contractor in any wall, ceiling, or floor shall be patched restoring the wall, ceiling, or floor to its original appearance, condition, fire resistance, and integrity.
 - 4. Location of all equipment, controls, piping, valves and drains shall be coordinated with other trades so as to be easily accessible for operation and maintenance. Location is subject to approval.
 - 5. All sprinklers and equipment shall be installed in accordance with manufacturer's instructions. All special tools recommended by the manufacturer shall be used.
 - 6. The sprinkler contractor shall provide all required construction coordination as specified in Division 01. All coordination issues and conflicts shall be resolved by the Contractors at no additional cost to the Owner. Resolutions may include, but not be limited to, moving pipe mains, sprinkler heads drain and test piping, valves, etc.
- B. Installation of Piping:
 - 1. Piping installed under this Section shall be coordinated with work of all other trades so that all work may be installed in the most direct and workman-like manner and so that interference between piping, ducts, equipment, electrical, architectural and structural features will be avoided.
 - 2. Piping shall be installed and arranged to protect it from freezing and corrosion, and shall be pitched for drainage. Installation of all piping shall be in coordination with air devices, ductwork, light fixtures, and any other work that may obstruct sprinklers.
 - 3. Drains and test piping shall be furnished and installed so that all parts of the system may be drained and tested properly. Wet piping shall not be exposed to freezing. All risers including the alarm check valve shall be equipped with drains. The alarm check valve drain ("main drain") shall be piped to the outside of the building at a point free from

causing water damage.

- 4. A test pipe(s) of not less than one (1) inch diameter, terminating in a smooth bore corrosion resistant outlet, giving a flow equivalent to one (1) sprinkler, shall be provided (Inspector's test). The test pipe shall be connected at the top of sprinkler system, piped from the end of the most remote branch line and discharged outside the building including a forty-five (45) degree elbow pointed downward at a point where it can be readily observed. Show each discharge location on shop drawings.
- 5. All valves controlling water supply for sprinklers shall be accessible for use by emergency and maintenance personnel. All valves controlling water supply for sprinklers shall be electrically supervised and shall be red in color or painted red by the sprinkler subcontractor.
- 6. All exterior or exposed piping (except in the stairs) shall be primed with zinc chromate and painted red by the Contractor.
- 7. All exposed pipe which passes through a wall, ceiling, or floor shall be provided with escutcheon plates.
- 8. All exposed piping, equipment, and devices shall be installed as high as possible, but no less than 7'-6" above the finished floor, and so as not to obstruct any portion of a window, doorway, stairway or passageway, and shall not interfere with the operation or accessibility of any mechanical, plumbing, or electrical equipment.
- 9. Pipe which passes through existing fire-resistive barriers (including shaft walls and stairways) shall be sleeved and grouted to maintain the structural integrity and rating of fire barriers.
- C. System Drains:
 - 1. Discharge from inspector's test pipe and system drains shall be extended and terminated with an indirect connection over an open standpipe drain at a location approved by the Engineer.
 - 2. All interior sectional control valves including riser control valves shall be provided with auxiliary drainage so located as to drain that portion of the system controlled by the sectional valve. These drains shall discharge either outside, to drain connection leading to the main drain, or to a drain system. Obtain approval of all discharge locations by showing locations on shop drawings.
 - 3. Auxiliary drains shall be provided to properly drain points of the system when a change in direction prevents drainage.
 - 4. Drain and auxiliary drain valves shall be globe or angle valves as required and readily accessible for maintenance personnel. The Inspector's test shall be one (1) inch or larger globe valve installed not over seven (7) feet above the floor and in a readily accessible location. Test valves and the sight test shall be located at readily accessible points not above seven (7) feet above the floor.
- D. Flexible Couplings, Hangers, and Sway Bracing:
 - 1. Provide as required by adopted codes.

3.3 IDENTIFICATION

A. Identification signs similar to or the same as those recommended in NFPA Standard 13 shall be affixed securely by chain to all valves. The signs shall be red in color (Reliable Model A, Style A and B, or equivalent). The main drain sign shall be labeled "MAIN DRAIN". Riser drains

shall read "RISER DRAIN" or "DRAIN". Auxiliary drain signs shall be labeled "AUXILIARY DRAIN". Inspector's Test's signs shall be labeled "INSPECTORS TEST".

B. All water supply control valves shall have a standard sign identifying the portion of the system controlled, noting that the valve must be kept open, and leaving a blank space for notification information. All valves which are placed in concealed spaces shall have the standard sign affixed in a visible location (valves hidden by a drop ceiling shall have a sign mounted on the ceiling or wall under the valve). Obtain final approval of the Architect/Engineer of all sign locations in finished spaces.

3.4 INSTALLATION, ACCEPTANCES, AND TESTS

- A. Installation, tests, and acceptance shall be in accordance with all applicable codes and AHJ.
- B. Installation shall be in accordance with all applicable codes, including the Occupational Safety and Health Administration Acts. Installation of equipment and devices that pertain to other work in the contract shall be closely coordinated with the appropriate subcontractors.
- C. The Contractor shall make arrangements with the Engineer for final inspection and witnessing of the final acceptance test. The Engineer or the Owner will conduct a final inspection and witness the final acceptance test.
- D. The hydrostatic tests shall be documented and subject to third party witness. Failure to document any test or notify the Engineer may require retesting at no cost to the Owner.
- E. All tests and inspections required by the referenced Codes and Standards, AHJ, and the Engineer shall be performed by the Contractor.
 - 1. When third parties are required to witness tests, the contractor shall be responsible for making all necessary arrangements.
 - 2. The Contractor shall be responsible for obtaining all test documents with necessary signatures for approval by the AHJ. The Contractor shall submit one original copy of the "Contractor's Material and Test Certificate for Above Ground Piping" (from NFPA 13R) to the Engineer. All applicable information shall be filled out.
- F. An Owner's Representative will visit the job site to inspect the work and witness acceptance tests when he has been advised by the Contractor that the work is completed and ready for test. If the work is not complete or the test is unsatisfactory, the Contractor shall be responsible for the Representative's extra time and expenses for re-inspection and witnessing the re-testing of the work. Such extra fees shall be deducted from payments to the Contractor.
- G. Contractor shall provide at least five (5) working days notice for all tests. As a minimum the following test shall be provided:
 - 1. All piping shall be tested hydrostatically at not less the 200 pounds per square inch (psi) for two (2) hours. The hydrostatic test pressure shall be measured at the high point of the system. The hydrostatic test shall be for the entire system as installed and specified.
 - a. In addition to the hydrostatic test, the attic dry pipe system shall undergo an air pressure leakage test at 40psi shall be conducted for 24 hours. Any leakage that

results in a loss of pressure in excess of 1 ½ psi for the 24 hours shall be corrected.

- 2. All alarm equipment, drainage facilities, inspector's tests, etc., shall be operated while the control valves are wide open. The main drain shall be opened and remain open until the system pressure stabilizes. All air shall have been bled from the system at the top inspector's test connection prior to these tests.
- H. After completion of installation and tests, clean interior and exterior surfaces of equipment and materials, painted or unpainted, installed under this section of specifications of dirt, rust, loose scale, oils, grease and other foreign matter.

3.5 MATERIAL HANDLING

- A. Receiving Storage and Handling:
 - 1. The Contractor shall be responsible for all receiving, handling, and storage of his materials at the job site.
 - 2. Site access shall be coordinated with the Owner.

3.6 FLOW TEST DATA

A. Refer to the FSSSS.

END OF SECTION 211313



Fire Sprinkler System Specification Sheet (Per §40-10-250)



Project Data											
Project name: University of South Carolina Softball Stadium Construction											
Location in South Carolina:		Addre	ss: Athle	tic Villa	ge, South Marion S	Street 29201	eet 29201			State project: State Project: No	
		City:	Columbia	ì	County: Richland			S	State project #: H27-6088-MJ		
Water Supply Information (flow test data must be less than 1 year old per \$40-10-250(A)(1))											
Date tes	t conducted	l: 11/14/	2011		Static pressure (psi): 88 R			esidual pressure (psi): 71 Flow (gpm): 1570			
Distance	es of test g	auges re	lative to	the base of the riser: Horizonta			(ft): 310	ft): 310 Vertical (elevation difference in ft): -23*			
Source	of water su	pply:	🗆 Muni	cipal dead-	end Municipal circu	ulation DOther:	on Dother:			Pipe Size (in.):	
Test dat	ta by/from	: Na	Name: Jason A. Shaw, P.E.				Title: Water Engineer				
		Org	Organization: City of Columbia					Telephone #: 803 545 3400			
Fire pump:		□Yes ■	No		Pump Capacity (gpm):		Chur	Churn Pressure (psi):			
		□ New	□ New □Existing		Rated Pressure (psi):		Pressure @ 150% flow (psi):				
On-site storage tank:			□ Yes	■No	□ New □ Existing	Tank capac	Tank capacity (gallons):				
NFPA Hazard Classification (attach continuation page when necessary)											
Area #	Class or Code Reference Description of Hazard Protected (commodity description, storage height, and arrangement as applicable.)										
1	Light Haza	rd	Offices, Meeting, Locker, Team Room, Mech, Elec, Data, Custodial, Mudroom, Training, Corridors, Lobby, Restrooms, First Aid, Enclosed Seating, TV, Media, Radio, PA/SB								
2	Ordinary H	azard Grou	ip 1	Laundry, Concessions, Kitchenette, Hoistway, Elev. Mach, Equipment, Field Storage							
3	NFPA-14 Class 1			Exit Stair Towers							
	Design Parameters										
Area #	(attach continuation page when necessary)										
1	Automatic - Dry 0.10/195			io			e section)	0	(gpm)	100	
2	Automatic - Dry 0.15 / 195			60				0		250	
3	Manual - Dry		NFPA-14 7.10.1.2					750		0	
Seismic Design Data: S _S =0.55 short period centroid											
Codes and Standards											
(attach continuation page when necessary)											
Applicable Codes, Standards & Editions (i.e. "2006 IBC", "2007 NFPA 13", etc.) for the Scope of Work on the Sprinkler System											
NEPA-15(2010), NEPA-14 (2010), ICC IBC (2009), ICC IFC (2009) Scope of work: Above ground fire sprinkler including to five fact outside building footprint. Stordning at four principal											
* Test hydrant is above the base of the riser.											
Specifier's Information											
Name: Todd E. Smith, P.E.											
Engineering services provided through a firm: Yes No											
Firm name: RMF Engineering, Inc.											
Address: 194 Seven Farms Drive, Suite G											
City:	Charleston C-00831										
State:	South C	South Carolina Zip: 29492							2 9.s.		
Phone #:	one #: 843 971 9639 Fax #: 843 971 9641							DE SMIL			
E-mail: todd.smith@rmf.com Certific Seal											

Revision No.: 1

Page _____ of ____

Signature: ITST Shi TH

Date: 03/29/2012

SECTION 220513 - COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.3 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 - 1. Motor controllers.
 - 2. Torque, speed, and horsepower requirements of the load.
 - 3. Ratings and characteristics of supply circuit and required control sequence.
 - 4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with NEMA MG 1 unless otherwise indicated.
- B. Comply with IEEE 841 for severe-duty motors.

2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Energy efficient, as defined in NEMA MG 1.
- C. Service Factor: 1.15.
- D. Multispeed Motors: Variable torque.
 - 1. For motors with 2:1 speed ratio, consequent pole, single winding.
 - 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- E. Multispeed Motors: Separate winding for each speed.
- F. Rotor: Random-wound, squirrel cage.
- G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- H. Temperature Rise: Match insulation rating.
- I. Insulation: Class F.
- J. Code Letter Designation:
 - 1. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
- K. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

- A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
 - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
 - 2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
 - 3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
 - 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
- C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.
2.5 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
 - 1. Permanent-split capacitor.
 - 2. Split phase.
 - 3. Capacitor start, inductor run.
 - 4. Capacitor start, capacitor run.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- D. Motors 1/20 HP and Smaller: Shaded-pole type.
- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 220513

SECTION 220517 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

- 1. Sleeves.
- 2. Stack-sleeve fittings.
- 3. Sleeve-seal systems.
- 4. Sleeve-seal fittings.
- 5. Grout.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.
- C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.
- D. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.
- E. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- F. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.
- G. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

2.2 SLEEVE-SEAL FITTINGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Presealed Systems.
- B. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall. Unit has plastic or rubber waterstop collar with center opening to match piping OD.

2.3 GROUT

- A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
 - 1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
 - 1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
 - 2. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
 - 3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.
 - 1. Cut sleeves to length for mounting flush with both surfaces.

SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

- 2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
- 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint.
- E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.

3.2 SLEEVE-SEAL-FITTING INSTALLATION

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Using grout, seal the space around outside of sleeve-seal fittings.

3.3 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
 - 1. Exterior Concrete Walls above Grade:
 - a. Piping Smaller Than NPS 6: Sleeve-seal fittings.
 - b. Piping NPS 6 and Larger: Galvanized-steel-pipe sleeves.
 - 2. Exterior Concrete Walls below Grade:
 - a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
 - b. Piping NPS 6 and Larger: Galvanized-steel-pipe sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
 - 3. Concrete Slabs-on-Grade:
 - a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
 - b. Piping NPS 6 and Larger: Galvanized-steel-pipe sleeves with sleeve-seal system.

- 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
- 4. Concrete Slabs above Grade:
 - a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.
 - b. Piping NPS 6 and Larger: Galvanized-steel-pipe sleeves.
- 5. Interior Partitions:
 - a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.
 - b. Piping NPS 6 and Larger: Galvanized-steel-sheet sleeves.

END OF SECTION 220517

SECTION 220518 - ESCUTCHEONS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Escutcheons.
 - 2. Floor plates.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

- A. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.
- C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.
- D. Split-Casting Brass Type: With polished, chrome-plated finish and with concealed hinge and setscrew.
- E. Split-Plate, Stamped-Steel Type: With chrome-plated finish, concealed hinge, and spring-clip fasteners.

2.2 FLOOR PLATES

- A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.
- B. Split-Casting Floor Plates: Cast brass with concealed hinge.

3.1 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.
 - 1. Escutcheons for New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Insulated Piping: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.
 - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, castbrass type with polished, chrome-plated finish.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.
 - e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
 - f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.
 - g. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with chrome-plated finish.
 - h. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type or splitplate, stamped-steel type with concealed hinge.
 - i. Bare Piping in Equipment Rooms: One-piece, cast-brass or split-casting brass type with chrome-plated finish.
 - j. Bare Piping in Equipment Rooms: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.
- C. Install floor plates for piping penetrations of equipment-room floors.
- D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
 - 1. New Piping: One-piece, floor-plate type.

3.2 FIELD QUALITY CONTROL

A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION 220518

SECTION 220519 - METERS AND GAGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Liquid-in-glass thermometers.
 - 2. Thermowells.
 - 3. Dial-type pressure gages.
 - 4. Gage attachments.
 - 5. Test plugs.
 - 6. Test-plug kits.
- B. Related Sections:
 - 1. Section 211313 "Fire Protection Sprinkler Systems"
 - 2. Section 221116 "Domestic Water Piping" for water meters inside the building.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of meter and gage, from manufacturer.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 LIQUID-IN-GLASS THERMOMETERS

A. Metal-Case, Compact-Style, Liquid-in-Glass Thermometers:

METERS AND GAGES FOR PLUMBING PIPING

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Trerice, H. O. Co.
- 2. Standard: ASME B40.200.
- 3. Case: Cast aluminum; 6-inch nominal size.
- 4. Case Form: Straight unless otherwise indicated.
- 5. Tube: Glass with magnifying lens and blue or red organic liquid.
- 6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
- 7. Window: Glass or plastic.
- 8. Stem: Aluminum or brass and of length to suit installation.
 - a. Design for Thermowell Installation: Bare stem.
- 9. Connector: 3/4 inch, with ASME B1.1 screw threads.
- 10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.2 THERMOWELLS

- A. Thermowells:
 - 1. Standard: ASME B40.200.
 - 2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
 - 3. Material for Use with Copper Tubing: CNR or CUNI.
 - 4. Material for Use with Steel Piping: CRES.
 - 5. Type: Stepped shank unless straight or tapered shank is indicated.
 - 6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
 - 7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
 - 8. Bore: Diameter required to match thermometer bulb or stem.
 - 9. Insertion Length: Length required to match thermometer bulb or stem.
 - 10. Lagging Extension: Include on thermowells for insulated piping and tubing.
 - 11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.
- B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.3 PRESSURE GAGES

- A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. AMETEK, Inc.; U.S. Gauge.

- b. Ashcroft Inc.
- c. Ernst Flow Industries.
- d. Flo Fab Inc.
- e. Marsh Bellofram.
- f. Miljoco Corporation.
- g. Noshok.
- h. Palmer Wahl Instrumentation Group.
- i. REOTEMP Instrument Corporation.
- j. Tel-Tru Manufacturing Company.
- k. Trerice, H. O. Co.
- 1. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
- m. Weiss Instruments, Inc.
- n. WIKA Instrument Corporation USA.
- o. Winters Instruments U.S.
- 2. Standard: ASME B40.100.
- 3. Case: Liquid-filled type(s); cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
- 4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
- 5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
- 6. Movement: Mechanical, with link to pressure element and connection to pointer.
- 7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
- 8. Pointer: Dark-colored metal.
- 9. Window: Glass].
- 10. Ring: Stainless steel.
- 11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

2.4 GAGE ATTACHMENTS

- A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and piston-type surge-dampening device. Include extension for use on insulated piping.
- B. Valves: Brass ball, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.

2.5 TEST PLUGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Flow Design, Inc.
 - 2. Miljoco Corporation.
 - 3. National Meter, Inc.
 - 4. Peterson Equipment Co., Inc.
 - 5. Sisco Manufacturing Company, Inc.
 - 6. Trerice, H. O. Co.
 - 7. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
 - 8. Weiss Instruments, Inc.
- B. Description: Test-station fitting made for insertion into piping tee fitting.

- C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.
- D. Thread Size: NPS 1/4 ASME B1.20.1 pipe thread.
- E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.
- F. Core Inserts: Chlorosulfonated polyethylene synthetic and EPDM self-sealing rubber.

2.6 TEST-PLUG KITS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Flow Design, Inc.
 - 2. Miljoco Corporation.
 - 3. National Meter, Inc.
 - 4. Peterson Equipment Co., Inc.
 - 5. Sisco Manufacturing Company, Inc.
 - 6. Trerice, H. O. Co.
 - 7. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
 - 8. Weiss Instruments, Inc.
- B. Furnish one test-plug kit containing one thermometer(s), one pressure gage and adapter, and carrying case. Thermometer sensing elements, pressure gage, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.
- C. Low-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch diameter dial and tapered-end sensing element. Dial range shall be at least 25 to 125 deg F.
- D. High-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch diameter dial and tapered-end sensing element. Dial range shall be at least 0 to 220 deg F.
- E. Pressure Gage: Small, Bourdon-tube insertion type with 2- to 3-inch diameter dial and probe. Dial range shall be at least 0 to 200 psig.
- F. Carrying Case: Metal or plastic, with formed instrument padding.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install thermowells with socket extending to center of pipe and in vertical position in piping tees.
- B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

- C. Install thermowells with extension on insulated piping.
- D. Fill thermowells with heat-transfer medium.
- E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
- F. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.
- G. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.
- H. Install remote-mounted pressure gages on panel.
- I. Install valve and snubber in piping for each pressure gage for fluids.
- J. Install test plugs in piping tees.
- K. Install thermometers in the following locations:
 - 1. Inlet and outlet of each water heater.
- L. Install pressure gages in the following locations:
 - 1. Building water service entrance into building.
 - 2. Inlet and outlet of each pressure-reducing valve.
 - 3. Suction and discharge of each domestic water pump.

3.2 CONNECTIONS

A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

3.3 ADJUSTING

A. Adjust faces of meters and gages to proper angle for best visibility.

3.4 THERMOMETER SCHEDULE

- A. Thermometers at inlet and outlet of each domestic water heater shall be the following:
 - 1. Liquid-filled, bimetallic-actuated type.
- B. Insert additional paragraphs for thermometer applications here.
- C. Thermometer stems shall be of length to match thermowell insertion length.

3.5 THERMOMETER SCALE-RANGE SCHEDULE

- A. Scale Range for Domestic Cold-Water Piping: 0 to 100 deg F.
- B. Scale Range for Domestic Hot-Water Piping: 0 to 250 deg F.

3.6 PRESSURE-GAGE SCHEDULE

- A. Pressure gages at discharge of each water service into building shall be the following:
 - 1. Liquid-filled direct-mounted, metal case.
- B. Pressure gages at inlet and outlet of each water pressure-reducing valve shall be the following:
 - 1. Liquid-filled direct-mounted, metal case.
- C. Pressure gages at suction and discharge of each domestic water pump shall be the following:
 - 1. Liquid-filled direct-mounted, metal case.

3.7 PRESSURE-GAGE SCALE-RANGE SCHEDULE

A. Scale Range for Domestic Water Piping: 0 to 100 psi.

END OF SECTION 220519

SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Bronze angle valves.
 - 2. Brass ball valves.
 - 3. Bronze ball valves.
 - 4. Iron ball valves.
 - 5. Bronze swing check valves.
 - 6. Iron swing check valves.
 - 7. Bronze gate valves.
 - 8. Iron gate valves.
 - 9. Bronze globe valves.
 - 10. Iron globe valves.
 - 11. Chainwheels.
- B. Related Sections:
 - 1. Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
 - 2. Section 221116 "Domestic Water Piping" for valves applicable only to this piping.

1.3 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Nonrising stem.
- E. OS&Y: Outside screw and yoke.
- F. RS: Rising stem.
- G. SWP: Steam working pressure.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of valve indicated.

1.5 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
 - 1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 - 2. ASME B31.1 for power piping valves.
 - 3. ASME B31.9 for building services piping valves.
- C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooves, and weld ends.
 - 3. Set angle, gate, and globe valves closed to prevent rattling.
 - 4. Set ball and plug valves open to minimize exposure of functional surfaces.
 - 5. Set butterfly valves closed or slightly open.
 - 6. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to valve schedule articles for applications of valves.
- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.

GENERAL-DUTY VALVES FOR PLUMBING PIPING

- D. Valve Actuator Types:
 - 1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
 - 2. Handwheel: For valves other than quarter-turn types.
 - 3. Handlever: For quarter-turn valves NPS 6 and smaller.
 - 4. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.
- E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
 - 1. Gate Valves: With rising stem.
 - 2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
 - 3. Butterfly Valves: With extended neck.
- F. Valve-End Connections:
 - 1. Flanged: With flanges according to ASME B16.1 for iron valves.
 - 2. Solder Joint: With sockets according to ASME B16.18.
 - 3. Threaded: With threads according to ASME B1.20.1.
- G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE ANGLE VALVES

- A. Class 125, Bronze Angle Valves with Bronze Disc:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Hammond Valve.
 - b. Milwaukee Valve Company.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded.
 - e. Stem and Disc: Bronze.
 - f. Packing: Asbestos free.
 - g. Handwheel: Malleable iron, bronze, or aluminum.

2.3 BRASS BALL VALVES

A. Two-Piece, Full-Port, Brass Ball Valves with Brass Trim:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. DynaQuip Controls.
 - d. Flow-Tek, Inc.; a subsidiary of Bray International, Inc.
 - e. Hammond Valve.
 - f. Jamesbury; a subsidiary of Metso Automation.
 - g. Jomar International, LTD.
 - h. Kitz Corporation.
 - i. Legend Valve.
 - j. Marwin Valve; a division of Richards Industries.
 - k. Milwaukee Valve Company.
 - 1. NIBCO INC.
 - m. Red-White Valve Corporation.
 - n. RuB Inc.
- 2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Two piece.
 - e. Body Material: Forged brass.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Brass.
 - i. Ball: Chrome-plated brass.
 - j. Port: Full.

2.4 BRONZE BALL VALVES

- A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. American Valve, Inc.
 - b. Conbraco Industries, Inc.; Apollo Valves.
 - c. Crane Co.; Crane Valve Group; Crane Valves.
 - d. Hammond Valve.
 - e. Lance Valves; a division of Advanced Thermal Systems, Inc.
 - f. Legend Valve.
 - g. Milwaukee Valve Company.
 - h. NIBCO INC.
 - i. Red-White Valve Corporation.
 - j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

University of South Carolina Softball Stadium Construction BID SET

- 2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Two piece.
 - e. Body Material: Bronze.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Bronze.
 - i. Ball: Chrome-plated brass.
 - j. Port: Full.

2.5 IRON BALL VALVES

- A. Class 125, Iron Ball Valves:
 - 1. Manufacturers: Subject to compliance with requirements, [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. American Valve, Inc.
 - b. Conbraco Industries, Inc.; Apollo Valves.
 - c. Kitz Corporation.
 - d. Sure Flow Equipment Inc.
 - e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

- a. Standard: MSS SP-72.
- b. CWP Rating: 200 psig.
- c. Body Design: Split body.
- d. Body Material: ASTM A 126, gray iron.
- e. Ends: Flanged.
- f. Seats: PTFE or TFE.
- g. Stem: Stainless steel.
- h. Ball: Stainless steel.
- i. Port: Full.

2.6 BRONZE SWING CHECK VALVES

- A. Class 125, Bronze Swing Check Valves with Bronze Disc:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. American Valve, Inc.
 - b. Crane Co.; Crane Valve Group; Crane Valves.

- c. Crane Co.; Crane Valve Group; Jenkins Valves.
- d. Crane Co.; Crane Valve Group; Stockham Division.
- e. Hammond Valve.
- f. Kitz Corporation.
- g. Milwaukee Valve Company.
- h. NIBCO INC.
- i. Powell Valves.
- j. Red-White Valve Corporation.
- k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- l. Zy-Tech Global Industries, Inc.
- 2. Description:
 - a. Standard: MSS SP-80, Type 3.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: Bronze.

2.7 IRON SWING CHECK VALVES

- A. Class 125, Iron Swing Check Valves with Metal Seats:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Hammond Valve.
 - e. Kitz Corporation.
 - f. Legend Valve.
 - g. Milwaukee Valve Company.
 - h. NIBCO INC.
 - i. Powell Valves.
 - j. Red-White Valve Corporation.
 - k. Sure Flow Equipment Inc.
 - 1. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - m. Zy-Tech Global Industries, Inc.
 - 2. Description:
 - a. Standard: MSS SP-71, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Clear or full waterway.
 - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - e. Ends: Flanged.
 - f. Trim: Bronze.

g. Gasket: Asbestos free.

2.8 BRONZE GATE VALVES

- A. Class 125, NRS Bronze Gate Valves:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. American Valve, Inc.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Division.
 - e. Hammond Valve.
 - f. Kitz Corporation.
 - g. Milwaukee Valve Company.
 - h. NIBCO INC.
 - i. Powell Valves.
 - j. Red-White Valve Corporation.
 - k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 1. Zy-Tech Global Industries, Inc.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded or solder joint.
 - e. Stem: Bronze.
 - f. Disc: Solid wedge; bronze.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron, bronze, or aluminum.

2.9 IRON GATE VALVES

- A. Class 125, NRS, Iron Gate Valves:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Flo Fab Inc.
 - e. Hammond Valve.
 - f. Kitz Corporation.
 - g. Legend Valve.

- h. Milwaukee Valve Company.
- i. NIBCO INC.
- j. Powell Valves.
- k. Red-White Valve Corporation.
- 1. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- m. Zy-Tech Global Industries, Inc.
- 2. Description:
 - a. Standard: MSS SP-70, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - d. Ends: Flanged.
 - e. Trim: Bronze.
 - f. Disc: Solid wedge.
 - g. Packing and Gasket: Asbestos free.

2.10 BRONZE GLOBE VALVES

- A. Class 125, Bronze Globe Valves with Bronze Disc:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. Hammond Valve.
 - d. Kitz Corporation.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Powell Valves.
 - h. Red-White Valve Corporation.
 - i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - j. Zy-Tech Global Industries, Inc.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded or solder joint.
 - e. Stem and Disc: Bronze.
 - f. Packing: Asbestos free.
 - g. Handwheel: Malleable iron, bronze, or aluminum.

2.11 IRON GLOBE VALVES

A. Class 125, Iron Globe Valves:

GENERAL-DUTY VALVES FOR PLUMBING PIPING

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Hammond Valve.
 - e. Kitz Corporation.
 - f. Milwaukee Valve Company.
 - g. NIBCO INC.
 - h. Powell Valves.
 - i. Red-White Valve Corporation.
 - j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - k. Zy-Tech Global Industries, Inc.
- 2. Description:
 - a. Standard: MSS SP-85, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - d. Ends: Flanged.
 - e. Trim: Bronze.
 - f. Packing and Gasket: Asbestos free.

2.12 CHAINWHEELS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Babbitt Steam Specialty Co.
 - 2. Roto Hammer Industries.
 - 3. Trumbull Industries.
- B. Description: Valve actuation assembly with sprocket rim, brackets, and chain.
 - 1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
 - 2. Attachment: For connection to ball and plug valve stems.
 - 3. Sprocket Rim with Chain Guides: Ductile or cast iron, of type and size required for valve. Include zinc coating.
 - 4. Chain: Hot-dip, galvanized steel, of size required to fit sprocket rim.

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install chainwheels on operators for ball, gate, globe and plug valves NPS 4 and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.
- F. Install check valves for proper direction of flow and as follows:
 - 1. Swing Check Valves: In horizontal position with hinge pin level.
 - 2. Lift Check Valves: With stem upright and plumb.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 - 1. Shutoff Service: Ball or gate valves.

GENERAL-DUTY VALVES FOR PLUMBING PIPING

- 2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
- 3. Pump-Discharge Check Valves:
 - a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.
 - b. NPS 2-1/2 and Larger for Domestic Water: Iron swing check valves with lever and weight or with spring or iron, center-guided, metal-seat check valves.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- C. Select valves, except wafer types, with the following end connections:
 - 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valveend option is indicated in valve schedules below.
 - 2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - 3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
 - 4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
 - 5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - 6. For Steel Piping, NPS 5 and Larger: Flanged ends.

3.5 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
 - 1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
 - 2. Bronze Angle Valves: Class 125, bronze disc.
 - 3. Ball Valves: Two piece, full port, brass with brass trim.
 - 4. Bronze Swing Check Valves: Class 125, bronze disc.
 - 5. Bronze Gate Valves: Class 125, NRS.
 - 6. Bronze Globe Valves: Class 125, bronze disc.
- B. Pipe NPS 2-1/2 and Larger:
 - 1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
 - 2. Iron Ball Valves: Class 150.
 - 3. Iron Swing Check Valves: Class 125, metal seats.
 - 4. Iron Gate Valves: Class 125, NRS.
 - 5. Iron Globe Valves: Class 125.

END OF SECTION 220523

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Metal pipe hangers and supports.
 - 2. Metal framing systems.
 - 3. Thermal-hanger shield inserts.
 - 4. Fastener systems.
 - 5. Pipe stands.
 - 6. Pipe positioning systems.
 - 7. Equipment supports.
- B. Related Sections:
 - 1. Section 220516 "Expansion Fittings and Loops for Plumbing Piping" for pipe guides and anchors.
 - 2. Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment" for vibration isolation devices.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
 - 1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.

- 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- 3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following; include Product Data for components:
 - 1. Metal framing systems.
 - 2. Pipe stands.
 - 3. Equipment supports.
- C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Detail fabrication and assembly of trapeze hangers.
 - 2. Design Calculations: Calculate requirements for designing trapeze hangers.

1.6 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- 1.7 QUALITY ASSURANCE
 - A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code Steel."
 - B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:
 - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 - 2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
 - 3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
 - 4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.

- 5. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.
- B. Stainless-Steel Pipe Hangers and Supports:
 - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 - 2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
 - 3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.
- C. Copper Pipe Hangers:
 - 1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
 - 2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

2.2 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 METAL FRAMING SYSTEMS

- A. MFMA Manufacturer Metal Framing Systems:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.
 - c. Flex-Strut Inc.
 - d. GS Metals Corp.
 - e. Thomas & Betts Corporation.
 - f. Unistrut Corporation; Tyco International, Ltd.
 - g. Wesanco, Inc.
 - 2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
 - 3. Standard: MFMA-4.
 - 4. Channels: Continuous slotted steel channel with inturned lips.
 - 5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
 - 6. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.
 - 7. Metallic Coating: Hot-dipped galvanized.
 - 8. Paint Coating: Epoxy.
 - 9. Plastic Coating: Epoxy.
- B. Non-MFMA Manufacturer Metal Framing Systems:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Anvil International; a subsidiary of Mueller Water Products Inc.
 - b. Empire Industries, Inc.
 - c. ERICO International Corporation.
 - d. Haydon Corporation; H-Strut Division.
 - e. NIBCO INC.
 - f. PHD Manufacturing, Inc.
 - g. PHS Industries, Inc.
- 2. Description: Shop- or field-fabricated pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
- 3. Standard: Comply with MFMA-4.
- 4. Channels: Continuous slotted steel channel with inturned lips.
- 5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
- 6. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.
- 7. Coating: Zinc.

2.4 THERMAL-HANGER SHIELD INSERTS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Carpenter & Paterson, Inc.
 - 2. Clement Support Services.
 - 3. ERICO International Corporation.
 - 4. National Pipe Hanger Corporation.
 - 5. PHS Industries, Inc.
 - 6. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
 - 7. Piping Technology & Products, Inc.
 - 8. Rilco Manufacturing Co., Inc.
 - 9. Value Engineered Products, Inc.
- B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig minimum compressive strength and vapor barrier.
- C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig minimum compressive strength.
- D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.5 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type, stainless-steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.6 PIPE STANDS

- A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
- C. Low-Type, Single-Pipe Stand: One-piece stainless-steel base unit with plastic roller, for roof installation without membrane penetration.
- D. High-Type, Single-Pipe Stand:
 - 1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
 - 2. Base: Stainless steel.
 - 3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
 - 4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainlesssteel, roller-type pipe support.
- E. High-Type, Multiple-Pipe Stand:
 - 1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
 - 2. Bases: One or more; plastic.
 - 3. Vertical Members: Two or more protective-coated-steel channels.
 - 4. Horizontal Member: Protective-coated-steel channel.
 - 5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.
- F. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.7 PIPE POSITIONING SYSTEMS

A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.8 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbonsteel shapes.

2.9 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
 - 2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. Fastener System Installation:
 - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

- F. Pipe Stand Installation:
 - 1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
 - 2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Section 077200 "Roof Accessories" for curbs.
- G. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.
- H. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- I. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- J. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- K. Install lateral bracing with pipe hangers and supports to prevent swaying.
- L. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- M. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- N. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- O. Insulated Piping:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
 - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weightdistribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

- 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weightdistribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
- 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
 - b. NPS 4: 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
 - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
 - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
- 5. Pipes NPS 8 and Larger: Include reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
- 6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports, metal trapeze pipe hangers and metal framing systems and attachments for general service applications.
- F. Use stainless-steel pipe hangers and stainless-steel attachments for hostile environment applications. This includes unconditioned areas.
- G. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.
- H. Use padded hangers for piping that is subject to scratching.
- I. Use thermal-hanger shield inserts for insulated piping and tubing.
- J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.

- 2. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
- 3. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
- 4. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow offcenter closure for hanger installation before pipe erection.
- 5. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
- 6. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
- 7. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
- 8. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
- 9. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
- 10. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
- 11. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
- 12. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
- 13. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steelpipe base stanchion support and cast-iron floor flange or carbon-steel plate.
- 14. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
- 15. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
- 16. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
- 17. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.
- 18. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
- 19. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
- 20. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
 - 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 - 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
 - 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 - 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 - 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 - 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
 - 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 - 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 - 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 - 6. C-Clamps (MSS Type 23): For structural shapes.
 - 7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 - 8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 - 9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel Ibeams for heavy loads.
 - 10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel Ibeams for heavy loads, with link extensions.
 - 11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 - 12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
 - 13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 - 14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
 - 15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 - 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.

- 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
 - 2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 - 3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
 - 4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
 - 5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
 - 6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
 - 7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
 - 8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
 - a. Horizontal (MSS Type 54): Mounted horizontally.
 - b. Vertical (MSS Type 55): Mounted vertically.
 - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- P. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- Q. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- R. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.
- S. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 220529

SECTION 220533 - HEAT TRACING FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes plumbing piping heat tracing for freeze prevention:
 - 1. Self-regulating, parallel resistance.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated capacities, operating characteristics, and furnished specialties and accessories.
 - 2. Schedule heating capacity, length of cable, spacing, and electrical power requirement for each electric heating cable required.
- B. Shop Drawings: For electric heating cable.
 - 1. Include plans, elevations, sections, and attachment details.
 - 2. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For electric heating cables to include in operation and maintenance manuals.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace electric heating cable that fails in materials or workmanship within specified warranty period.

HEAT TRACING FOR PLUMBING PIPING

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SELF-REGULATING, PARALLEL-RESISTANCE HEATING CABLES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. BriskHeat.
 - 2. Chromalox.
 - 3. Delta-Therm Corporation.
 - 4. Easy Heat; a division of EGS Electrical Group LLC.
 - 5. Nelson Heat Trace; a division of EGS Electrical Group LLC.
 - 6. Pyrotenax; a brand of Tyco Thermal Controls LLC.
 - 7. Raychem; a brand of Tyco Thermal Controls LLC.
 - 8. Thermon Americas Inc.
 - 9. Trasor Corp.
- B. Comply with IEEE 515.1.
- C. Heating Element: Pair of parallel No. 16 or No. 18 AWG, nickel-coated, stranded copper bus wires embedded in crosslinked conductive polymer core, which varies heat output in response to temperature along its length. Terminate with waterproof, factory-assembled, nonheating leads with connectors at one end, and seal the opposite end watertight. Cable shall be capable of crossing over itself once without overheating.
- D. Electrical Insulating Jacket: Flame-retardant polyolefin.
- E. Cable Cover: Tinned-copper braid and polyolefin outer jacket with ultraviolet inhibitor.
- F. Maximum Operating Temperature (Power On): 150 deg F.
- G. Maximum Exposure Temperature (Power Off): 185 deg F.
- H. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 CONTROLS

- A. Pipe-Mounted Thermostats for Freeze Protection:
 - 1. Remote bulb unit with adjustable temperature range from 30 to 50 deg F.
 - 2. Snap action; open-on-rise, single-pole switch with minimum current rating adequate for connected cable.
 - 3. Remote bulb on capillary, resistance temperature device, or thermistor for directly sensing pipe-wall temperature.
 - 4. Corrosion-resistant, waterproof control enclosure.

2.3 ACCESSORIES

- A. Cable Installation Accessories: Fiberglass tape, heat-conductive putty, cable ties, silicone end seals and splice kits, and installation clips all furnished by manufacturer, or as recommended in writing by manufacturer.
- B. Warning Labels: Refer to Section 220553 "Identification for Plumbing Piping and Equipment."
- C. Warning Tape: Continuously printed "Electrical Tracing"; vinyl, at least 3 mils thick, and with pressure-sensitive, permanent, waterproof, self-adhesive back.
 - 1. Width for Markers on Pipes with OD, Including Insulation, Less Than 6 Inches: 3/4 inch minimum.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces and substrates to receive electric heating cables for compliance with requirements for installation tolerances and other conditions affecting performance.
 - 1. Ensure surfaces and pipes in contact with electric heating cables are free of burrs and sharp protrusions.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install electric heating cable across expansion, construction, and control joints according to manufacturer's written instructions; use cable-protection conduit and slack cable to allow movement without damage to cable.
- B. Electric Heating-Cable Installation for Freeze Protection for Piping:
 - 1. Install electric heating cables after piping has been tested and before insulation is installed.
 - 2. Install electric heating cables according to IEEE 515.1.
 - 3. Install insulation over piping with electric cables according to Section 220719 "Plumbing Piping Insulation."
 - 4. Install warning tape on piping insulation where piping is equipped with electric heating cables.
- C. Set field-adjustable switches and circuit-breaker trip ranges.

3.3 CONNECTIONS

A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

HEAT TRACING FOR PLUMBING PIPING

B. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. Perform tests after cable installation but before application of coverings such as insulation, wall or ceiling construction, or concrete.
 - 2. Test cables for electrical continuity and insulation integrity before energizing.
 - 3. Test cables to verify rating and power input. Energize and measure voltage and current simultaneously.
- C. Repeat tests for continuity, insulation resistance, and input power after applying thermal insulation on pipe-mounted cables.
- D. Cables will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

3.5 PROTECTION

- A. Protect installed heating cables, including nonheating leads, from damage during construction.
- B. Remove and replace damaged heat-tracing cables.

END OF SECTION 220533

University of South Carolina Softball Stadium Construction BID SET

SECTION 220548 - VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Isolation pads.
 - 2. Isolation mounts.
 - 3. Restrained elastomeric isolation mounts.
 - 4. Freestanding and restrained spring isolators.
 - 5. Housed spring mounts.
 - 6. Elastomeric hangers.
 - 7. Spring hangers.
 - 8. Spring hangers with vertical-limit stops.
 - 9. Pipe riser resilient supports.
 - 10. Resilient pipe guides.
 - 11. Seismic snubbers.
 - 12. Restraining braces and cables.
 - 13. Steel and inertia, vibration isolation equipment bases.

1.3 DEFINITIONS

- A. IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.
- C. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.4 PERFORMANCE REQUIREMENTS

- A. Seismic-Restraint Loading:
 - 1. Site Class as Defined in the IBC: C.
 - 2. Assigned Seismic Use Group or Building Category as Defined in the IBC: II.
 - a. Component Importance Factor: 1.0.
 - b. Component Response Modification Factor: 1.5.
 - c. Component Amplification Factor: 1.0.

- 3. Design Spectral Response Acceleration at Short Periods (0.2 Second): .558.
- 4. Design Spectral Response Acceleration at 1-Second Period: .150.

1.5 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
 - 2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
 - a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
 - b. Annotate to indicate application of each product submitted and compliance with requirements.
 - 3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.
- B. Delegated-Design Submittal: For vibration isolation and seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic forces required to select vibration isolators, seismic restraints, and for designing vibration isolation bases.
 - 2. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system has been examined for excessive stress and that none will exist.
 - 3. Vibration Isolation Base Details: Detail overall dimensions, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads.
 - 4. Seismic-Restraint Details:
 - a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
 - b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
 - c. Preapproval and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

1.6 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Show coordination of seismic bracing for plumbing piping and equipment with other systems and equipment in the vicinity, including other supports and seismic restraints.
- B. Qualification Data: For professional engineer and testing agency.
- C. Welding certificates.
- D. Field quality-control test reports.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air-mounting systems to include in operation and maintenance manuals.

1.8 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
- B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code Steel."
- D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproved by ICC-ES, or preapproved by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ace Mountings Co., Inc.

- 2. Amber/Booth Company, Inc.
- 3. California Dynamics Corporation.
- 4. Isolation Technology, Inc.
- 5. Kinetics Noise Control.
- 6. Mason Industries.
- 7. Vibration Eliminator Co., Inc.
- 8. Vibration Isolation.
- 9. Vibration Mountings & Controls, Inc.
- C. Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.
 - 1. Resilient Material: Oil- and water-resistant neoprene.
- D. Mounts: Double-deflection type, with molded, oil-resistant rubber, hermetically sealed compressed fiberglass, or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.
 - 1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
 - 2. Neoprene: Shock-absorbing materials compounded according to the standard for bridgebearing neoprene as defined by AASHTO.
- E. Restrained Mounts: All-directional mountings with seismic restraint.
 - 1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
 - 2. Neoprene: Shock-absorbing materials compounded according to the standard for bridgebearing neoprene as defined by AASHTO.
- F. Spring Isolators: Freestanding, laterally stable, open-spring isolators.
 - 1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - 2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - 3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 - 4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 - 5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch-thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 500 psig.
 - 6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.
- G. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic or limit-stop restraint.

- 1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled baseplate bonded to 1/4-inch-thick, neoprene or rubber isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
- 2. Restraint: Seismic or limit-stop as required for equipment and authorities having jurisdiction.
- 3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
- 4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
- 5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
- 6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
- H. Housed Spring Mounts: Housed spring isolator with integral seismic snubbers.
 - 1. Housing: Ductile-iron or steel housing to provide all-directional seismic restraint.
 - 2. Base: Factory drilled for bolting to structure.
 - 3. Snubbers: Vertically adjustable to allow a maximum of 1/4-inch travel up or down before contacting a resilient collar.
- I. Elastomeric Hangers: Single or double-deflection type, fitted with molded, oil-resistant elastomeric isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity range.
- J. Spring Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.
 - 1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
 - 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 - 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 - 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
 - 7. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.
- K. Spring Hangers with Vertical-Limit Stop: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression and with a vertical-limit stop.
 - 1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
 - 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

- 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
- 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
- 7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
- 8. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.
- L. Pipe Riser Resilient Support: All-directional, acoustical pipe anchor consisting of 2 steel tubes separated by a minimum of 1/2-inch-thick neoprene. Include steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions. Design support for a maximum load on the isolation material of 500 psig and for equal resistance in all directions.
- M. Resilient Pipe Guides: Telescopic arrangement of 2 steel tubes or post and sleeve arrangement separated by a minimum of 1/2-inch-thick neoprene. Where clearances are not readily visible, a factory-set guide height with a shear pin to allow vertical motion due to pipe expansion and contraction shall be fitted. Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.2 VIBRATION ISOLATION EQUIPMENT BASES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Amber/Booth Company, Inc.
 - 2. California Dynamics Corporation.
 - 3. Isolation Technology, Inc.
 - 4. Kinetics Noise Control.
 - 5. Mason Industries.
 - 6. Vibration Eliminator Co., Inc.
 - 7. Vibration Isolation.
 - 8. Vibration Mountings & Controls, Inc.
- C. Steel Base: Factory-fabricated, welded, structural-steel bases and rails.
 - 1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
 - a. Include supports for suction and discharge elbows for pumps.
 - 2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
 - 3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

- D. Inertia Base: Factory-fabricated, welded, structural-steel bases and rails ready for placement of cast-in-place concrete.
 - 1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
 - a. Include supports for suction and discharge elbows for pumps.
 - 2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
 - 3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
 - 4. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

2.3 SEISMIC-RESTRAINT DEVICES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Amber/Booth Company, Inc.
 - 2. California Dynamics Corporation.
 - 3. Cooper B-Line, Inc.; a division of Cooper Industries.
 - 4. Hilti, Inc.
 - 5. Kinetics Noise Control.
 - 6. Loos & Co.; Cableware Division.
 - 7. Mason Industries.
 - 8. TOLCO Incorporated; a brand of NIBCO INC.
 - 9. Unistrut; Tyco International, Ltd.
- C. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.
 - 1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.
- D. Snubbers: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.
 - 1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
 - 2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
 - 3. Maximum 1/4-inch air gap, and minimum 1/4-inch-thick resilient cushion.

- E. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.
- F. Restraint Cables: ASTM A 492 stainless-steel cables with end connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.
- G. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.
- H. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.
- I. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.
- J. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.
- K. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.
- L. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.4 FACTORY FINISHES

- A. Finish: Manufacturer's standard prime-coat finish ready for field painting.
- B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
 - 1. Powder coating on springs and housings.
 - 2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
 - 3. Baked enamel or powder coat for metal components on isolators for interior use.
 - 4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.
- B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Equipment Restraints:
 - 1. Install seismic snubbers on plumbing equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
 - 2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inches.
 - 3. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.
- B. Piping Restraints:
 - 1. Comply with requirements in MSS SP-127.
 - 2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
 - 3. Brace a change of direction longer than 12 feet.
- C. Install cables so they do not bend across edges of adjacent equipment or building structure.
- D. Install seismic-restraint devices using methods approved an agency acceptable to authorities having jurisdiction providing required submittals for component.

- E. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- F. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- G. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- H. Drilled-in Anchors:
 - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
 - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 - 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
 - 4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
 - 5. Set anchors to manufacturer's recommended torque, using a torque wrench.
 - 6. Install zinc-coated steel anchors for interior and stainless steel anchors for exterior applications.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
 - 1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
 - 2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
 - 3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
 - 4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
 - 5. Test to 90 percent of rated proof load of device.
 - 6. Measure isolator restraint clearance.
 - 7. Measure isolator deflection.
 - 8. Verify snubber minimum clearances.

- 9. Air-Mounting System Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
- 10. Air-Mounting System Operational Test: Test the compressed-air leveling system.
- 11. Test and adjust air-mounting system controls and safeties.
- 12. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.
- D. Remove and replace malfunctioning units and retest as specified above.
- E. Prepare test and inspection reports.

3.5 ADJUSTING

- A. Adjust isolators after piping system is at operating weight.
- B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
- C. Adjust active height of sprint isolators.
- D. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION 220548

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Pipe labels.
 - 4. Stencils.
 - 5. Valve tags.
 - 6. Warning tags.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve numbering scheme.
- E. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

2.1 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
 - 1. Material and Thickness: Stainless steel, 0.025-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 - 3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 - 4. Fasteners: Stainless-steel rivets or self-tapping screws.
 - 5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Plastic Labels for Equipment:
 - 1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
 - 2. Letter Color: Black.
 - 3. Background Color: White.
 - 4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
 - 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 - 6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 - 7. Fasteners: Stainless-steel rivets or self-tapping screws.
 - 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.
- D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: White.

- C. Background Color: Red.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 inches high.

2.4 STENCILS

- A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; and minimum letter height of 3/4 inch for access panel and door labels, equipment labels, and similar operational instructions.
 - 1. Stencil Material: Fiberboard or metal.
 - 2. Stencil Paint: Exterior, gloss, acrylic enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.
 - 3. Identification Paint: Exterior, acrylic enamel in colors according to ASME A13.1 unless otherwise indicated.

2.5 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
 - 1. Tag Material: Stainless steel, 0.025-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. Fasteners: Brass wire-link or beaded chain.
- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
 - 1. Valve-tag schedule shall be included in operation and maintenance data.

2.6 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
 - 1. Size: Approximately 4 by 7 inches.
 - 2. Fasteners: Brass grommet and wire.
 - 3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
 - 4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

A. Piping Color-Coding: Painting of piping is specified in Section 099123 "Interior Painting."

- B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels with painted, color-coded bands or rectangles, complying with ASME A13.1, on each piping system.
 - 1. Identification Paint: Use for contrasting background.
 - 2. Stencil Paint: Use for pipe marking.
- C. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- D. Pipe Label Color Schedule:
 - 1. Domestic Water Piping:
 - a. Background Color: White.
 - b. Letter Color: Black.
 - 2. Sanitary Waste and Storm Drainage Piping:
 - a. Background Color: White.
 - b. Letter Color: Black.

3.4 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
 - 1. Valve-Tag Size and Shape:
 - a. Cold Water: 1-1/2 inches, round.
 - b. Hot Water: 1-1/2 inches round.
 - 2. Valve-Tag Color:

- a. Cold Water: Natural.
- b. Hot Water: Natural.
- 3. Letter Color:
 - a. Cold Water: Black.
 - b. Hot Water: Black.

3.5 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 220553

SECTION 220716 - PLUMBING EQUIPMENT INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes insulating the following plumbing equipment:
 - 1. Domestic water and hot-water pumps.
 - 2. Domestic water storage tanks.
- B. Related Sections:
 - 1. Section 220719 "Plumbing Piping Insulation."

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied, if any).
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Detail attachment and covering of heat tracing inside insulation.
 - 3. Detail removable insulation at equipment connections and access panels.
 - 4. Detail application of field-applied jackets.
 - 5. Detail application at linkages of control devices.
 - 6. Detail field application for each equipment type.
- C. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use. Sample sizes are as follows:
 - 1. Sheet Form Insulation Materials: 12 inches square.
 - 2. Sheet Jacket Materials: 12 inches square.
 - 3. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

PLUMBING EQUIPMENT INSULATION

- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- C. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
- B. Coordinate clearance requirements with equipment Installer for equipment insulation application.
- C. Coordinate installation and testing of heat tracing.

1.8 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

2.1 INSULATION MATERIALS

- A. Comply with requirements in "Equipment Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Calcium Silicate:
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Industrial Insulation Group (IIG); Thermo-12 Gold.
 - 2. Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
- G. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Pittsburgh Corning Corporation; Foamglas.
 - 2. Block Insulation: ASTM C 552, Type I.
 - 3. Special-Shaped Insulation: ASTM C 552, Type III.
 - 4. Board Insulation: ASTM C 552, Type IV.
 - 5. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
 - 6. Preformed Pipe Insulation with Factory-Applied ASJ-SSL: Comply with ASTM C 552, Type II, Class 2.
 - 7. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
- H. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.

- 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Aeroflex USA, Inc.; Aerocel.
 - b. Armacell LLC; AP Armaflex.
 - c. K-Flex USA; Insul-Sheet and K-FLEX LS.
- I. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. CertainTeed Corp.; SoftTouch Duct Wrap.
 - b. Johns Manville; Microlite.
 - c. Knauf Insulation; Friendly Feel Duct Wrap.
 - d. Manson Insulation Inc.; Alley Wrap.
 - e. Owens Corning; SOFTR All-Service Duct Wrap.
- J. High-Temperature, Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type V, without factory-applied jacket.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Industrial Insulation Group (IIG); MinWool-1200 Flexible Batt.
 - b. Johns Manville; HTB 26 Spin-Glas.
 - c. Roxul Inc.; Roxul RW.
- K. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For equipment applications, provide insulation with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. CertainTeed Corp.; CertaPro Commercial Board.
 - b. Fibrex Insulations Inc.; FBX.
 - c. Johns Manville; 800 Series Spin-Glas.
 - d. Knauf Insulation; Insulation Board.
 - e. Manson Insulation Inc.; AK Board.
 - f. Owens Corning; Fiberglas 700 Series.
- L. High-Temperature, Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type III, without factory-applied jacket.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- a. Fibrex Insulations Inc.; FBX.
- b. Industrial Insulation Group (IIG); MinWool-1200 Industrial Board.
- c. Rock Wool; Delta Board.
- d. Roxul Inc.; RHT and RockBoard.
- e. Thermafiber, Inc.; Thermafiber Industrial Felt.
- M. Mineral-Fiber, Preformed Pipe Insulation:
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Fibrex Insulations Inc.; Coreplus 1200.
 - b. Johns Manville; Micro-Lok.
 - c. Knauf Insulation; 1000-Degree Pipe Insulation.
 - d. Manson Insulation Inc.; Alley-K.
 - e. Owens Corning; Fiberglas Pipe Insulation.
 - 2. Type I, 850 Deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factoryapplied jacket requirements are specified in "Factory-Applied Jackets" Article.
- N. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied FSK jacket complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. CertainTeed Corp.; CrimpWrap.
 - b. Johns Manville; MicroFlex.
 - c. Knauf Insulation; Pipe and Tank Insulation.
 - d. Manson Insulation Inc.; AK Flex.
 - e. Owens Corning; Fiberglas Pipe and Tank Insulation.
- O. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials and Type II, Grade 1 for sheet materials.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Armacell LLC; Tubolit.
 - b. Nomaco Insulation; IMCOLOCK, IMCOSHEET, NOMALOCK, and NOMAPLY.

2.2 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

- 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Ramco Insulation, Inc.; Super-Stik.
- B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Ramco Insulation, Inc.; Thermokote V.
- C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Ramco Insulation, Inc.; Ramcote 1200 and Quik-Cote.

2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Calcium Silicate Adhesive: Fibrous, sodium-silicate-based adhesive with a service temperature range of 50 to 800 deg F.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-97.
 - b. Eagle Bridges Marathon Industries; 290.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-27.
 - d. Mon-Eco Industries, Inc.; 22-30.
 - e. Vimasco Corporation; 760.
 - 2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-84.
- 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Aeroflex USA, Inc.; Aeroseal.
 - b. Armacell LLC; Armaflex 520 Adhesive.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
 - d. K-Flex USA; R-373 Contact Adhesive.
 - 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- E. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
 - b. Eagle Bridges Marathon Industries; 225.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
 - d. Mon-Eco Industries, Inc.; 22-25.
 - 2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- F. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
- b. Eagle Bridges Marathon Industries; 225.
- c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.
- d. Mon-Eco Industries, Inc.; 22-25.
- 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- G. PVC Jacket Adhesive: Compatible with PVC jacket.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dow Corning Corporation; 739, Dow Silicone.
 - b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
 - c. P.I.C. Plastics, Inc.; Welding Adhesive.
 - d. Speedline Corporation; Polyco VP Adhesive.
 - 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.4 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
 - 1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
 - b. Vimasco Corporation; 749.
 - 2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
 - 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 - 4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.

5. Color: White.

- C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-30.
 - b. Eagle Bridges Marathon Industries; 501.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-35.
 - d. Mon-Eco Industries, Inc.; 55-10.
 - 2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
 - 3. Service Temperature Range: 0 to 180 deg F.
 - 4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
 - 5. Color: White.
- D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Encacel.
 - b. Eagle Bridges Marathon Industries; 570.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 60-95/60-96.
 - 2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
 - 3. Service Temperature Range: Minus 50 to plus 220 deg F.
 - 4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
 - 5. Color: White.
- E. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
 - b. Eagle Bridges Marathon Industries; 550.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
 - d. Mon-Eco Industries, Inc.; 55-50.
 - e. Vimasco Corporation; WC-1/WC-5.
 - 2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
 - 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 - 4. Solids Content: 60 percent by volume and 66 percent by weight.

5. Color: White.

2.5 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A, and shall be compatible with insulation materials, jackets, and substrates.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-50 AHV2.
 - b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-36.
 - c. Vimasco Corporation; 713 and 714.
 - 2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over insulation.
 - 3. Service Temperature Range: 0 to plus 180 deg F.
 - 4. Color: White.

2.6 SEALANTS

- A. Joint Sealants:
 - 1. Joint Sealants for Cellular-Glass Products: available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
 - b. Eagle Bridges Marathon Industries; 405.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-45.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Pittsburgh Corning Corporation; Pittseal 444.
 - 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 - 3. Permanently flexible, elastomeric sealant.
 - 4. Service Temperature Range: Minus 100 to plus 300 deg F.
 - 5. Color: White or gray.
 - 6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. FSK and Metal Jacket Flashing Sealants:

- 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
 - b. Eagle Bridges Marathon Industries; 405.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
 - d. Mon-Eco Industries, Inc.; 44-05.
- 2. Materials shall be compatible with insulation materials, jackets, and substrates.
- 3. Fire- and water-resistant, flexible, elastomeric sealant.
- 4. Service Temperature Range: Minus 40 to plus 250 deg F.
- 5. Color: Aluminum.
- 6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- 7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
 - 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 - 3. Fire- and water-resistant, flexible, elastomeric sealant.
 - 4. Service Temperature Range: Minus 40 to plus 250 deg F.
 - 5. Color: White.
 - 6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.7 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
 - 1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
 - 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
 - 3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

- 4. PVDC Jacket for Indoor Applications: 4-mil-thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perm when tested according to ASTM E 96/E 96M and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

2.8 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Glass-Fiber Fabric: Approximately 6 oz./sq. yd. with a thread count of 5 strands by 5 strands/sq. in. for covering equipment.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Chil-Glas No. 5.
- B. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for equipment.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Mast-A-Fab.
 - b. Vimasco Corporation; Elastafab 894.

2.9 FIELD-APPLIED CLOTHS

- A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd..
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Alpha Associates, Inc.; Alpha-Maritex 84215 and 84217/9485RW, Luben 59.

2.10 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
- 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Johns Manville; Zeston.
 - b. P.I.C. Plastics, Inc.; FG Series.
 - c. Proto Corporation; LoSmoke.
 - d. Speedline Corporation; SmokeSafe.
- 2. Adhesive: As recommended by jacket material manufacturer.
- 3. Color: Color-code jackets based on system.
- 4. Factory-fabricated tank heads and tank side panels.
- C. Metal Jacket:
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.
 - b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
 - c. RPR Products, Inc.; Insul-Mate.
 - 2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
 - a. Factory cut and rolled to size.
 - b. Finish and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Indoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
 - d. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
 - 3. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.
 - a. Factory cut and rolled to size.
 - b. Material, finish, and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Indoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
 - d. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.

2.11 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABI, Ideal Tape Division; 428 AWF ASJ.

- b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
- c. Compac Corporation; 104 and 105.
- d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
- 2. Width: 3 inches.
- 3. Thickness: 11.5 mils.
- 4. Adhesion: 90 ounces force/inch in width.
- 5. Elongation: 2 percent.
- 6. Tensile Strength: 40 lbf/inch in width.
- 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABI, Ideal Tape Division; 491 AWF FSK.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
 - c. Compac Corporation; 110 and 111.
 - d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.
 - 2. Width: 3 inches.
 - 3. Thickness: 6.5 mils.
 - 4. Adhesion: 90 ounces force/inch in width.
 - 5. Elongation: 2 percent.
 - 6. Tensile Strength: 40 lbf/inch in width.
 - 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABI, Ideal Tape Division; 370 White PVC tape.
 - b. Compac Corporation; 130.
 - c. Venture Tape; 1506 CW NS.
 - 2. Width: 2 inches.
 - 3. Thickness: 6 mils.
 - 4. Adhesion: 64 ounces force/inch in width.
 - 5. Elongation: 500 percent.
 - 6. Tensile Strength: 18 lbf/inch in width.
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABI, Ideal Tape Division; 488 AWF.

- b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
- c. Compac Corporation; 120.
- d. Venture Tape; 3520 CW.
- 2. Width: 2 inches.
- 3. Thickness: 3.7 mils.
- 4. Adhesion: 100 ounces force/inch in width.
- 5. Elongation: 5 percent.
- 6. Tensile Strength: 34 lbf/inch in width.
- E. PVDC Tape: White vapor-retarder PVDC tape with acrylic adhesive.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dow Chemical Company (The); Saran 540 Vapor Retarder Tape and Saran 560 Vapor Retarder Tape.
 - 2. Width: 3 inches
 - 3. Film Thickness: 4 mils
 - 4. Adhesive Thickness: 1.5 mils.
 - 5. Elongation at Break: 145 percent.
 - 6. Tensile Strength: 55 lbf/inch in width.

2.12 SECUREMENTS

- A. Bands:
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ITW Insulation Systems; Gerrard Strapping and Seals.
 - b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.
 - 2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing seal or closed seal.
 - 3. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.
- B. Insulation Pins and Hangers:
 - 1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch-diameter shank, length to suit depth of insulation indicated.
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) AGM Industries, Inc.; CWP-1.
 - 2) GEMCO; CD.

- 3) Midwest Fasteners, Inc.; CD.
- 4) Nelson Stud Welding; TPA, TPC, and TPS.
- 2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch-diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) AGM Industries, Inc.; CHP-1.
 - 2) GEMCO; Cupped Head Weld Pin.
 - 3) Midwest Fasteners, Inc.; Cupped Head.
 - 4) Nelson Stud Welding; CHP.
- 3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place.
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) AGM Industries, Inc.; Tactoo Perforated Base Insul-Hangers.
 - 2) GEMCO; Perforated Base.
 - 3) Midwest Fasteners, Inc.; Spindle.
 - b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c. Spindle: Copper- or zinc-coated, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
- 4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place.
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) GEMCO; Nylon Hangers.
 - 2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.
 - b. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
 - c. Spindle: Nylon, 0.106-inch-diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

- 5. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place.
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) AGM Industries, Inc.; Tactoo Self-Adhering Insul-Hangers.
 - 2) GEMCO; Peel & Press.
 - 3) Midwest Fasteners, Inc.; Self Stick.
 - b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c. Spindle: Copper- or zinc-coated, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive-backed base with a peel-off protective cover.
- 6. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick, stainless-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) AGM Industries, Inc.; RC 150.
 - 2) GEMCO; R-150.
 - 3) Midwest Fasteners, Inc.; WA-150.
 - 4) Nelson Stud Welding; Speed Clips.
 - b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
- 7. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inchthick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) GEMCO.
 - 2) Midwest Fasteners, Inc.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.
- D. Wire: 0.062-inch soft-annealed, stainless steel.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. C & F Wire.

2.13 CORNER ANGLES

- A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.
- B. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14.
- C. Stainless-Steel Corner Angles: 0.024 inch thick, minimum 1 by 1 inch, stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
 - 1. Verify that systems and equipment to be insulated have been tested and are free of defects.
 - 2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
 - 1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
 - 2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Keep insulation materials dry during application and finishing.
- G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- H. Install insulation with least number of joints practical.
- I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.

- 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
- 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints.
- L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- O. For above ambient services, do not install insulation to the following:
 - 1. Vibration-control devices.
 - 2. Testing agency labels and stamps.
 - 3. Nameplates and data plates.
 - 4. Manholes.
 - 5. Handholes.
 - 6. Cleanouts.

3.4 INSTALLATION OF EQUIPMENT, TANK, AND VESSEL INSULATION

- A. Mineral-Fiber, Pipe, and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.
 - 1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of tank and vessel surfaces.
 - 2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
 - 3. Protect exposed corners with secured corner angles.
 - 4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:
 - a. Do not weld anchor pins to ASME-labeled pressure vessels.
 - b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
 - c. On tanks and vessels, maximum anchor-pin spacing is 3 inches from insulation end joints, and 16 inches o.c. in both directions.
 - d. Do not overcompress insulation during installation.
 - e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
 - f. Impale insulation over anchor pins and attach speed washers.
 - g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

- 5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
- 6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches from each end. Install wire or cable between two circumferential girdles 12 inches o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches o.c. Use this network for securing insulation with tie wire or bands.
- 7. Stagger joints between insulation layers at least 3 inches.
- 8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
- 9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
- 10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.
- B. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.
 - 1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
 - 2. Seal longitudinal seams and end joints.
- C. Insulation Installation on Pumps:
 - 1. Fabricate metal boxes lined with insulation. Fit boxes around pumps and coincide box joints with splits in pump casings. Fabricate joints with outward bolted flanges. Bolt flanges on 6-inch centers, starting at corners. Install 3/8-inch-diameter fasteners with wing nuts. Alternatively, secure the box sections together using a latching mechanism.
 - 2. Fabricate boxes from stainless steel, at least 0.050 inch thick.
 - 3. For below ambient services, install a vapor barrier at seams, joints, and penetrations. Seal between flanges with replaceable gasket material to form a vapor barrier.

3.5 INSTALLATION OF CALCIUM SILICATE INSULATION

- A. Insulation Installation on Domestic Water Boiler Breechings:
 - 1. Secure single-layer insulation with stainless-steel bands at 12-inch intervals and tighten bands without deforming insulation material.
 - 2. Install two-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.
 - 3. On exposed applications without metal jacket, finish insulation surface with a skim coat of mineral-fiber, hydraulic-setting cement. When cement is dry, apply flood coat of lagging adhesive and press on one layer of glass cloth. Overlap edges at least 1 inch.

Apply finish coat of lagging adhesive over glass cloth. Thin finish coat to achieve smooth, uniform finish.

3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 FIELD-APPLIED JACKET INSTALLATION

- A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
 - 1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
 - 2. Embed glass cloth between two 0.062-inch-thick coats of lagging adhesive.
 - 3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- B. Where FSK jackets are indicated, install as follows:
 - 1. Draw jacket material smooth and tight.
 - 2. Install lap or joint strips with same material as jacket.
 - 3. Secure jacket to insulation with manufacturer's recommended adhesive.
 - 4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
 - 5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
 - 1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.
- E. Where PVDC jackets are indicated, install as follows:
 - 1. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches or less. 33-1/2-inch-circumference limit allows for 2-inch-overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fishmouthing," and use PVDC tape along lap seal to secure joint.
 - 2. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

- 3.8 FINISHES
 - A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
 - 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.
 - B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
 - C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
 - D. Do not field paint aluminum or stainless-steel jackets.

3.9 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Inspect field-insulated equipment, randomly selected by Architect, by removing fieldapplied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to two location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.10 EQUIPMENT INSULATION SCHEDULE

- A. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.
- B. Insulate indoor and outdoor equipment that is not factory insulated.
- C. Domestic hot-water pump insulation shall be the following:
 - 1. Mineral-Fiber Blanket: 1 inch thick and 3-lb/cu. ft. nominal density.
- D. Domestic water, domestic chilled-water (potable), and domestic hot-water hydropneumatic tank insulation shall be the following:
 - 1. Cellular Glass: 1-1/2 inches thick.

- E. Domestic water storage tank insulation shall be the following:
 - 1. Cellular Glass: 2 inches thick.

END OF SECTION 220716

SECTION 220719 - PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes insulating the following plumbing piping services:
 - 1. Domestic cold-water piping.
 - 2. Domestic hot-water piping.
 - 3. Domestic recirculating hot-water piping.
 - 4. Sanitary waste piping exposed to freezing conditions.
 - 5. Storm-water piping exposed to freezing conditions.
 - 6. Roof drains and rainwater leaders.
 - 7. Supplies and drains for handicap-accessible lavatories and sinks.
- B. Related Sections:
 - 1. Section 220716 "Plumbing Equipment Insulation."

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied, if any).
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Detail attachment and covering of heat tracing inside insulation.
 - 3. Detail insulation application at pipe expansion joints for each type of insulation.
 - 4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 - 5. Detail removable insulation at piping specialties, equipment connections, and access panels.
 - 6. Detail application of field-applied jackets.
 - 7. Detail application at linkages of control devices.
- C. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use. Sample sizes are as follows:
 - 1. Preformed Pipe Insulation Materials: 12 inches long by NPS 2.

- 2. Jacket Materials for Pipe: 12 inches long by NPS 2.
- 3. Sheet Jacket Materials: 12 inches square.
- 4. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- C. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.
- C. Mockups: Before installing insulation, build mockups for each type of insulation and finish listed below to demonstrate quality of insulation application and finishes. Build mockups in the location indicated or, if not indicated, as directed by Architect. Use materials indicated for the completed Work.
 - 1. Piping Mockups:
 - a. One 10-foot section of NPS 2 straight pipe.
 - b. One each of a 90-degree threaded, welded, and flanged elbow.
 - c. One each of a threaded, welded, and flanged tee fitting.
 - d. One NPS 2 or smaller valve, and one NPS 2-1/2 or larger valve.
 - e. Four support hangers including hanger shield and insert.
 - f. One threaded strainer and one flanged strainer with removable portion of insulation.
 - g. One threaded reducer and one welded reducer.
 - h. One pressure temperature tap.
 - i. One mechanical coupling.

- 2. For each mockup, fabricate cutaway sections to allow observation of application details for insulation materials, adhesives, mastics, attachments, and jackets.
- 3. Notify Architect seven days in advance of dates and times when mockups will be constructed.
- 4. Obtain Architect's approval of mockups before starting insulation application.
- 5. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
- 6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
- 7. Demolish and remove mockups when directed.
- D. Comply with the following applicable standards and other requirements specified for miscellaneous components:
 - 1. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

1.8 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

2.1 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Pittsburgh Corning Corporation; Foamglas.
 - 2. Block Insulation: ASTM C 552, Type I.
 - 3. Special-Shaped Insulation: ASTM C 552, Type III.
 - 4. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
 - 5. Preformed Pipe Insulation with Factory-Applied ASJ-SSL: Comply with ASTM C 552, Type II, Class 2.
 - 6. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
- G. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Aeroflex USA, Inc.; Aerocel.
 - b. Armacell LLC; AP Armaflex.
 - c. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.

2.2 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

- B. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-84.
 - 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Aeroflex USA, Inc.; Aeroseal.
 - b. Armacell LLC; Armaflex 520 Adhesive.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
 - d. K-Flex USA; R-373 Contact Adhesive.
 - 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
 - b. Eagle Bridges Marathon Industries; 225.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-20.
 - d. Mon-Eco Industries, Inc.; 22-25.
 - 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

- E. PVC Jacket Adhesive: Compatible with PVC jacket.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dow Corning Corporation; 739, Dow Silicone.
 - b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
 - c. P.I.C. Plastics, Inc.; Welding Adhesive.
 - d. Speedline Corporation; Polyco VP Adhesive.
 - 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.3 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
 - 1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
 - b. Vimasco Corporation; 749.
 - 2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
 - 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 - 4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
 - 5. Color: White.
- C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below-ambient services.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-30.
 - b. Eagle Bridges Marathon Industries; 501.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-35.
 - d. Mon-Eco Industries, Inc.; 55-10.

- 2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
- 3. Service Temperature Range: 0 to 180 deg F.
- 4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
- 5. Color: White.
- D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below-ambient services.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Encacel.
 - b. Eagle Bridges Marathon Industries; 570.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 60-95/60-96.
 - 2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
 - 3. Service Temperature Range: Minus 50 to plus 220 deg F.
 - 4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
 - 5. Color: White.
- E. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
 - b. Eagle Bridges Marathon Industries; 550.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
 - d. Mon-Eco Industries, Inc.; 55-50.
 - e. Vimasco Corporation; WC-1/WC-5.
 - 2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
 - 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 - 4. Solids Content: 60 percent by volume and 66 percent by weight.
 - 5. Color: White.

2.4 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A, and shall be compatible with insulation materials, jackets, and substrates.
 - 1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-50 AHV2.
- b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-36.
- c. Vimasco Corporation; 713 and 714.
- 3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
- 4. Service Temperature Range: 0 to plus 180 deg F.
- 5. Color: White.

2.5 SEALANTS

- A. Joint Sealants:
 - 1. Joint Sealants for Cellular-Glass and Phenolic Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
 - b. Eagle Bridges Marathon Industries; 405.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-45.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Pittsburgh Corning Corporation; Pittseal 444.
 - f.
 - 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 - 3. Permanently flexible, elastomeric sealant.
 - 4. Service Temperature Range: Minus 100 to plus 300 deg F.
 - 5. Color: White or gray.
 - 6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. FSK and Metal Jacket Flashing Sealants:
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
 - b. Eagle Bridges Marathon Industries; 405.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
 - d. Mon-Eco Industries, Inc.; 44-05.

- 2. Materials shall be compatible with insulation materials, jackets, and substrates.
- 3. Fire- and water-resistant, flexible, elastomeric sealant.
- 4. Service Temperature Range: Minus 40 to plus 250 deg F.
- 5. Color: Aluminum.
- 6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- 7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
 - 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 - 3. Fire- and water-resistant, flexible, elastomeric sealant.
 - 4. Service Temperature Range: Minus 40 to plus 250 deg F.
 - 5. Color: White.
 - 6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.6 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
 - 1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
 - 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
 - 3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.7 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Glass-Fiber Fabric: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in. for covering pipe and pipe fittings.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Chil-Glas Number 10.
- B. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in, in a Leno weave, for pipe.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Mast-A-Fab.
 - b. Vimasco Corporation; Elastafab 894.

2.8 FIELD-APPLIED CLOTHS

- A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd..
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Alpha Associates, Inc.; Alpha-Maritex 84215 and 84217/9485RW, Luben 59.

2.9 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Johns Manville; Zeston.
 - b. P.I.C. Plastics, Inc.; FG Series.
 - c. Proto Corporation; LoSmoke.
 - d. Speedline Corporation; SmokeSafe.
 - 2. Adhesive: As recommended by jacket material manufacturer.
 - 3. Color: Color-code jackets based on system.
 - 4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
 - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
- C. Metal Jacket:

- 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.
 - b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
 - c. RPR Products, Inc.; Insul-Mate.
- 2. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.
 - a. Sheet and roll stock ready for shop or field sizing.
 - b. Material, finish, and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Indoor Applications: 1-mil-thick, heat-bonded polyethylene and kraft paper.
 - d. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
 - e. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - 3) Tee covers.
 - 4) Flange and union covers.
 - 5) End caps.
 - 6) Beveled collars.
 - 7) Valve covers.
 - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.10 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABI, Ideal Tape Division; 428 AWF ASJ.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
 - c. Compac Corporation; 104 and 105.
 - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
 - 2. Width: 3 inches.
 - 3. Thickness: 11.5 mils.
 - 4. Adhesion: 90 ounces force/inch in width.
 - 5. Elongation: 2 percent.
 - 6. Tensile Strength: 40 lbf/inch in width.
 - 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following]:
 - a. ABI, Ideal Tape Division; 491 AWF FSK.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
 - c. Compac Corporation; 110 and 111.
 - d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.
 - 2. Width: 3 inches.
 - 3. Thickness: 6.5 mils.
 - 4. Adhesion: 90 ounces force/inch in width.
 - 5. Elongation: 2 percent.
 - 6. Tensile Strength: 40 lbf/inch in width.
 - 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABI, Ideal Tape Division; 370 White PVC tape.
 - b. Compac Corporation; 130.
 - c. Venture Tape; 1506 CW NS.
 - 2. Width: 2 inches.
 - 3. Thickness: 6 mils.
 - 4. Adhesion: 64 ounces force/inch in width.
 - 5. Elongation: 500 percent.
 - 6. Tensile Strength: 18 lbf/inch in width.
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABI, Ideal Tape Division; 488 AWF.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
 - c. Compac Corporation; 120.
 - d. Venture Tape; 3520 CW.
 - 2. Width: 2 inches.
 - 3. Thickness: 3.7 mils.
 - 4. Adhesion: 100 ounces force/inch in width.
 - 5. Elongation: 5 percent.
 - 6. Tensile Strength: 34 lbf/inch in width.

2.11 SECUREMENTS

- A. Bands:
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ITW Insulation Systems; Gerrard Strapping and Seals.
 - b. RPR Products, Inc.; Insul-Mate Strapping and Seals.
 - 2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing seal or closed seal.
- B. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.
- C. Wire: 0.062-inch soft-annealed, stainless steel.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. C & F Wire.

2.12 PROTECTIVE SHIELDING GUARDS

- A. Protective Shielding Pipe Covers:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Engineered Brass Company.
 - b. Insul-Tect Products Co.; a subsidiary of MVG Molded Products.
 - c. McGuire Manufacturing.
 - d. Plumberex.
 - e. Truebro; a brand of IPS Corporation.
 - f. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.
 - 2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and coldwater supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.
- B. Protective Shielding Piping Enclosures:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Truebro; a brand of IPS Corporation.
 - b. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.

2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
 - 1. Verify that systems to be insulated have been tested and are free of defects.
 - 2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
 - 1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
 - 2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
 - a. For below-ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
 - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above-ambient services, do not install insulation to the following:
 - 1. Vibration-control devices.
 - 2. Testing agency labels and stamps.
 - 3. Nameplates and data plates.
 - 4. Cleanouts.

3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 - 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 - 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
 - 1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:

- 1. Pipe: Install insulation continuously through floor penetrations.
- 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
 - 1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
 - 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 - 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 - 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 - 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
 - 6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 - 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 - 8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
 - 9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
 - 1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
 - 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
 - 3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
 - 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
 - 5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 INSTALLATION OF CELLULAR-GLASS INSULATION

- A. Insulation Installation on Straight Pipes and Tubes:
 - 1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
 - 2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
 - 3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward clinched staples at 6 inches o.c.
 - 4. For insulation with factory-applied jackets on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
- B. Insulation Installation on Pipe Flanges:
 - 1. Install preformed pipe insulation to outer diameter of pipe flange.
 - 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 - 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
 - 4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

- C. Insulation Installation on Pipe Fittings and Elbows:
 - 1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
 - 2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.
- D. Insulation Installation on Valves and Pipe Specialties:
 - 1. Install preformed sections of cellular-glass insulation to valve body.
 - 2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 - 3. Install insulation to flanges as specified for flange insulation application.

3.7 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
 - 1. Install pipe insulation to outer diameter of pipe flange.
 - 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 - 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
 - 4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
 - 1. Install mitered sections of pipe insulation.
 - 2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- D. Insulation Installation on Valves and Pipe Specialties:
 - 1. Install preformed valve covers manufactured of same material as pipe insulation when available.
 - 2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 - 3. Install insulation to flanges as specified for flange insulation application.
 - 4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.8 FIELD-APPLIED JACKET INSTALLATION

- A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
 - 1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
 - 2. Embed glass cloth between two 0.062-inch-thick coats of lagging adhesive.
 - 3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- B. Where FSK jackets are indicated, install as follows:
 - 1. Draw jacket material smooth and tight.
 - 2. Install lap or joint strips with same material as jacket.
 - 3. Secure jacket to insulation with manufacturer's recommended adhesive.
 - 4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
 - 5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.
 - 1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.9 FINISHES

- A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
 - 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

3.10 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.11 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
 - 1. Drainage piping located in crawl spaces.
 - 2. Underground piping.
 - 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.12 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Cold Water:
 - 1. NPS 1 and Smaller: Insulation shall be the following:
 - a. Flexible Elastomeric: 1 inch thick.
 - 2. NPS 1-1/4 and Larger: Insulation shall be the following:
 - a. Flexible Elastomeric: 1 inch thick.
- B. Domestic Hot and Recirculated Hot Water:
 - 1. NPS 1-1/4 and Smaller: Insulation shall be the following:
 - a. Flexible Elastomeric: 1 inch thick.
 - 2. NPS 1-1/2 and Larger: Insulation shall be the following:
 - a. Flexible Elastomeric: 1 inch thick.

- C. Stormwater and Overflow:
 - 1. All Pipe Sizes: Insulation shall be the following:
 - a. Flexible Elastomeric: 1 inch thick.
- D. Roof Drain and Overflow Drain Bodies:
 - 1. All Pipe Sizes: Insulation shall be the following:
 - a. Flexible Elastomeric: 1 inch thick.
- E. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:
 - 1. All Pipe Sizes: Insulation shall be the following:
 - a. Flexible Elastomeric: 3/4 inch thick.
- F. Where Heat Tracing Is Installed:
 - 1. All Pipe Sizes: Insulation shall be the following:
 - a. Cellular Glass: 2 inches thick.
- G. Floor Drains, Traps, and Sanitary Drain Piping within 10 Feet of Drain Receiving Condensate and Equipment Drain Water below 60 Deg F:
 - All Pipe Sizes: Insulation shall be the following:
 a. Flexible Elastomeric: 3/4 inch thick.

3.13 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

- A. Domestic Water Piping:
 - 1. All Pipe Sizes: Insulation shall be the following:
 - a. Flexible Elastomeric: 2 inches thick.
- B. Domestic Hot and Recirculated Hot Water:
 - 1. All Pipe Sizes: Insulation shall be the following:
 - a. Flexible Elastomeric: 2 inches thick.
- C. Piping Where Heat Tracing Is Installed:
 - 1. All Pipe Sizes: Insulation shall be the following:
 - a. Cellular Glass: 2 inches thick.

3.14 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Piping, Concealed:
 - 1. PVC, Color-Coded by System: 30 mils thick.
- D. Piping, Exposed:
 - 1. PVC, Color-Coded by System: 30 mils thick.

3.15 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Piping, Concealed:
 - 1. Stainless Steel, Type 304 or Type 316, Smooth 2B Finish with Z-Shaped Locking Seam: 0.020 inch thick.
- D. Piping, Exposed:
 - 1. Stainless Steel, Type 304 or Type 316, Smooth 2B Finish with Z-Shaped Locking Seam: 0.020 inch thick.

3.16 UNDERGROUND, FIELD-INSTALLED INSULATION JACKET

A. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material.

END OF SECTION 220719
SECTION 221116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Under-building-slab and aboveground domestic water pipes, tubes, and fittings inside buildings.
 - 2. Encasement for piping.
- B. Related Requirements:
 - 1. Section 221113 "Facility Water Distribution Piping" for water-service piping and water meters outside the building from source to the point where water-service piping enters the building.

1.3 ACTION SUBMITTALS

A. Product Data: For transition fittings and dielectric fittings.

1.4 INFORMATIONAL SUBMITTALS

- A. System purging and disinfecting activities report.
- B. Field quality-control reports.

1.5 FIELD CONDITIONS

- A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
 - 1. Notify Architect no fewer than seven days in advance of proposed interruption of water service.
 - 2. Do not interrupt water service without Architect's written permission.

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.
- B. Potable-water piping and components shall comply with NSF 14 and NSF 61. Plastic piping components shall be marked with "NSF-pw."

2.2 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L and ASTM B 88, Type M water tube, drawn temper.
- B. Soft Copper Tube: ASTM B 88, Type K and ASTM B 88, Type L water tube, annealed temper.
- C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.
- D. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
- E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
- F. Copper Unions:
 - 1. MSS SP-123.
 - 2. Cast-copper-alloy, hexagonal-stock body.
 - 3. Ball-and-socket, metal-to-metal seating surfaces.
 - 4. Solder-joint or threaded ends.
- G. Copper Pressure-Seal-Joint Fittings:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Elkhart Products Corporation.
 - b. NIBCO Inc.
 - c. Viega.
 - 2. Fittings for NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber, O-ring seal in each end.
 - 3. Fittings for NPS 2-1/2 to NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber, O-ring seal in each end.

2.3 DUCTILE-IRON PIPE AND FITTINGS

A. Mechanical-Joint, Ductile-Iron Pipe:

- 1. AWWA C151/A21.51, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
- 2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- B. Standard-Pattern, Mechanical-Joint Fittings:
 - 1. AWWA C110/A21.10, ductile or gray iron.
 - 2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- C. Compact-Pattern, Mechanical-Joint Fittings:
 - 1. AWWA C153/A21.53, ductile iron.
 - 2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- D. Push-on-Joint, Ductile-Iron Pipe:
 - 1. AWWA C151/A21.51.
 - 2. Push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.
- E. Standard-Pattern, Push-on-Joint Fittings:
 - 1. AWWA C110/A21.10, ductile or gray iron.
 - 2. Gaskets: AWWA C111/A21.11, rubber.
- F. Compact-Pattern, Push-on-Joint Fittings:
 - 1. AWWA C153/A21.53, ductile iron.
 - 2. Gaskets: AWWA C111/A21.11, rubber.
- G. Plain-End, Ductile-Iron Pipe: AWWA C151/A21.51.

2.4 PVC PIPE AND FITTINGS

- A. PVC Pipe: ASTM D 1785, Schedule 40.
- B. PVC Socket Fittings: ASTM D 2466 for Schedule 40.
- C. PVC Schedule 80 Threaded Fittings: ASTM D 2464.

2.5 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials:
 - 1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
 - 2. Full-face or ring type unless otherwise indicated.

- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys.
- D. Flux: ASTM B 813, water flushable.
- E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for generalduty brazing unless otherwise indicated.
- F. Solvent Cements for Joining CPVC Piping and Tubing: ASTM F 493.
 - 1. CPVC solvent cement shall have a VOC content of 490 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 3. Solvent cement and adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- G. Solvent Cements for Joining PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
 - 1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 3. Solvent cement and adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- H. Plastic, Pipe-Flange Gaskets, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.6 ENCASEMENT FOR PIPING

- A. Standard: ASTM A 674 or AWWA C105/A21.5.
- B. Form: Sheet or tube.
- C. Color: Black or natural.

2.7 TRANSITION FITTINGS

- A. General Requirements:
 - 1. Same size as pipes to be joined.
 - 2. Pressure rating at least equal to pipes to be joined.

- 3. End connections compatible with pipes to be joined.
- B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
- C. Sleeve-Type Transition Coupling: AWWA C219.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Cascade Waterworks Manufacturing.
 - b. Dresser, Inc.; Piping Specialties Products.
 - c. Ford Meter Box Company, Inc. (The).
 - d. JCM Industries.
 - e. Romac Industries, Inc.
 - f. Smith-Blair, Inc.; a Sensus company.
 - g. Viking Johnson.
- D. Plastic-to-Metal Transition Fittings:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Charlotte Pipe and Foundry Company.
 - b. Harvel Plastics, Inc.
 - c. Spears Manufacturing Company.
 - 2. Description:
 - a. PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions.
 - b. One end with threaded brass insert and one solvent-cement-socket or threaded end.
- E. Plastic-to-Metal Transition Unions:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Colonial Engineering, Inc.
 - b. NIBCO Inc.
 - c. Spears Manufacturing Company.
 - 2. Description:
 - a. PVC four-part union.
 - b. Brass or stainless-steel threaded end.
 - c. Solvent-cement-joint or threaded plastic end.
 - d. Rubber O-ring.
 - e. Union nut.

2.8 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Unions:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Capitol Manufacturing Company; member of the Phoenix Forge Group.
 - b. Central Plastics Company.
 - c. Hart Industries International, Inc.
 - d. Jomar International.
 - e. Matco-Norca.
 - f. McDonald, A. Y. Mfg. Co.
 - g. Watts; a division of Watts Water Technologies, Inc.
 - h. Wilkins; a Zurn company.
 - 2. Standard: ASSE 1079.
 - 3. Pressure Rating: 125 psig minimum at 180 deg F.
 - 4. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. Dielectric Flanges:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Capitol Manufacturing Company; member of the Phoenix Forge Group.
 - b. Central Plastics Company.
 - c. Matco-Norca.
 - d. Watts; a division of Watts Water Technologies, Inc.
 - e. Wilkins; a Zurn company.
 - 2. Standard: ASSE 1079.
 - 3. Factory-fabricated, bolted, companion-flange assembly.
 - 4. Pressure Rating: 125 psig minimum at 180 deg F.
 - 5. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- D. Dielectric-Flange Insulating Kits:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Central Plastics Company.

- d. Pipeline Seal and Insulator, Inc.
- 2. Nonconducting materials for field assembly of companion flanges.
- 3. Pressure Rating: 150 psig
- 4. Gasket: Neoprene or phenolic.
- 5. Bolt Sleeves: Phenolic or polyethylene.
- 6. Washers: Phenolic with steel backing washers.
- E. Dielectric Nipples:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Elster Perfection Corporation.
 - b. Grinnell Mechanical Products; Tyco Fire Products LP.
 - c. Matco-Norca.
 - d. Precision Plumbing Products, Inc.
 - e. Victaulic Company.
 - 2. Standard: IAPMO PS 66.
 - 3. Electroplated steel nipple complying with ASTM F 1545.
 - 4. Pressure Rating and Temperature: 300 psig at 225 deg F.
 - 5. End Connections: Male threaded or grooved.
 - 6. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Comply with requirements in Division 300000 sections for excavating, trenching, and backfilling.

3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."
- C. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.
- D. Install underground copper tube and ductile-iron pipe in PE encasement according to ASTM A 674 or AWWA C105/A21.5.

- E. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each domestic water-service entrance. Comply with requirements for pressure gages in Section 220519 "Meters and Gages for Plumbing Piping" and with requirements for drain valves and strainers in Section 221119 "Domestic Water Piping Specialties."
- F. Install shutoff valve immediately upstream of each dielectric fitting.
- G. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in Section 221119 "Domestic Water Piping Specialties."
- H. Install domestic water piping level with 0.25 percent slope downward toward drain and plumb.
- I. Rough-in domestic water piping for water-meter installation according to utility company's requirements.
- J. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- K. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- L. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- M. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- N. Install piping to permit valve servicing.
- O. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.
- P. Install piping free of sags and bends.
- Q. Install fittings for changes in direction and branch connections.
- R. Install PEX piping with loop at each change of direction of more than 90 degrees.
- S. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- T. Install pressure gages on suction and discharge piping for each plumbing pump and packaged booster pump. Comply with requirements for pressure gages in Section 220519 "Meters and Gages for Plumbing Piping."
- U. Install thermostats in hot-water circulation piping. Comply with requirements for thermostats in Section 221123 "Domestic Water Pumps."

- V. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements for thermometers in Section 220519 "Meters and Gages for Plumbing Piping."
- W. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- X. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- Y. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Brazed Joints" chapter.
- E. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- F. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.
- G. Push-on Joints for Copper Tubing: Clean end of tube. Measure insertion depth with manufacturer's depth gage. Join copper tube and push-on-joint fittings by inserting tube to measured depth.
- H. Extruded-Tee Connections: Form tee in copper tube according to ASTM F 2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.
- I. Joint Construction for Grooved-End Copper Tubing: Make joints according to AWWA C606. Roll groove ends of tubes. Lubricate and install gasket over ends of tubes or tube and fitting. Install coupling housing sections over gasket with keys seated in tubing grooves. Install and tighten housing bolts.

- J. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
- K. Joint Construction for Solvent-Cemented Plastic Piping: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.
 - 2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 - 3. PVC Piping: Join according to ASTM D 2855.
- L. Joints for PEX Piping: Join according to ASTM F 1807.
- M. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.4 TRANSITION FITTING INSTALLATION

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Underground Domestic Water Piping:
 - 1. Fittings for NPS 1-1/2 and Smaller: Fitting-type coupling.
 - 2. Fittings for NPS 2 and Larger: Sleeve-type coupling.
- C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-tometal transition fittings or unions.

3.5 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings or nipples.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flange kits.
- D. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.6 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Comply with requirements for pipe hanger, support products, and installation in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
 - 1. Vertical Piping: MSS Type 8 or 42, clamps.
 - 2. Individual, Straight, Horizontal Piping Runs:

DOMESTIC WATER PIPING

- a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
- b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
- c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
- 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
- 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.
- E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
 - 2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
 - 3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
 - 4. NPS 2-1/2: 108 inches with 1/2-inch rod.
 - 5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
 - 6. NPS 6: 10 feet with 5/8-inch rod.
 - 7. NPS 8: 10 feet with 3/4-inch rod.
- F. Install supports for vertical copper tubing every 10 feet.
- G. Install supports for vertical steel piping every 15 feet.
- H. Install vinyl-coated hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 2 and Smaller: 48 inches with 3/8-inch rod.
 - 2. NPS 2-1/2 to NPS 3-1/2: 48 inches with 1/2-inch rod.
 - 3. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
 - 4. NPS 6: 48 inches with 3/4-inch rod.
 - 5. NPS 8: 48 inches with 7/8-inch rod.
- I. Install supports for vertical PVC piping every 48 inches.
- J. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
 - 1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
 - 2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
 - 3. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
 - 4. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.8 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification materials and installation in Section 220553 "Identification for Plumbing Piping and Equipment."
- B. Label pressure piping with system operating pressure.

3.9 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Piping Inspections:
 - a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
 - b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - 1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
 - 2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
 - c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
 - d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
 - 2. Piping Tests:
 - a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
 - b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.

- c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
- d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
- e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
- f. Prepare reports for tests and for corrective action required.
- B. Domestic water piping will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.10 ADJUSTING

- A. Perform the following adjustments before operation:
 - 1. Close drain valves, hydrants, and hose bibbs.
 - 2. Open shutoff valves to fully open position.
 - 3. Open throttling valves to proper setting.
 - 4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
 - a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
 - b. Adjust calibrated balancing valves to flows indicated.
 - 5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
 - 6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
 - 7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
 - 8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.11 CLEANING

- A. Clean and disinfect potable domestic water piping as follows:
 - 1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
 - 2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system according to either of the following:

- 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
- 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
- c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
- d. Repeat procedures if biological examination shows contamination.
- e. Submit water samples in sterile bottles to authorities having jurisdiction.
- B. Clean non-potable domestic water piping as follows:
 - 1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
 - 2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- C. Prepare and submit reports of purging and disinfecting activities. Include copies of watersample approvals from authorities having jurisdiction.
- D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.12 PIPING SCHEDULE

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.
- D. Under-building-slab, domestic water, NPS 4 to NPS 8 and larger, shall be one of the following:
 - 1. Soft copper tube, ASTM B 88, Type K; wrought-copper, solder-joint fittings; and brazed joints.
 - 2. Mechanical-joint, ductile-iron pipe; standard or compact-pattern, mechanical-joint fittings; and mechanical joints.
- E. Under-building-slab, combined domestic water, building-service, and fire-service-main piping, NPS 6 to NPS 12, shall be the following:
 - 1. Mechanical-joint, ductile-iron pipe; standard or compact-pattern, mechanical-joint fittings; and mechanical joints.

- F. Under-building-slab, domestic water piping, NPS 3 and smaller, shall be one of the following:
 - 1. Hard or soft copper tube, ASTM B 88, Type L; wrought-copper, solder-joint fittings; and brazed joints.
 - 2. PVC, Schedule 40; socket fittings; and solvent-cemented joints.
- G. Aboveground domestic water piping, NPS 2 and smaller, shall be the following:
 - 1. Hard copper tube, ASTM B 88, Type L or ASTM B 88, Type M; copper pressure-sealjoint fittings; and pressure-sealed joints.
- H. Aboveground domestic water piping, NPS 2-1/2 to NPS 4, shall be the following:
 - 1. Hard copper tube, ASTM B 88, Type L or ASTM B 88, Type M; copper pressure-sealjoint fittings; and pressure-sealed joints.
- I. Aboveground domestic water piping, NPS 5 to NPS 8, shall be the following:
 - 1. Hard copper tube, ASTM B 88, Type L or ASTM B 88, Type M; copper pressure-sealjoint fittings; and pressure-sealed joints.

3.13 VALVE SCHEDULE

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 - 1. Shutoff Duty: Use ball or gate valves for piping NPS 2 and smaller. Use butterfly, ball, or gate valves with flanged ends for piping NPS 2-1/2 and larger.
 - 2. Throttling Duty: Use ball or globe valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.
 - 3. Hot-Water Circulation Piping, Balancing Duty: Memory-stop balancing valves.
 - 4. Drain Duty: Hose-end drain valves.
- B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

END OF SECTION 221116

SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Vacuum breakers.
 - 2. Backflow preventers.
 - 3. Water pressure-reducing valves.
 - 4. Balancing valves.
 - 5. Temperature-actuated, water mixing valves.
 - 6. Strainers.
 - 7. Outlet boxes.
 - 8. Hose stations.
 - 9. Hose bibbs.
 - 10. Wall hydrants.
 - 11. Ground hydrants.
 - 12. Post hydrants.
 - 13. Drain valves.
 - 14. Water-hammer arresters.
 - 15. Air vents.
 - 16. Trap-seal primer valves.
 - 17. Trap-seal primer systems.
 - 18. Specialty valves.
 - 19. Flexible connectors.
 - 20. Water meters.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For domestic water piping specialties.
 - 1. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

DOMESTIC WATER PIPING SPECIALTIES

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

A. Potable-water piping and components shall comply with NSF 61 and NSF 14. Mark "NSF-pw" on plastic piping components.

2.2 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

2.3 VACUUM BREAKERS

- A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
 - b. Cash Acme; a division of Reliance Worldwide Corporation.
 - c. Conbraco Industries, Inc.
 - d. FEBCO; a division of Watts Water Technologies, Inc.
 - e. Rain Bird Corporation.
 - f. Toro Company (The); Irrigation Div.
 - g. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - h. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
 - 2. Standard: ASSE 1001.
 - 3. Size: NPS 1/4 to NPS 3, as required to match connected piping.
 - 4. Body: Bronze.
 - 5. Inlet and Outlet Connections: Threaded.
 - 6. Finish: Chrome plated.
- B. Hose-Connection Vacuum Breakers:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Arrowhead Brass Products.

- b. Cash Acme; a division of Reliance Worldwide Corporation.
- c. Conbraco Industries, Inc.
- d. Legend Valve.
- e. MIFAB, Inc.
- f. Prier Products, Inc.
- g. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
- h. Woodford Manufacturing Company; a division of WCM Industries, Inc.
- i. Zurn Industries, LLC; Plumbing Products Group; Light Commercial Products.
- j. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
- 2. Standard: ASSE 1011.
- 3. Body: Bronze, nonremovable, with manual drain.
- 4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
- 5. Finish: Chrome plated.

2.4 BACKFLOW PREVENTERS

- A. Intermediate Atmospheric-Vent Backflow Preventers:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Cash Acme; a division of Reliance Worldwide Corporation.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; a division of Watts Water Technologies, Inc.
 - d. Honeywell International Inc.
 - e. Legend Valve.
 - f. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - g. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
 - 2. Standard: ASSE 1012.
 - 3. Operation: Continuous-pressure applications.
 - 4. Body: Bronze.
 - 5. End Connections: Union, solder joint.
 - 6. Finish: Rough bronze.
- B. Reduced-Pressure-Principle Backflow Preventers:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; a division of Watts Water Technologies, Inc.
 - d. Flomatic Corporation.
 - e. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - f. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.

- 2. Standard: ASSE 1013.
- 3. Operation: Continuous-pressure applications.
- 4. Body: Bronze for NPS 2 and smaller; steel with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
- 5. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
- 6. Accessories:
 - a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
 - b. Valves NPS 2-1/2and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
 - c. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.
- C. Double-Check, Backflow-Prevention Assemblies:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; a division of Watts Water Technologies, Inc.
 - d. Flomatic Corporation.
 - e. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - f. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
 - 2. Standard: ASSE 1015.
 - 3. Operation: Continuous-pressure applications unless otherwise indicated.
 - 4. Body: Bronze for NPS 2 and smaller; steel with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
 - 5. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
 - 6. Accessories:
 - a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
 - b. ValvesNPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
- D. Beverage-Dispensing-Equipment Backflow Preventers:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Conbraco Industries, Inc.
 - b. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - c. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
 - 2. Standard: ASSE 1022.
 - 3. Operation: Continuous-pressure applications.
 - 4. Body: Stainless steel.
 - 5. End Connections: Threaded.

- E. Dual-Check-Valve Backflow Preventers:
 - 1. Manufacturers: Subject to compliance with requirements vailable manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Cash Acme; a division of Reliance Worldwide Corporation.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; a division of Watts Water Technologies, Inc.
 - d. Flomatic Corporation.
 - e. Ford Meter Box Company, Inc. (The).
 - f. Honeywell International Inc.
 - g. Legend Valve.
 - h. McDonald, A. Y. Mfg. Co.
 - i. Mueller Co. Ltd.; a subsidiary of Mueller Water Products Inc.
 - j. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - k. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
 - 2. Standard: ASSE 1024.
 - 3. Operation: Continuous-pressure applications.
 - 4. Body: Bronze with union inlet.
- F. Reduced-Pressure-Detector, Fire-Protection, Backflow-Preventer Assemblies:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; a division of Watts Water Technologies, Inc.
 - d. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - e. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
 - 2. Standard: ASSE 1047 and is FM Global approved or UL listed.
 - 3. Operation: Continuous-pressure applications.
 - 4. Body: Steel with interior lining that complies with AWWA C550 or that is FDA approved.
 - 5. End Connections: Flanged.
 - 6. Accessories:
 - a. Valves: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
 - b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.
 - c. Bypass: With displacement-type water meter, shutoff valves, and reduced-pressure backflow preventer.
- G. Double-Check, Detector-Assembly Backflow Preventers:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
- b. Conbraco Industries, Inc.
- c. FEBCO; a division of Watts Water Technologies, Inc.
- d. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
- e. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
- 2. Standard: ASSE 1048 and is FM Global approved or UL listed.
- 3. Operation: Continuous-pressure applications.
- 4. Body: Steel with interior lining that complies with AWWA C550 or that is FDA approved.
- 5. End Connections: Flanged.
- 6. Accessories:
 - a. Valves: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
 - b. Bypass: With displacement-type water meter, shutoff valves, and reduced-pressure backflow preventer.
- H. Hose-Connection Backflow Preventers:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Conbraco Industries, Inc.
 - b. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - c. Woodford Manufacturing Company; a division of WCM Industries, Inc.
 - 2. Standard: ASSE 1052.
 - 3. Outlet Size: Garden-hose thread complying with ASME B1.20.7.

2.5 WATER PRESSURE-REDUCING VALVES

- A. Water Regulators:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Cash Acme; a division of Reliance Worldwide Corporation.
 - b. Conbraco Industries, Inc.
 - c. Honeywell International Inc.
 - d. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - e. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
 - 2. Standard: ASSE 1003.
 - 3. Pressure Rating: Initial working pressure of 150 psig.
 - 4. Body: Bronzefor NPS 2 and smaller; cast ironwith interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and NPS.
 - 5. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and NPS 3.

2.6 BALANCING VALVES

- A. Copper-Alloy Calibrated Balancing Valves:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Armstrong International, Inc.
 - b. Flo Fab Inc.
 - c. ITT Corporation; Bell & Gossett Div.
 - d. NIBCO Inc.
 - e. TAC.
 - f. TACO Incorporated.
 - g. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - 2. Type: Ball or Y-pattern globe valve with two readout ports and memory-setting indicator.
 - 3. Body: Brass.
 - 4. Size: Same as connected piping, but not larger than NPS 2.
 - 5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.
- B. Memory-Stop Balancing Valves:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Conbraco Industries, Inc.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Div.
 - e. Hammond Valve.
 - f. Milwaukee Valve Company.
 - g. NIBCO Inc.
 - h. Red-White Valve Corp.
 - 2. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
 - 3. Pressure Rating: 400-psig minimum CWP.
 - 4. Size: NPS 2 or smaller.
 - 5. Body: Copper alloy.
 - 6. Port: full port.
 - 7. Ball: Chrome-plated brass.
 - 8. Seats and Seals: Replaceable.
 - 9. End Connections: Solder joint or threaded.
 - 10. Handle: Vinyl-covered steel with memory-setting device.

2.7 TEMPERATURE-ACTUATED, WATER MIXING VALVES

A. Water-Temperature Limiting Devices:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Armstrong International, Inc.
 - b. Cash Acme; a division of Reliance Worldwide Corporation.
 - c. Conbraco Industries, Inc.
 - d. Honeywell International Inc.
 - e. Legend Valve.
 - f. Leonard Valve Company.
 - g. Powers; a division of Watts Water Technologies, Inc.
 - h. Symmons Industries, Inc.
 - i. TACO Incorporated.
 - j. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - k. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
- 2. Standard: ASSE 1017.
- 3. Pressure Rating: 125 psig.
- 4. Type: Thermostatically controlled, water mixing valve.
- 5. Material: Bronze body with corrosion-resistant interior components.
- 6. Connections: union inlets and outlet.
- 7. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperaturecontrol handle.
- 8. Valve Finish: Chrome plated.
- B. Primary, Thermostatic, Water Mixing Valves:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Armstrong International, Inc.
 - b. Lawler Manufacturing Company, Inc.
 - c. Leonard Valve Company.
 - d. Powers; a division of Watts Water Technologies, Inc.
 - e. Symmons Industries, Inc.
 - 2. Standard: ASSE 1017.
 - 3. Pressure Rating: 125 psig minimum unless otherwise indicated.
 - 4. Type: Exposed-mounted, thermostatically controlled, water mixing valve.
 - 5. Material: Bronze body with corrosion-resistant interior components.
 - 6. Connections: union inlets and outlet.
 - 7. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
 - 8. Valve Finish: Chrome plated.
 - 9. Piping Finish: Copper

2.8 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

- 1. Pressure Rating: 125 psig minimum unless otherwise indicated.
- 2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and for NPS 2-1/2 and larger.
- 3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
- 4. Screen: Stainless steel with round perforations unless otherwise indicated.
- 5. Perforation Size:
 - a. Strainers NPS 2 and Smaller: 0.020 inch.
 - b. Strainers NPS 2-1/2 to NPS 4: 0.045 inch .
 - c. Strainers NPS 5 and Larger: 0.10 inch.
- 6. Drain: Factory-installed, hose-end drain valve.

2.9 OUTLET BOXES

- A. Clothes Washer Outlet Boxes:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Acorn Engineering Company.
 - b. Guy Gray Manufacturing Co., Inc.
 - c. IPS Corporation.
 - d. LSP Products Group, Inc.
 - e. Oatey.
 - f. Plastic Oddities.
 - g. Symmons Industries, Inc.
 - h. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - i. Whitehall Manufacturing; a div. of Acorn Engineering Company.
 - j. Zurn Industries, LLC; Plumbing Products Group; Light Commercial Products.
 - 2. Mounting: Recessed.
 - 3. Material and Finish: Stainless-steel box and faceplate.
 - 4. Faucet: Combination valved fitting or separate hot- and cold-water valved fittings complying with ASME A112.18.1. Include garden-hose thread complying with ASME B1.20.7 on outlets.
 - 5. Supply Shutoff Fittings: NPS 1/2 gate, globe, or ball valves and NPS 1/2 copper, water tubing.
 - 6. Drain: NPS 2 standpipe and P-trap for direct waste connection to drainage piping.
 - 7. Inlet Hoses: Two 60-inch-long, rubber household clothes washer inlet hoses with female, garden-hose-thread couplings. Include rubber washers.
 - 8. Drain Hose: One 48-inch- long, rubber household clothes washer drain hose with hooked end.
- B. Icemaker Outlet Boxes:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Acorn Engineering Company.
- b. IPS Corporation.
- c. LSP Products Group, Inc.
- d. Oatey.
- e. Plastic Oddities.
- 2. Mounting: Recessed.
- 3. Material and Finish: Stainless-steel box and faceplate.
- 4. Faucet: Valved fitting complying with ASME A112.18.1. Include NPS 1/2 or smaller copper tube outlet.
- 5. Supply Shutoff Fitting: NPS 1/2 gate, globe, or ball valve and NPS 1/2 copper, water tubing.

2.10 HOSE BIBBS

- A. Hose Bibbs:
 - 1. Standard: ASME A112.18.1 for sediment faucets.
 - 2. Body Material: Bronze.
 - 3. Seat: Bronze, replaceable.
 - 4. Operation: Loose key.
 - 5. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
 - 6. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
 - 7. Pressure Rating: 125 psig.
 - 8. Vacuum Breaker: Integral nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
 - 9. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
 - 10. Finish for Service Areas: Chrome or nickel plated.
 - 11. Finish for Finished Rooms: Chrome or nickel plated.
 - 12. Operation for Equipment Rooms: Wheel handle or operating key.
 - 13. Operation for Service Areas: Operating key.
 - 14. Operation for Finished Rooms: Operating key.
 - 15. Include operating key with each operating-key hose bibb.
 - 16. Include integral wall flange with each chrome- or nickel-plated hose bibb.

2.11 WALL HYDRANTS

- A. Nonfreeze Wall Hydrants:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Josam Company.
 - b. MIFAB, Inc.
 - c. Prier Products, Inc.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - e. Tyler Pipe; Wade Div.
 - f. Watts Drainage Products.

- g. Woodford Manufacturing Company; a division of WCM Industries, Inc.
- h. Zurn Industries, LLC; Plumbing Products Group; Light Commercial Products.
- i. Zurn Industries, LLC; Plumbing Products Group; Specification Drainage Products.
- 2. Standard: ASME A112.21.3M for concealed-outlet, self-draining wall hydrants.
- 3. Pressure Rating: 125 psig.
- 4. Operation: Loose key.
- 5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
- 6. Inlet: NPS 3/4 or NPS 1.
- 7. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
- 8. Box: Deep, flush mounted with cover.
- 9. Box and Cover Finish: Chrome plated.
- 10. Outlet: Exposed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
- 11. Nozzle and Wall-Plate Finish: Rough bronze.
- 12. Operating Keys(s): One with each wall hydrant.

2.12 DRAIN VALVES

- A. Ball-Valve-Type, Hose-End Drain Valves:
 - 1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
 - 2. Pressure Rating: 400-psig minimum CWP.
 - 3. Size: NPS 3/4.
 - 4. Body: Copper alloy.
 - 5. Ball: Chrome-plated brass.
 - 6. Seats and Seals: Replaceable.
 - 7. Handle: Vinyl-covered steel.
 - 8. Inlet: Threaded or solder joint.
 - 9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.
- B. Gate-Valve-Type, Hose-End Drain Valves:
 - 1. Standard: MSS SP-80 for gate valves.
 - 2. Pressure Rating: Class 125.
 - 3. Size: NPS 3/4.
 - 4. Body: ASTM B 62 bronze.
 - 5. Inlet: NPS 3/4 threaded or solder joint.
 - 6. Outlet: Garden-hose thread complying with ASME B1.20.7 and cap with brass chain.
- C. Stop-and-Waste Drain Valves:
 - 1. Standard: MSS SP-110 for ball valves or MSS SP-80 for gate valves.
 - 2. Pressure Rating: 200-psig minimum CWP or Class 125.
 - 3. Size: NPS 3/4.
 - 4. Body: Copper alloy or ASTM B 62 bronze.
 - 5. Drain: NPS 1/8 side outlet with cap.

2.13 WATER-HAMMER ARRESTERS

- A. Water-Hammer Arresters:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. AMTROL, Inc.
 - b. Josam Company.
 - c. MIFAB, Inc.
 - d. Precision Plumbing Products, Inc.
 - e. Sioux Chief Manufacturing Company, Inc.
 - f. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - g. Tyler Pipe; Wade Div.
 - h. Watts Drainage Products.
 - i. Zurn Industries, LLC; Plumbing Products Group; Specification Drainage Products.
 - 2. Standard: ASSE 1010 or PDI-WH 201.
 - 3. Type: Copper tube with piston.
 - 4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

2.14 AIR VENTS

- A. Bolted-Construction Automatic Air Vents:
 - 1. Body: Bronze.
 - 2. Pressure Rating and Temperature: 125-psig minimum pressure rating at 140 deg F.
 - 3. Float: Replaceable, corrosion-resistant metal.
 - 4. Mechanism and Seat: Stainless steel.
 - 5. Size: NPS 1/2 minimum inlet.
 - 6. Inlet and Vent Outlet End Connections: Threaded.

2.15 TRAP-SEAL PRIMER DEVICE

- A. Supply-Type, Trap-Seal Primer Device:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. MIFAB, Inc.
 - b. Precision Plumbing Products, Inc.
 - c. Sioux Chief Manufacturing Company, Inc.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - e. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - 2. Standard: ASSE 1018.
 - 3. Pressure Rating: 125 psig minimum.

- 4. Body: Bronze.
- 5. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
- 6. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
- 7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

2.16 SPECIALTY VALVES

A. Comply with requirements for general-duty metal valves in Section 220523 "General-Duty Valves for Plumbing Piping."

2.17 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Flex-Hose Co., Inc.
 - 2. Flexicraft Industries.
 - 3. Flex Pression, Ltd.
 - 4. Flex-Weld Incorporated.
 - 5. Hyspan Precision Products, Inc.
 - 6. Mercer Gasket & Shim, Inc.
 - 7. Metraflex, Inc.
 - 8. Proco Products, Inc.
 - 9. TOZEN Corporation.
 - 10. Unaflex.Universal Metal Hose; a Hyspan company.
- B. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
 - 1. Working-Pressure Rating: Minimum 200 psig
 - 2. End Connections NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.
 - 3. End Connections NPS 2-1/2 and Larger: Flanged copper alloy.
- C. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.
 - 1. Working-Pressure Rating: Minimum 200 psig.
 - 2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.
 - 3. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

2.18 WATER METERS

- A. Displacement-Type Water Meters:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. AALIANT; a Venture Measurement product line.ABB.Badger Meter, Inc.
- b. Carlon Meter.
- c. Mueller Co. Ltd.; a subsidiary of Mueller Water Products Inc.
- d. Schlumberger Limited; Water Services.
- e. Sensus.
- 2. Description:
 - a. Standard: AWWA C700.
 - b. Pressure Rating: 150-psig working pressure.
 - c. Body Design: Nutating disc; totalization meter.
 - d. Registration: In gallons or cubic feet as required by utility company.
 - e. Case: Bronze.
 - f. End Connections: Threaded.
- B. Turbine-Type Water Meters:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. AALIANT; a Venture Measurement product line.
 - b. ABB.
 - c. Badger Meter, Inc.
 - d. Hays Fluid Controls.
 - e. Master Meter, Inc.
 - f. McCrometer, Inc.
 - g. Mueller Co. Ltd.; a subsidiary of Mueller Water Products Inc.
 - h. Schlumberger Limited; Water Services.
 - i. SeaMetrics Inc.
 - j. Sensus.
 - 2. Description:
 - a. Standard: AWWA C701.
 - b. Pressure Rating: 150-psig working pressure.
 - c. Body Design: Turbine; totalization meter.
 - d. Registration: In gallons or cubic feet as required by utility company.
 - e. Case: Bronze.
 - f. End Connections for Meters NPS 2 and Smaller: Threaded.
 - g. End Connections for Meters NPS 2-1/2 and Larger: Flanged.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.

- 1. Locate backflow preventers in same room as connected equipment or system.
- 2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe-to-floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are unacceptable for this application.
- 3. Do not install bypass piping around backflow preventers.
- B. Install water regulators with inlet and outlet shutoff valves and bypass with memory-stop balancing valve. Install pressure gages on inlet and outlet.
- C. Install water-control valves with inlet and outlet shutoff valves and bypass with globe valve. Install pressure gages on inlet and outlet.
- D. Install balancing valves in locations where they can easily be adjusted.
- E. Install temperature-actuated, water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
 - 1. Install cabinet-type units recessed in or surface mounted on wall as specified.
- F. Install Y-pattern strainers for water on supply side of each control valve, water pressurereducing valve, solenoid valve and pump.
- G. Install outlet boxes recessed in wall or surface mounted on wall. Install 2-by-4-inch wood blocking, wall reinforcement between studs. Comply with requirements for wood blocking in Section 061053 "Miscellaneous Rough Carpentry."
- H. Install hose stations with check stops or shutoff valves on inlets and with thermometer on outlet.
 - 1. Install cabinet-type units recessed in or surface mounted on wall as specified. Install 2by-4-inch treated-wood blocking, wall reinforcement between studs.
- I. Set nonfreeze, nondraining-type post hydrants in concrete or pavement.
- J. Set freeze-resistant yard hydrants with riser pipe in concrete or pavement. Do not encase canister in concrete.
- K. Install water-hammer arresters in water piping according to PDI-WH 201.
- L. Install air vents at high points of water piping. Install drain piping and discharge onto floor drain.
- M. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.
- N. Install drainage-type, trap-seal primer valves as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting.
- O. Install trap-seal primer systems with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust system for proper flow.

3.2 CONNECTIONS

- A. Comply with requirements for ground equipment in Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for electrical connections.

3.3 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
 - 1. Pressure vacuum breakers.
 - 2. Intermediate atmospheric-vent backflow preventers.
 - 3. Reduced-pressure-principle backflow preventers.
 - 4. Double-check, backflow-prevention assemblies.
 - 5. Dual-check-valve backflow preventers.
 - 6. Reduced-pressure-detector, fire-protection, backflow-preventer assemblies.
 - 7. Double-check, detector-assembly backflow preventers.
 - 8. Water pressure-reducing valves.
 - 9. Calibrated balancing valves.
 - 10. Primary, thermostatic, water mixing valves.
 - 11. Manifold, thermostatic, water mixing-valve assemblies.
 - 12. Primary water tempering valves.
 - 13. Outlet boxes.
 - 14. Hose stations.
- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

A. Prepare test and inspection reports.

3.5 ADJUSTING

- A. Set field-adjustable pressure set points of water pressure-reducing valves.
- B. Set field-adjustable flow set points of balancing valves.
- C. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.

END OF SECTION 221119

SECTION 221123 - DOMESTIC WATER PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Horizontally mounted, in-line, close-coupled centrifugal pumps.

1.3 DEFINITIONS

A. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include materials of construction, rated capacities, certified performance curves with operating points plotted on curves, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For domestic water pumps to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Retain shipping flange protective covers and protective coatings during storage.
- B. Protect bearings and couplings against damage.

DOMESTIC WATER PUMPS

C. Comply with pump manufacturer's written rigging instructions for handling.

1.8 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.1 HORIZONTALLY MOUNTED, IN-LINE, CLOSE-COUPLED CENTRIFUGAL PUMPS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Alyan Pump Co.
 - 2. Armstrong Pumps Inc.
 - 3. Bell & Gossett Domestic Pump; ITT Corporation.
 - 4. Marshall Engineered Products Co.
 - 5. PACO Pumps; Grundfos Pumps Corporation, U.S.A.
 - 6. Pentair Pump Group; Aurora Pump.
 - 7. TACO Incorporated.
 - 8. Thrush Company, Inc.
- B. Description: Factory-assembled and -tested, in-line, single-stage, close-coupled, overhungimpeller centrifugal pumps designed for installation with pump and motor shaft mounted horizontal.
- C. Pump Construction:
 - 1. Casing: Radially split with threaded companion-flange connections for pumps with NPS 2 pipe connections and flanged connections for pumps with NPS 2-1/2 pipe connections.
 - 2. Impeller: Statically and dynamically balanced, closed, and keyed to shaft.
 - 3. Shaft and Shaft Sleeve: Steel shaft with deflector, with copper-alloy shaft sleeve. Include water slinger on shaft between motor and seal.
 - 4. Seal: Mechanical, with carbon-steel rotating ring, stainless-steel spring, ceramic seat, and rubber bellows and gasket.
 - 5. Bearings: Oil-lubricated; bronze-journal or ball type.
 - 6. Shaft Coupling: Flexible, capable of absorbing torsional vibration and shaft misalignment.
- D. Motor: Single speed, with grease-lubricated ball bearings; and resiliently or rigidly mounted to pump casing.

2.2 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 220513 "Common Motor Requirements for Plumbing Equipment."
 - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

2.3 CONTROLS

- A. Thermostats: Electric; adjustable for control of hot-water circulation pump.
 - 1. Type: Water-immersion temperature sensor, for installation in piping.
 - 2. Range: 50 to 125 deg F.
 - 3. Enclosure: NEMA 250, Type 4X.
 - 4. Operation of Pump: On or off.
 - 5. Transformer: Provide if required.
 - 6. Power Requirement: 120 V, ac.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of domestic-water-piping system to verify actual locations of connections before pump installation.

3.2 PUMP INSTALLATION

- A. Comply with HI 1.4.
- B. Install in-line, sealless centrifugal pumps with shaft horizontal unless otherwise indicated.
- C. Install horizontally mounted, in-line, close-coupled centrifugal pumps with shaft(s) horizontal.
- D. Install vertically mounted, in-line, close-coupled centrifugal pumps with shaft vertical.
- E. Install continuous-thread hanger rods and spring hangers with vertical-limit stop of size required to support pump weight.
 - 1. Comply with requirements for vibration isolation devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment." Fabricate brackets or supports as required.
 - 2. Comply with requirements for hangers and supports specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
- F. Install thermostats in hot-water return piping.

3.3 CONNECTIONS

- A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to pumps to allow service and maintenance.
- C. Connect domestic water piping to pumps. Install suction and discharge piping equal to or greater than size of pump nozzles.
 - 1. Install flexible connectors adjacent to pumps in suction and discharge piping of the following pumps:
 - a. Horizontally mounted, in-line, separately coupled centrifugal pumps.
 - b. Horizontally mounted, in-line, close-coupled centrifugal pumps.
 - c. Vertically mounted, in-line, close-coupled centrifugal pumps.
 - d. Comply with requirements for flexible connectors specified in Section 221116 "Domestic Water Piping."
 - 2. Install shutoff valve and strainer on suction side of each pump, and check, shutoff, and throttling valves on discharge side of each pump. Install valves same size as connected piping. Comply with requirements for valves specified in Section 220523 "General-Duty Valves for Plumbing Piping" and comply with requirements for strainers specified in Section 221119 "Domestic Water Piping Specialties."
 - 3. Install pressure gage and snubber at suction of each pump and pressure gage and snubber at discharge of each pump. Install at integral pressure-gage tappings where provided or install pressure-gage connectors in suction and discharge piping around pumps. Comply with requirements for pressure gages and snubbers specified in Section 220519 "Meters and Gages for Plumbing Piping."
- D. Connect thermostats to pumps that they control.
- E. Interlock pump between water heater and hot-water storage tank with water heater burner and time-delay relay.

3.4 IDENTIFICATION

A. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment" for identification of pumps.

3.5 STARTUP SERVICE

- A. Perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Check piping connections for tightness.
 - 3. Clean strainers on suction piping.
 - 4. Set thermostats for automatic starting and stopping operation of pumps.
 - 5. Perform the following startup checks for each pump before starting:
- a. Verify bearing lubrication.
- b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
- c. Verify that pump is rotating in the correct direction.
- 6. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
- 7. Start motor.
- 8. Open discharge valve slowly.
- 9. Adjust temperature settings on thermostats.
- 10. Adjust timer settings.

3.6 ADJUSTING

- A. Adjust domestic water pumps to function smoothly, and lubricate as recommended by manufacturer.
- B. Adjust initial temperature set points.
- C. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

END OF SECTION 221123

SECTION 221316 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Pipe, tube, and fittings.
 - 2. Specialty pipe fittings.
 - 3. Encasement for underground metal piping.

1.3 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
 - 1. Soil, Waste, and Vent Piping: 10-foot head of water.
- B. Seismic Performance: Soil, waste, and vent piping and support and installation shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For sovent drainage system. Include plans, elevations, sections, and details.

1.5 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Certificates: For waste and vent piping, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Detailed description of piping anchorage devices on which the certification is based and their installation requirements.
- B. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF/ANSI 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.

1.7 PROJECT CONDITIONS

- A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
 - 1. Notify Architectno fewer than seven days in advance of proposed interruption of sanitary waste service.
 - 2. Do not proceed with interruption of sanitary waste service without Architect's written permission.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 74, Service and Extra Heavy class(es).
- B. Gaskets: ASTM C 564, rubber.
- C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.3 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. Sovent Stack Fittings: ASME B16.45 or ASSE 1043, hubless, cast-iron aerator and deaerator drainage fittings.
- C. CISPI, Hubless-Piping Couplings:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. ANACO-Husky.
- b. Dallas Specialty & Mfg. Co.
- c. Fernco Inc.
- d. Matco-Norca, Inc.
- e. MIFAB, Inc.
- f. Mission Rubber Company; a division of MCP Industries, Inc.
- g. Stant.
- h. Tyler Pipe.
- 2. Standards: ASTM C 1277 and CISPI 310.
- 3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.
- D. Heavy-Duty, Hubless-Piping Couplings:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ANACO-Husky.
 - b. Clamp-All Corp.
 - c. Dallas Specialty & Mfg. Co.
 - d. MIFAB, Inc.
 - e. Mission Rubber Company; a division of MCP Industries, Inc.
 - f. Stant.
 - g. Tyler Pipe.
 - 2. Standards: ASTM C 1277 and ASTM C 1540.
 - 3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.
- E. Cast-Iron, Hubless-Piping Couplings:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. MG Piping Products Company.
 - 2. Standard: ASTM C 1277.
 - 3. Description: Two-piece ASTM A 48/A 48M, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.4 SPECIALTY PIPE FITTINGS

- A. Transition Couplings:
 - 1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.

- 2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
- 3. Unshielded, Nonpressure Transition Couplings:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Dallas Specialty & Mfg. Co.
 - 2) Fernco Inc.
 - 3) Mission Rubber Company; a division of MCP Industries, Inc.
 - 4) Plastic Oddities; a division of Diverse Corporate Technologies, Inc.
 - b. Standard: ASTM C 1173.
 - c. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - d. Sleeve Materials:
 - 1) For Cast-Iron Soil Pipes: ASTM C 564, rubber.
 - 2) For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
 - 3) For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
- 4. Shielded, Nonpressure Transition Couplings:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Cascade Waterworks Mfg. Co.
 - 2) Mission Rubber Company; a division of MCP Industries, Inc.
 - b. Standard: ASTM C 1460.
 - c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
- 5. Pressure Transition Couplings:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Cascade Waterworks Mfg. Co.
 - 2) Dresser, Inc.
 - 3) EBAA Iron, Inc.
 - 4) JCM Industries, Inc.
 - 5) Romac Industries, Inc.
 - 6) Smith-Blair, Inc.; a Sensus company.
 - 7) The Ford Meter Box Company, Inc.

- 8) Viking Johnson.
- b. Standard: AWWA C219.
- c. Description: Metal, sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.
- d. Center-Sleeve Material: Manufacturer's standard.
- e. Gasket Material: Natural or synthetic rubber.
- f. Metal Component Finish: Corrosion-resistant coating or material.
- B. Dielectric Fittings:
 - 1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
 - 2. Dielectric Unions:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Capitol Manufacturing Company.
 - 2) Central Plastics Company.
 - 3) Hart Industries International, Inc.
 - 4) Jomar International Ltd.
 - 5) Matco-Norca, Inc.
 - 6) McDonald, A. Y. Mfg. Co.
 - 7) Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 8) Wilkins; a Zurn company.
 - b. Description:
 - 1) Standard: ASSE 1079.
 - 2) Pressure Rating: 125 psig minimum at 180 deg F.
 - 3) End Connections: Solder-joint copper alloy and threaded ferrous.
 - 3. Dielectric Flanges:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Capitol Manufacturing Company.
 - 2) Central Plastics Company.
 - 3) Matco-Norca, Inc.
 - 4) Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 5) Wilkins; a Zurn company.
 - b. Description:
 - 1) Standard: ASSE 1079.
 - 2) Factory-fabricated, bolted, companion-flange assembly.

- 3) Pressure Rating: 125 psig minimum at 180 deg F.
- 4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- 4. Dielectric-Flange Insulating Kits:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Advance Products & Systems, Inc.
 - 2) Calpico, Inc.
 - 3) Central Plastics Company.
 - 4) Pipeline Seal and Insulator, Inc.
 - b. Description:
 - 1) Nonconducting materials for field assembly of companion flanges.
 - 2) Pressure Rating: 150 psig.
 - 3) Gasket: Neoprene or phenolic.
 - 4) Bolt Sleeves: Phenolic or polyethylene.
 - 5) Washers: Phenolic with steel backing washers.
- 5. Dielectric Nipples:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Elster Perfection.
 - 2) Grinnell Mechanical Products.
 - 3) Matco-Norca, Inc.
 - 4) Precision Plumbing Products, Inc.
 - 5) Victaulic Company.
 - b. Description:
 - 1) Standard: IAPMO PS 66
 - 2) Electroplated steel nipple.
 - 3) Pressure Rating: 300 psig at 225 deg F.
 - 4) End Connections: Male threaded or grooved.
 - 5) Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in division 300000 sections.

3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- K. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- L. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- M. Install soil and waste drainage and vent piping at the following minimum slopes unless otherwise indicated:
 - 1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 2 percent downward in direction of flow for piping NPS 4 and larger.
 - 2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.

- 3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- N. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
 - 1. Install encasement on underground piping according to ASTM A 674 or AWWA C105/A 21.5.
- O. Install steel piping according to applicable plumbing code.
- P. Install stainless-steel piping according to ASME A112.3.1 and applicable plumbing code.
- Q. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."
- R. Install aboveground ABS piping according to ASTM D 2661.
- S. Install aboveground PVC piping according to ASTM D 2665.
- T. Install engineered soil and waste drainage and vent piping systems as follows:
 - 1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
 - 2. Sovent Drainage System: Comply with ASSE 1043 and sovent fitting manufacturer's written installation instructions.
 - 3. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.
- U. Install underground, ductile-iron, force-main piping according to AWWA C600. Install buried piping inside building between wall and floor penetrations and connection to sanitary sewer piping outside building with restrained joints. Anchor pipe to wall or floor. Install thrust-block supports at vertical and horizontal offsets.
 - 1. Install encasement on piping according to ASTM A 674 or AWWA C105/A 21.5.
- V. Install underground, copper, force-main tubing according to CDA's "Copper Tube Handbook."
 - 1. Install encasement on piping according to ASTM A 674 or AWWA C105/A 21.5.
- W. Install force mains at elevations indicated.
- X. Plumbing Specialties:
 - 1. Install backwater valves in sanitary waster gravity-flow piping. Comply with requirements for backwater valves specified in Section 221319 "Sanitary Waste Piping Specialties."
 - 2. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary drainage gravity-flow piping. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."
 - 3. Install drains in sanitary drainage gravity-flow piping. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."

- Y. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- Z. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- AA. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- BB. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

- A. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- B. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead-and-oakum calked joints.
- C. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.
- D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- E. Join stainless-steel pipe and fittings with gaskets according to ASME A112.3.1.
- F. Join copper tube and fittings with soldered joints according to ASTM B 828. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.
- G. Grooved Joints: Cut groove ends of pipe according to AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections, over gasket, with keys seated in piping grooves. Install and tighten housing bolts.
- H. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.
- I. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

- 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
- 2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
- 3. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.

3.4 SPECIALTY PIPE FITTING INSTALLATION

- A. Transition Couplings:
 - 1. Install transition couplings at joints of piping with small differences in OD's.
 - 2. In Drainage Piping: Shielded, nonpressure transition couplings.
 - 3. In Aboveground Force Main Piping: Fitting-type transition couplings.
 - 4. In Underground Force Main Piping:
 - a. NPS 1-1/2 and Smaller: Fitting-type transition couplings.
 - b. NPS 2 and Larger: Pressure transition couplings.

B. Dielectric Fittings:

- 1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- 2. Dielectric Fittings for NPS 2 and Smaller: Use dielectric unions.
- 3. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flange kits.
- 4. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.5 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
 - 1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
 - 2. Install stainless-steel pipe hangers for horizontal piping in corrosive environments.
 - 3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
 - 4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
 - 5. Vertical Piping: MSS Type 8 or Type 42, clamps.
 - 6. Install individual, straight, horizontal piping runs:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
 - 7. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 8. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.

- D. Support vertical piping and tubing at base and at each floor.
- E. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.
- F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
 - 2. NPS 3: 60 inches with 1/2-inch rod.
 - 3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
 - 4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.
 - 5. NPS 10 and NPS 12: 60 inches with 7/8-inch rod.
 - 6. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.
- G. Install supports for vertical cast-iron soil piping every 15 feet.

3.6 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect drainage and vent piping to the following:
 - 1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
 - 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
 - 3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
 - 4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
 - 5. Comply with requirements for cleanouts and drains specified in Section 221319 "Sanitary Waste Piping Specialties."
 - 6. Equipment: Connect drainage piping as indicated. Provide shutoff valve if indicated and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.
- D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- E. Make connections according to the following unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.7 IDENTIFICATION

A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.8 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 - 2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - 3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping except outside leaders on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
 - 4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
 - 5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 - 6. Prepare reports for tests and required corrective action.
- E. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

- 1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
- 2. Cap and subject piping to static-water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
- 3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
- 4. Prepare reports for tests and required corrective action.

3.9 CLEANING AND PROTECTION

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.10 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground, soil and waste piping NPS 4 and smaller shall any of be the following:
 - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 - 2. Hubless, cast-iron soil pipe and fittings and sovent stack fittings; heavy-duty hublesspiping couplings; and coupled joints.
- C. Aboveground, soil and waste piping NPS 5 and larger shall be any of the following:
 - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 - 2. Hubless, cast-iron soil pipe and fittings and sovent stack fittings; heavy-duty hublesspiping couplings; and coupled joints.
- D. Aboveground, vent piping NPS 4 and smaller shall be any of the following:
 - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 - 2. Hubless, cast-iron soil pipe and fittings; heavy-duty hubless-piping couplings; and coupled joints.
- E. Aboveground, vent piping NPS 5 and larger shall be any of the following:
 - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 - 2. Hubless, cast-iron soil pipe and fittings; heavy-duty hubless-piping couplings; and coupled joints.
- F. Underground, soil, waste, and vent piping NPS 4 and smaller shall be any of the following:

- 1. Extra Heavy class, cast-iron soil piping; gaskets; and gasketed joints.
- 2. Hubless, cast-iron soil pipe and fittings; heavy-duty cast-iron hubless-piping couplings; and coupled joints.
- G. Underground, soil and waste piping NPS 5 and larger shall be any of the following:
 - 1. Extra Heavy class, cast-iron soil piping; gaskets; and gasketed joints.
 - 2. Hubless, cast-iron soil pipe and fittings; heavy-duty cast-iron hubless-piping couplings; coupled joints.

END OF SECTION 221316

SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Cleanouts.
 - 2. Floor drains.
 - 3. Air-admittance valves.
 - 4. Roof flashing assemblies.
 - 5. Through-penetration firestop assemblies.
 - 6. Miscellaneous sanitary drainage piping specialties.
 - 7. Flashing materials.
 - 8. Grease interceptors.
- B. Related Requirements:
 - 1. Section 221423 "Storm Drainage Piping Specialties" for storm drainage piping inside the building, drainage piping specialties, and drains.

1.3 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. FOG: Fats, oils, and greases.
- C. FRP: Fiberglass-reinforced plastic.
- D. HDPE: High-density polyethylene plastic.
- E. PE: Polyethylene plastic.
- F. PP: Polypropylene plastic.
- G. PVC: Polyvinyl chloride plastic.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories for the following:
 - 1. Grease interceptors.
- B. Shop Drawings: Show fabrication and installation details for frost-resistant vent terminals.
 - 1. Wiring Diagrams: Power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

- A. Manufacturer Seismic Qualification Certification: Submit certification that [grease interceptors accessories, and components will withstand seismic forces defined in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment." Include the following:
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
 - b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- B. Field quality-control test reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

1.8 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Section 033000 "Cast-in-Place Concrete."
- B. Coordinate size and location of roof penetrations.

PART 2 - PRODUCTS

2.1 CLEANOUTS

- A. Exposed Metal Cleanouts:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
 - g. Josam Company; Blucher-Josam Div.
 - 2. Standard: ASME A112.36.2M for cast iron, for cleanout test tee.
 - 3. Size: Same as connected drainage piping
 - 4. Body Material: Hub-and-spigot, cast-iron soil pipe T-branch or Hubless, cast-iron soil pipe test tee as required to match connected piping.
 - 5. Closure: Countersunk, brass plug.
 - 6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
 - 7. Closure: Stainless-steel plug with seal.
- B. Metal Floor Cleanout:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Josam Company; Josam Div.
 - b. Oatey.
 - c. Sioux Chief Manufacturing Company, Inc.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - e. Tyler Pipe; Wade Div.
 - f. Watts Drainage Products Inc.
 - g. Zurn Plumbing Products Group; Light Commercial Operation.
 - h. Zurn Plumbing Products Group; Specification Drainage Operation.
 - i. Josam Company; Josam Div.

- j. Kusel Equipment Co.
- k. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
- 1. Josam Company; Blucher-Josam Div.
- 2. Standard: ASME A112.36.2M for adjustable housing cast-iron soil pipe with cast-iron ferrule or heavy-duty, adjustable housing cleanout.
- 3. Size: Same as connected branch.
- 4. Type: Adjustable housing Cast-iron soil pipe with cast-iron ferrule.
- 5. Body or Ferrule: Cast iron.
- 6. Clamping Device: Required.
- 7. Outlet Connection: Inside calk.
- 8. Closure: Brass plug with tapered threads.
- 9. Adjustable Housing Material: Cast iron with threads.
- 10. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
- 11. Frame and Cover Shape: Round.
- 12. Top Loading Classification: Heavy Duty.
- 13. Riser: ASTM A 74, Extra or Heavy Service class, cast-iron drainage pipe fitting and riser to cleanout.
- 14. Standard: ASME A112.3.1.
- 15. Size: Same as connected branch.
- 16. Housing: Stainless steel.
- 17. Closure: Stainless steel with seal.
- 18. Riser: Stainless-steel drainage pipe fitting to cleanout.
- C. Cast-Iron Wall Cleanouts:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; d of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
 - 2. Standard: ASME A112.36.2M. Include wall access.
 - 3. Size: Same as connected drainage piping.
 - 4. Body: Hub-and-spigot, cast-iron soil pipe T-branch or Hubless, cast-iron soil pipe test tee as required to match connected piping.
 - 5. Closure: Countersunk, drilled-and-threaded brass plug.
 - 6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
 - 7. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.
 - 8. Wall Access: Round, nickel-bronze, copper-alloy, or stainless-steel wall-installation frame and cover.

2.2 FLOOR DRAINS

A. Cast-Iron Floor Drains:

- 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Commercial Enameling Co.
 - b. Josam Company; Josam Div.
 - c. MIFAB, Inc.
 - d. Prier Products, Inc.
 - e. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - f. Tyler Pipe; Wade Div.
 - g. Watts Drainage Products Inc.
 - h. Zurn Plumbing Products Group; Light Commercial Operation.
 - i. Zurn Plumbing Products Group; Specification Drainage Operation.
- 2. Standard: ASME A112.6.3.
- 3. Pattern: Floor drain.
- 4. Body Material: Gray iron.
- 5. Seepage Flange: Required.
- 6. Anchor Flange: Required.
- 7. Clamping Device: Required.
- 8. Outlet: Bottom.
- 9. Top or Strainer Material: Nickel bronze.
- 10. Top of Body and Strainer Finish: Nickel bronze.
- 11. Top Shape: Round.
- 12. Top Loading Classification: Heavy Duty.

2.3 AIR-ADMITTANCE VALVES

- A. Fixture Air-Admittance Valves <Insert drawing designation if any>:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Ayrlett, LLC.
 - b. Durgo, Inc.
 - c. Oatey.
 - d. ProSet Systems Inc.
 - e. RectorSeal.
 - f. Studor, Inc.
 - 2. Standard: ASSE 1051, Type A for single fixture or Type B for branch piping.
 - 3. Housing: Plastic.
 - 4. Operation: Mechanical sealing diaphragm.
 - 5. Size: Same as connected fixture or branch vent piping.

2.4 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Acorn Engineering Company; Elmdor/Stoneman Div.
 - b. Thaler Metal Industries Ltd.
- B. Description: Manufactured assembly made of 4.0-lb/sq. ft., 0.0625-inch-thick, lead flashing collar and skirt extending at least 8 inches from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.
 - 1. Open-Top Vent Cap: Without cap.

2.5 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

- A. Through-Penetration Firestop Assemblies:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ProSet Systems Inc.
 - 2. Standard: UL 1479 assembly of sleeve and stack fitting with firestopping plug.
 - 3. Size: Same as connected soil, waste, or vent stack.
 - 4. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
 - 5. Stack Fitting: ASTM A 48/A 48M, gray-iron, hubless-pattern, wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
 - 6. Special Coating: Corrosion resistant on interior of fittings.

2.6 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

- A. Open Drains:
 - 1. Description: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast-iron, soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C 564, rubber gaskets.
 - 2. Size: Same as connected waste piping with increaser fitting of size indicated.
- B. Deep-Seal Traps:
 - 1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
 - 2. Size: Same as connected waste piping.
 - a. NPS 2: 4-inch-minimum water seal.
 - b. NPS 2-1/2 and Larger: 5-inch-minimum water seal.

- C. Floor-Drain, Trap-Seal Primer Fittings :
 - 1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
 - 2. Size: Same as floor drain outlet with NPS 1/2 side inlet.
- D. Air-Gap Fittings:
 - 1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
 - 2. Body: Bronze or cast iron.
 - 3. Inlet: Opening in top of body.
 - 4. Outlet: Larger than inlet.
 - 5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.
- E. Sleeve Flashing Device:
 - 1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 2 inches above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
 - 2. Size: As required for close fit to riser or stack piping.
- F. Stack Flashing Fittings:
 - 1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
 - 2. Size: Same as connected stack vent or vent stack.
- G. Vent Caps:
 - 1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
 - 2. Size: Same as connected stack vent or vent stack.
- H. Expansion Joints:
 - 1. Standard: ASME A112.21.2M.
 - 2. Body: Cast iron with bronze sleeve, packing, and gland.
 - 3. End Connections: Matching connected piping.
 - 4. Size: Same as connected soil, waste, or vent piping.

2.7 FLASHING MATERIALS

- A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:
 - 1. General Use: 4.0-lb/sq. ft., 0.0625-inch thickness.
 - 2. Vent Pipe Flashing: 3.0-lb/sq. ft., 0.0469-inch thickness.

- 3. Burning: 6-lb/sq. ft., 0.0938-inch thickness.
- B. Copper Sheet: ASTM B 152/B 152M, of the following minimum weights and thicknesses, unless otherwise indicated:
 - 1. General Applications: 12 oz./sq. ft. .
 - 2. Vent Pipe Flashing: 8 oz./sq. ft..
- C. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04inch minimum thickness, unless otherwise indicated. Include G90 hot-dip galvanized, millphosphatized finish for painting if indicated.
- D. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.
- E. Fasteners: Metal compatible with material and substrate being fastened.
- F. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
- G. Solder: ASTM B 32, lead-free alloy.
- H. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

2.8 GREASE INTERCEPTORS

- A. Grease Interceptors:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Applied Chemical Technology, Incorporated.
 - b. Josam Company; Josam Div.
 - c. MIFAB, Inc.
 - d. Rockford Sanitary Systems, Inc.
 - e. Schier Products Company.
 - f. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - g. Tyler Pipe; Wade Div.
 - h. Watts Drainage Products Inc.
 - i. Zurn Plumbing Products Group; Light Commercial Operation.
 - j. Zurn Plumbing Products Group; Specification Drainage Operation.
 - k. Ashland Trap Distribution Co.
 - 1. Bio-Microbics, Inc.
 - m. Canplas LLC.
 - n. Schier Products Company.
 - o. Zurn Plumbing Products Group; Light Commercial Operation.
 - 2. Standard: ASME A112.14.3, for intercepting and retaining fats, oils, and greases from food-preparation wastewater.

- 3. Plumbing and Drainage Institute Seal: Required.
- 4. Body Material: Cast iron or steel.
- 5. Interior Lining: Corrosion-resistant enamel.
- 6. Exterior Coating: Corrosion-resistant enamel.

2.9 MOTORS

- A. General requirements for motors are specified in Section 220513 "Common Motor Requirements for Plumbing Equipment."
 - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Equipment Mounting: Install grease interceptors on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases specified in Section 033000 "Cast-in-Place Concrete."
 - 1. Coordinate sizes and locations of concrete bases with actual equipment provided.
 - 2. Construct bases to withstand, without damage to equipment, seismic force required by code.
 - 3. Construct concrete bases 4 inches high and extend base not less than 6 inches in all directions beyond the maximum dimensions of grease interceptors unless otherwise indicated or unless required for seismic anchor support.
 - 4. Minimum Compressive Strength: 3000 psi at 28 days.
 - 5. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
 - 6. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base, and anchor into structural concrete floor.
 - 7. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 8. Install anchor bolts to elevations required for proper attachment to supported equipment.
- B. Install backwater valves in building drain piping. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.
- C. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
 - 1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
 - 2. Locate at each change in direction of piping greater than 45 degrees.
 - 3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.

- 4. Locate at base of each vertical soil and waste stack.
- D. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- E. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- F. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
 - 1. Position floor drains for easy access and maintenance.
 - 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
 - a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
 - b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
 - c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.
 - 3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
 - 4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- G. Install trench drains at low points of surface areas to be drained. Set grates of drains flush with finished surface, unless otherwise indicated.
- H. Assemble and install ASME A112.3.1, stainless-steel channel drainage systems according to ASME A112.3.1. Install on support devices so that top will be flush with surface.
- I. Assemble non-ASME A112.3.1, stainless-steel channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.
- J. Assemble FRP channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.
- K. Assemble plastic channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.
- L. Install fixture air-admittance valves on fixture drain piping.
- M. Install stack air-admittance valves at top of stack vent and vent stack piping.
- N. Install air-admittance-valve wall boxes recessed in wall.
- O. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.
- P. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.

- Q. Install through-penetration firestop assemblies in plastic conductors and stacks at floor penetrations.
- R. Assemble open drain fittings and install with top of hub 1 inch above floor.
- S. Install deep-seal traps on floor drains and other waste outlets, if indicated.
- T. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
 - 1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
 - 2. Size: Same as floor drain inlet.
- U. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- V. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
- W. Install vent caps on each vent pipe passing through roof.
- X. Install frost-resistant vent terminals on each vent pipe passing through roof. Maintain 1-inch (25-mm) clearance between vent pipe and roof substrate.
- Y. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.
- Z. Install frost-proof vent caps on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.
- AA. Assemble components of FOG disposal systems and install on floor. Install trap, vent, fresh-air inlet, and flow-control fitting according to authorities having jurisdiction. Install shelf fastened to reinforcement in wall construction and adjacent to unit, unless otherwise indicated. Install culture bottle, culture metering pump, timer, and control on shelf. Install tubing between culture bottle, metering pump, and chamber.
- BB. Install grease interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction and with clear space for servicing.
 - 1. Above-Floor Installation: Set unit with bottom resting on floor, unless otherwise indicated.
 - 2. Flush with Floor Installation: Set unit and extension, if required, with cover flush with finished floor.
 - 3. Recessed Floor Installation: Set unit in receiver housing having bottom or cradle supports, with receiver housing cover flush with finished floor.
 - 4. Install cleanout immediately downstream from interceptors not having integral cleanout on outlet.
- CC. Install grease removal devices on floor. Install trap, vent, and flow-control fitting according to authorities having jurisdiction. Install control panel adjacent to unit, unless otherwise indicated.

- DD. Install solids interceptors with cleanout immediately downstream from interceptors that do not have integral cleanout on outlet. Install trap on interceptors that do not have integral trap and are connected to sanitary drainage and vent systems.
- EE. Install wood-blocking reinforcement for wall-mounting-type specialties.
- FF. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

3.2 CONNECTIONS

- A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Grease Interceptors: Connect inlet and outlet to unit, and connect flow-control fitting and vent to unit inlet piping. Install valve on outlet of automatic drawoff-type unit.
- D. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- E. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.3 FLASHING INSTALLATION

- A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
 - 1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.
 - 2. Copper Sheets: Solder joints of copper sheets.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
 - 1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
 - 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
 - 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.
- D. Secure flashing into sleeve and specialty clamping ring or device.

- E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Section 076200 "Sheet Metal Flashing and Trim."
- F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.
- G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.4 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
 - 1. FOG disposal systems.
 - 2. Grease interceptors.
 - 3. Grease removal devices.
 - 4. Oil interceptors.
 - 5. Solids interceptors.
- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled grease removal devices and their installation, including piping and electrical connections, and to assist in testing.
- B. Tests and Inspections:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.6 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain grease removal devices.

END OF SECTION 221319

SECTION 221413 - FACILITY STORM DRAINAGE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Pipe, tube, and fittings.
 - 2. Specialty pipe fittings.
 - 3. Encasement for underground metal piping.
- B. Related Sections:
 - 1. Section 334100 "Storm Utility Drainage Piping" for storm drainage piping outside the building.

1.3 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
 - 1. Storm Drainage Piping: 10-foot head of water.
- B. Seismic Performance: Storm drainage piping and support and installation shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.5 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Certificates: For storm drainage piping, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

- 2. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- B. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF/ANSI 14, "Plastics Piping System Components and Related Materials," for plastic piping components. Include marking with "NSF-drain" for plastic drain piping and "NSF-sewer" for plastic sewer piping.

1.7 PROJECT CONDITIONS

- A. Interruption of Existing Storm-Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
 - 1. Notify Architect no fewer than seven days in advance of proposed interruption of stormdrainage service.
 - 2. Do not proceed with interruption of storm-drainage service without Architect's written permission.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. CISPI, Hubless-Piping Couplings:
 - 1. Manufacturers: Subject to compliance with requirements, [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ANACO-Husky.
 - b. Dallas Specialty & Mfg. Co.
 - c. Fernco Inc.
 - d. Matco-Norca, Inc.
 - e. MIFAB, Inc.
 - f. Mission Rubber Company; a division of MCP Industries, Inc.

- g. Stant.
- h. Tyler Pipe.
- 2. Standards: ASTM C 1277 and CISPI 310.
- 3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.
- C. Heavy-Duty, Hubless-Piping Couplings:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ANACO-Husky.
 - b. Clamp-All Corp.
 - c. Dallas Specialty & Mfg. Co.
 - d. MIFAB, Inc.
 - e. Mission Rubber Company; a division of MCP Industries, Inc.
 - f. Stant.
 - g. Tyler Pipe.
 - 2. Standards: ASTM C 1277 and ASTM C 1540.
 - 3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.
- D. Cast-Iron, Hubless-Piping Couplings:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. MG Piping Products Company.
 - 2. Standard: ASTM C 1277.
 - 3. Description: Two-piece ASTM A 48/A 48M, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.3 SPECIALTY PIPE FITTINGS

- A. Transition Couplings:
 - 1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.
 - 2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified-pipingsystem fitting.
 - 3. Unshielded, Nonpressure Transition Couplings:

- a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Dallas Specialty & Mfg. Co.
 - 2) Fernco Inc.
 - 3) Mission Rubber Company; a division of MCP Industries, Inc.
 - 4) Plastic Oddities; a division of Diverse Corporate Technologies, Inc.
- b. Standard: ASTM C 1173.
- c. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
- d. Sleeve Materials:
 - 1) For Cast-Iron Soil Pipes: ASTM C 564, rubber.
 - 2) For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
 - 3) For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
- 4. Shielded, Nonpressure Transition Couplings:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Cascade Waterworks Mfg. Co.
 - 2) Mission Rubber Company; a division of MCP Industries, Inc.
 - b. Standard: ASTM C 1460.
 - c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
- 5. Pressure Transition Couplings:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Cascade Waterworks Mfg. Co.
 - 2) Dresser, Inc.
 - 3) EBAA Iron, Inc.
 - 4) Ford Meter Box Company, Inc. (The)
 - 5) JCM Industries, Inc.
 - 6) Romac Industries, Inc.
 - 7) Smith-Blair, Inc.; a Sensus company.
 - 8) Viking Johnson; c/o Mueller Co.
 - b. Standard: AWWA C219.

- c. Description: Metal, sleeve-type couplings same size as, with pressure rating at least equal to and ends compatible with, pipes to be joined.
- d. Center-Sleeve Material: Manufacturer's standard.
- e. Gasket Material: Natural or synthetic rubber.
- f. Metal Component Finish: Corrosion-resistant coating or material.
- B. Dielectric Fittings:
 - 1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
 - 2. Dielectric Unions:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Capitol Manufacturing Company.
 - 2) Central Plastics Company.
 - 3) Hart Industries International, Inc.
 - 4) Jomar International Ltd.
 - 5) Matco-Norca, Inc.
 - 6) McDonald, A. Y. Mfg. Co.
 - 7) Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 8) Wilkins; a Zurn company.
 - b. Description:
 - 1) Standard: ASSE 1079.
 - 2) Pressure Rating: 150 psig at 180 deg F.
 - 3) End Connections: Solder-joint copper alloy and threaded ferrous.
 - 3. Dielectric Flanges:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Capitol Manufacturing Company.
 - 2) Central Plastics Company.
 - 3) Matco-Norca, Inc.
 - 4) Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 5) Wilkins; a Zurn company.
 - b. Description:
 - 1) Standard: ASSE 1079.
 - 2) Factory-fabricated, bolted, companion-flange assembly.
 - 3) Pressure Rating: 150 psig.
 - 4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

- 4. Dielectric-Flange Insulating Kits:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Advance Products & Systems, Inc.
 - 2) Calpico, Inc.
 - 3) Central Plastics Company.
 - 4) Pipeline Seal and Insulator, Inc.
 - b. Description:
 - 1) Nonconducting materials for field assembly of companion flanges.
 - 2) Pressure Rating: 150 psig.
 - 3) Gasket: Neoprene or phenolic.
 - 4) Bolt Sleeves: Phenolic or polyethylene.
 - 5) Washers: Phenolic with steel-backing washers.
- 5. Dielectric Nipples:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Elster Perfection.
 - 2) Grinnell Mechanical Products.
 - 3) Matco-Norca, Inc.
 - 4) Precision Plumbing Products, Inc.
 - 5) Victaulic Company.
 - b. Description:
 - 1) Electroplated steel nipple complying with ASTM F 1545.
 - 2) Pressure Rating: 300 psig at 225 deg F.
 - 3) End Connections: Male threaded or grooved.
 - 4) Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in division 300000 sections.
3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations from layout are approved on coordination drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- K. Make changes in direction for storm drainage piping using appropriate branches, bends, and long-sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- L. Lay buried building storm drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- M. Install storm drainage piping at the following minimum slopes unless otherwise indicated:
 - 1. Building Storm Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 2 percent downward in direction of flow for piping NPS 4 (DN 100) and larger.
 - 2. Horizontal Storm-Drainage Piping: 2 percent downward in direction of flow.
- N. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
 - 1. Install encasement on underground piping according to ASTM A 674 or AWWA C105.

- O. Install steel piping according to applicable plumbing code.
- P. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."
- Q. Install force mains at elevations indicated.
- R. Plumbing Specialties:
 - 1. Install backwater valves in storm drainage gravity-flow piping. Comply with requirements for backwater valves specified in Section 221423 "Storm Drainage Piping Specialties."
 - 2. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers in storm drainage gravity-flow piping. Install cleanout fitting with closure plug inside the building in storm drainage force-main piping. Comply with requirements for cleanouts specified in Section 221423 "Storm Drainage Piping Specialties."
 - 3. Install drains in storm drainage gravity-flow piping. Comply with requirements for drains specified in Section 221423 "Storm Drainage Piping Specialties."
- S. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- T. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- U. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- V. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

- A. Hub-and-Spigot, Cast-Iron Soil Piping Gasketed Joints: Join according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- B. Hub-and-Spigot, Cast-Iron Soil Piping Calked Joints: Join according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead-and-oakum calked joints.
- C. Hubless, Cast-Iron Soil Piping Coupled Joints: Join according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.
- D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

- E. Join copper tube and fittings with soldered joints according to ASTM B 828 procedure. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.
- F. Grooved Joints: Cut groove ends of pipe according to AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fittings. Install coupling housing sections, over gasket, with keys seated in piping grooves. Install and tighten housing bolts.
- G. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.
- H. Plastic, Nonpressure-Piping, Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
 - 3. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.

3.4 SPECIALTY PIPE FITTING INSTALLATION

- A. Transition Couplings:
 - 1. Install transition couplings at joints of piping with small differences in OD's.
 - 2. In Drainage Piping Shielded, nonpressure transition couplings.
 - 3. In Aboveground Force-Main Piping: Fitting-type transition couplings.
 - 4. In Underground Force-Main Piping:
 - a. NPS 1-1/2 and Smaller: Fitting-type transition couplings.
 - b. NPS 2 and Larger: Pressure transition couplings.
- B. Dielectric Fittings:
 - 1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
 - 2. Dielectric Fittings for NPS 2 and Smaller: Use dielectric unions.
 - 3. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flange kits.
 - 4. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.5 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
 - 1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
 - 2. Install stainless-steel pipe hangers for horizontal piping in corrosive environments.
 - 3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.

- 4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
- 5. Vertical Piping: MSS Type 8 or Type 42, clamps.
- 6. Individual, Straight, Horizontal Piping Runs:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
- 7. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
- 8. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.
- D. Support vertical piping and tubing at base and at each floor.
- E. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.
- F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
 - 2. NPS 3: 60 inches with 1/2-inch rod.
 - 3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
 - 4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.
 - 5. NPS 10 and NPS 12: 60 inches with 7/8-inch rod.
 - 6. Spacing for 10-foot pipe lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.
- G. Install supports for vertical cast-iron soil piping every 15 feet.

3.6 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect storm drainage piping to roof drains and storm drainage specialties.
 - 1. Install test tees (wall cleanouts) in conductors near floor, and floor cleanouts with cover flush with floor.
 - 2. Comply with requirements for cleanouts and drains specified in Section 221423 "Storm Drainage Piping Specialties."
- D. Connect force-main piping to the following:
 - 1. Storm Sewer: To exterior force main.
 - 2. Sump Pumps: To sump pump discharge.

- E. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- F. Make connections according to the following unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.7 IDENTIFICATION

A. Identify exposed storm drainage piping. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.8 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
 - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 - 2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - 3. Test Procedure: Test storm drainage piping[, except outside leaders,] on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts until completion of inspection, water level must not drop. Inspect joints for leaks.
 - 4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 - 5. Prepare reports for tests and required corrective action.
- E. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

- 1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
- 2. Cap and subject piping to static-water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
- 3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
- 4. Prepare reports for tests and required corrective action.

3.9 CLEANING

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.10 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground storm drainage piping NPS 6 shall be the following:
 - 1. Hubless, cast-iron soil pipe and fittings; CISPI, heavy-duty, hubless-piping couplings; and coupled joints.
- C. Aboveground, storm drainage piping[NPS 8 and larger shall be the following:
 - 1. Hubless, cast-iron soil pipe and fittings; CISPI, heavy-duty, hubless-piping couplings; and coupled joints.
- D. Underground storm drainage piping NPS 6 and smaller shall be the following:
 - 1. Hubless, cast-iron soil pipe and fittings; CISPI, heavy-duty, cast-iron, hubless-piping couplings; and coupled joints.
- E. Underground, storm drainage piping NPS 8 and larger shall be the following:
 - 1. Hubless, cast-iron soil pipe and fittings; CISPI, heavy-duty, cast-iron, hubless-piping couplings; and coupled joints.

END OF SECTION 221413

SECTION 221423 - STORM DRAINAGE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Roof drains.
 - 2. Miscellaneous storm drainage piping specialties.
 - 3. Cleanouts.
 - 4. Through-penetration firestop assemblies.
 - 5. Flashing materials.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- 1.4 QUALITY ASSURANCE
 - A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 METAL ROOF DRAINS

- A. Cast-Iron, Large-Sump, General-Purpose Roof Drains:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Josam Company.
 - b. Marathon Roofing Products.
 - c. MIFAB, Inc.
 - d. Smith, Jay R. Mfg. Co.
 - e. Tyler Pipe.
 - f. Watts Water Technologies, Inc.

- g. Zurn Plumbing Products Group; Specification Drainage Operation.
- 2. Standard: ASME A112.6.4, for general-purpose roof drains.
- 3. Body Material: Cast iron.
- 4. Dimension of Body: Nominal 14-inch diameter.
- 5. Combination Flashing Ring and Gravel Stop: Required.
- 6. Flow-Control Weirs: Required.
- 7. Outlet: Bottom.
- 8. Underdeck Clamp: Required.
- 9. Dome Material: Cast iron.

2.2 CLEANOUTS

- A. Floor Cleanouts:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Josam Company.
 - b. Oatey.
 - c. Sioux Chief Manufacturing Company, Inc.
 - d. Smith, Jay R. Mfg. Co.
 - e. Tyler Pipe.
 - f. Watts Water Technologies, Inc.
 - g. Zurn Plumbing Products Group; Light Commercial Products Operation.
 - h. Zurn Plumbing Products Group; Specification Drainage Operation.
 - 2. Standard: ASME A112.36.2M, for adjustable housing cast-iron soil pipe with cast-iron ferrule cleanouts.
 - 3. Size: Same as connected branch.
 - 4. Type: Cast-iron soil pipe with cast-iron ferrule, Threaded, adjustable housing.
 - 5. Body or Ferrule Material: Cast iron.
 - 6. Clamping Device: Required.
 - 7. Outlet Connection: Inside calk.
 - 8. Closure: Brass plug with tapered threads.
 - 9. Adjustable Housing Material: Cast iron with threads.
 - 10. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
 - 11. Frame and Cover Shape: Round.
 - 12. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.
- B. Wall Cleanouts:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Josam Company.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.

- d. Tyler Pipe.
- e. Watts Water Technologies, Inc.
- f. Zurn Plumbing Products Group; Specification Drainage Operation.
- 2. Standard: ASME A112.36.2M, for cleanouts. Include wall access.
- 3. Size: Same as connected drainage piping.
- 4. Body Material: Hub-and-spigot, cast-iron soil-pipe T-branch as required to match connected piping.
- 5. Closure: Countersunk brass plug.
- 6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
- 7. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.
- 8. Wall Access: Round wall-installation frame and cover.

2.3 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

- A. Through-Penetration Firestop Assemblies:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ProSet Systems Inc.
 - 2. Standard: ASTM E 814, for through-penetration firestop assemblies.
 - 3. Certification and Listing: Intertek Testing Service NA for through-penetration firestop assemblies.
 - 4. Size: Same as connected pipe.
 - 5. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
 - 6. Stack Fitting: ASTM A 48/A 48M, gray-iron, hubless-pattern, wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
 - 7. Special Coating: Corrosion resistant on interior of fittings.

2.4 FLASHING MATERIALS

- A. Copper Sheet: ASTM B 152/B 152M,12 oz./sq. ft..
- B. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04inch minimum thickness unless otherwise indicated. Include G90 hot-dip galvanized, millphosphatized finish for painting if indicated.
- C. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.
- D. Fasteners: Metal compatible with material and substrate being fastened.

- E. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
- F. Solder: ASTM B 32, lead-free alloy.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions.
 - 1. Install flashing collar or flange of roof drain to prevent leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
 - 2. Install expansion joints, if indicated, in roof drain outlets.
 - 3. Position roof drains for easy access and maintenance.
- B. Install downspout adapters on outlet of back-outlet parapet roof drains and connect to sheet metal downspouts.
- C. Install conductor nozzles at exposed bottom of conductors where they spill onto grade.
- D. Install cleanouts in aboveground piping and building drain piping according to the following instructions unless otherwise indicated:
 - 1. Use cleanouts the same size as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
 - 2. Locate cleanouts at each change in direction of piping greater than 45 degrees.
 - 3. Locate cleanouts at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
 - 4. Locate cleanouts at base of each vertical soil and waste stack.
- E. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- F. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- G. Install horizontal backwater valves in floor with cover flush with floor.
- H. Install drain-outlet backwater valves in outlet of drains.
- I. Install test tees in vertical conductors and near floor.
- J. Install wall cleanouts in vertical conductors. Install access door in wall if indicated.
- K. Install trench drains at low points of surface areas to be drained. Set grates of drains flush with finished surface unless otherwise indicated.

- L. Assemble channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.
- M. Install through-penetration firestop assemblies in plastic conductors at concrete floor penetrations.
- N. Install sleeve flashing device with each conductor passing through floors with waterproof membrane.

3.2 CONNECTIONS

A. Comply with requirements for piping specified in Section 221413 "Facility Storm Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

3.3 FLASHING INSTALLATION

- A. Fabricate flashing from single piece of metal unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
 - 1. Lead Sheets: Burn joints of 6.0-lb/sq. ft. lead sheets, 0.0938-inch thickness or thicker. Solder joints of 4.0-lb/sq. ft. lead sheets, 0.0625-inch thickness or thinner.
 - 2. Copper Sheets: Solder joints of copper sheets.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
 - 1. Pipe Flashing: Sleeve type, matching the pipe size, with a minimum length of 10 inches and with skirt or flange extending at least 8 inches around pipe.
 - 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
 - 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.
- D. Secure flashing into sleeve and specialty clamping ring or device.
- E. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.4 **PROTECTION**

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221423

SECTION 223300 - ELECTRIC, DOMESTIC-WATER HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Commercial, electric, storage, domestic-water heaters.
 - 2. Domestic-water heater accessories.

1.3 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Commercial domestic-water heaters shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.4 ACTION SUBMITTALS

- A. Product Data: For each type and size of domestic-water heater indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings:
 - 1. Wiring Diagrams: For power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Certificates: For commercial domestic-water heaters, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

- 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- B. Product Certificates: For each type of commercial, electric, domestic-water heater, from manufacturer.
- C. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.
- D. Source quality-control reports.
- E. Field quality-control reports.
- F. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For electric, domestic-water heaters to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1 version 2004 or later.
- C. ASME Compliance: Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61, "Drinking Water System Components Health Effects."

1.8 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of electric, domestic-water heaters that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including storage tank and supports.

ELECTRIC, DOMESTIC-WATER HEATERS

- b. Faulty operation of controls.
- c. Deterioration of metals, metal finishes, and other materials beyond normal use.
- 2. Warranty Periods: From date of Substantial Completion.
 - a. Commercial, Electric, Storage, Domestic-Water Heaters:
 - 1) Storage Tank: Three years.
 - 2) Controls and Other Components: Three years.

PART 2 - PRODUCTS

2.1 COMMERCIAL, ELECTRIC, WATER HEATERS

- A. Commercial, Electric, Storage, Domestic-Water Heaters:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. American Water Heaters.
 - b. Bradford White Corporation.
 - c. Cemline Corporation.
 - d. Electric Heater Company (The).
 - e. GSW Water Heating.
 - f. HESco Industries, Inc.
 - g. Lochinvar Corporation.
 - h. Precision Boilers, Inc.
 - i. PVI Industries, LLC.
 - j. RECO USA.
 - k. Rheem Manufacturing Company.
 - 1. Smith, A. O. Water Products Co.; a division of A. O. Smith Corporation.
 - m. State Industries.
 - n. Vaughn Manufacturing Corporation.
 - 2. Standard: UL 1453.
 - 3. Storage-Tank Construction: ASME-code, steel vertical arrangement.
 - a. Tappings: Factory fabricated of materials compatible with tank and piping connections. Attach tappings to tank before testing.
 - 1) NPS 2 and Smaller: Threaded ends according to ASME B1.20.1.
 - 2) NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges, and according to ASME B16.24 for copper and copper-alloy flanges.
 - b. Pressure Rating: 150 psig.

- c. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending lining material into tappings.
- 4. Factory-Installed Storage-Tank Appurtenances:
 - a. Anode Rod: Replaceable magnesium.
 - b. Drain Valve: Corrosion-resistant metal complying with ASSE 1005.
 - c. Insulation: Comply with ASHRAE/IESNA 90.1.
 - d. Jacket: Steel with enameled finish.
 - e. Heating Elements: Electric, screw-in or bolt-on immersion type arranged in multiples of three.
 - f. Temperature Control: Adjustable thermostat.
 - g. Safety Controls: High-temperature-limit and low-water cutoff devices or systems.
 - h. Relief Valves: ASME rated and stamped for combination temperature-andpressure relief valves. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.
- 5. Special Requirements: NSF 5 construction.

PART 3 - EXECUTION

3.1 DOMESTIC-WATER HEATER INSTALLATION

- A. Commercial, Electric, Domestic-Water Heater Mounting: Install commercial, electric, domestic-water heaters on concrete base. Comply with requirements for concrete bases specified in Section 033000 "Cast-in-Place Concrete"
 - 1. Exception: Omit concrete bases for commercial, electric, domestic-water heaters if installation on stand, bracket, suspended platform, or directly on floor is indicated.
 - 2. Maintain manufacturer's recommended clearances.
 - 3. Arrange units so controls and devices that require servicing are accessible.
 - 4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
 - 5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 6. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 7. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 8. Anchor domestic-water heaters to substrate.
- B. Install electric, domestic-water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
 - 1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Section 220523 "General-Duty Valves for Plumbing Piping."

- C. Install commercial, electric, domestic-water heaters with seismic-restraint devices. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- D. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
- E. Install combination temperature-and-pressure relief valves in water piping for electric, domestic-water heaters without storage. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
- F. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for electric, domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Section 221119 "Domestic Water Piping Specialties."
- G. Install thermometers on outlet piping of electric, domestic-water heaters. Comply with requirements for thermometers specified in Section 220519 "Meters and Gages for Plumbing Piping."
- H. Install thermometers on inlet and outlet piping of residential, solar, electric, domestic-water heaters. Comply with requirements for thermometers specified in Section 220519 "Meters and Gages for Plumbing Piping."
- I. Assemble and install inlet and outlet piping manifold kits for multiple electric, domestic-water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each electric, domestic-water heater. Include shutoff valve and thermometer in each domestic-water heater inlet and outlet, and throttling valve in each electric, domestic-water heater outlet. Comply with requirements for valves specified in Section 220523 "General-Duty Valves for Plumbing Piping," and comply with requirements for thermometers specified in Section 220519 "Meters and Gages for Plumbing Piping."
- J. Install pressure-reducing valve with integral bypass relief valve in electric, domestic-water booster-heater inlet piping and water hammer arrester in booster-heater outlet piping. Set pressure-reducing valve for outlet pressure of 25 psig. Comply with requirements for pressurereducing valves and water hammer arresters specified in Section 221119 "Domestic Water Piping Specialties."
- K. Install piping-type heat traps on inlet and outlet piping of electric, domestic-water heater storage tanks without integral or fitting-type heat traps.
- L. Fill electric, domestic-water heaters with water.
- M. Charge domestic-water compression tanks with air.

3.2 CONNECTIONS

- A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to electric, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.3 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
 - 2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.
- C. Prepare test and inspection reports.

3.5 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain commercial, electric, domestic-water heaters.

END OF SECTION 223300

SECTION 224000 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following conventional plumbing fixtures and related components:
 - 1. Faucets for lavatories and sinks.
 - 2. Laminar-flow faucet-spout outlets.
 - 3. Flushometers.
 - 4. Toilet seats.
 - 5. Protective shielding guards.
 - 6. Fixture supports.
 - 7. Water closets.
 - 8. Urinals.
 - 9. Lavatories.
 - 10. Commercial sinks.
 - 11. Kitchen sinks.
 - 12. Service sinks.
 - 13. Service basins.
- B. Related Sections include the following:
 - 1. Division 22 Section "Domestic Water Piping Specialties" for backflow preventers, floor drains, and specialty fixtures not included in this Section.

1.3 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.
- C. Cast Polymer: Cast-filled-polymer-plastic material. This material includes cultured-marble and solid-surface materials.
- D. Cultured Marble: Cast-filled-polymer-plastic material with surface coating.
- E. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are

included where indicated.

- F. FRP: Fiberglass-reinforced plastic.
- G. PMMA: Polymethyl methacrylate (acrylic) plastic.
- H. PVC: Polyvinyl chloride plastic.
- I. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

1.4 SUBMITTALS

- A. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Operation and Maintenance Data: For plumbing fixtures to include in emergency, operation, and maintenance manuals.
- D. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.
 - 1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.
- D. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
- E. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- F. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.
- G. Comply with the following applicable standards and other requirements specified for plumbing

fixtures:

- 1. Enameled, Cast-Iron Fixtures: ASME A112.19.1M.
- 2. Plastic Lavatories: ANSI Z124.3.
- 3. Plastic Laundry Trays: ANSI Z124.6.
- 4. Plastic Mop-Service Basins: ANSI Z124.6.
- 5. Plastic Shower Enclosures: ANSI Z124.2.
- 6. Plastic Sinks: ANSI Z124.6.
- 7. Plastic Urinal Fixtures: ANSI Z124.9.
- 8. Porcelain-Enameled, Formed-Steel Fixtures: ASME A112.19.4M.
- 9. Slip-Resistant Bathing Surfaces: ASTM F 462.
- 10. Solid-Surface-Material Lavatories and Sinks: ANSI/ICPA SS-1.
- 11. Stainless-Steel Commercial, Handwash Sinks: NSF 2 construction.
- 12. Stainless-Steel Residential Sinks: ASME A112.19.3.
- 13. Vitreous-China Fixtures: ASME A112.19.2M.
- 14. Water-Closet, Flush Valve, Tank Trim: ASME A112.19.5.
- 15. Water-Closet, Flushometer Tank Trim: ASSE 1037.
- H. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:
 - 1. Backflow Protection Devices for Faucets with Side Spray: ASME A112.18.3M.
 - 2. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
 - 3. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
 - 4. Faucets: ASME A112.18.1.
 - 5. Hose-Connection Vacuum Breakers: ASSE 1011.
 - 6. Hose-Coupling Threads: ASME B1.20.7.
 - 7. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
 - 8. NSF Potable-Water Materials: NSF 61.
 - 9. Pipe Threads: ASME B1.20.1.
 - 10. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
 - 11. Supply Fittings: ASME A112.18.1.
 - 12. Brass Waste Fittings: ASME A112.18.2.
- I. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:
 - 1. Atmospheric Vacuum Breakers: ASSE 1001.
 - 2. Brass and Copper Supplies: ASME A112.18.1.
 - 3. Dishwasher Air-Gap Fittings: ASSE 1021.
 - 4. Manual-Operation Flushometers: ASSE 1037.
 - 5. Plastic Tubular Fittings: ASTM F 409.
 - 6. Brass Waste Fittings: ASME A112.18.2.
 - 7. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.
- J. Comply with the following applicable standards and other requirements specified for miscellaneous components:
 - 1. Floor Drains: ASME A112.6.3.
 - 2. Hose-Coupling Threads: ASME B1.20.7.
 - 3. Off-Floor Fixture Supports: ASME A112.6.1M.

- 4. Pipe Threads: ASME B1.20.1.
- 5. Plastic Toilet Seats: ANSI Z124.5.
- 6. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.6 WARRANTY

- A. Special Warranties: Manufacturer's standard form in which manufacturer agrees to repair or replace components of whirlpools that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures of unit shell.
 - b. Faulty operation of controls, blowers, pumps, heaters, and timers.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal use.
 - 2. Warranty Period for Commercial Applications: Three year(s) from date of Substantial Completion.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
 - 2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.
 - 3. Flushometer Valve, Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than 12 of each type.
 - 4. Provide hinged-top wood or metal box, or individual metal boxes, with separate compartments for each type and size of extra materials listed above.
 - 5. Flushometer Tank, Repair Kits: Equal to 5 percent of amount of each type installed, but no fewer than 2 of each type.
 - 6. Water-Closet Tank, Repair Kits: Equal to 5 percent of amount of each type installed.
 - 7. Toilet Seats: Equal to 5 percent of amount of each type installed.
 - 8. Dry Urinal Trap-Seal Cartridges: Equal to 200 percent of amount of each type installed, but no fewer than 12 of each type.
 - 9. Dry Urinal Trap-Seal Liquid: Equal to 1 gal for each urinal installed.

1.8 FIXTURE CONNECTIONS

A. Provide all plumbing connections required by fixtures which is provided on this project. Certain items of fixtures shall be provided under this section and certain items will be furnished and set under other sections of the specifications. In all cases, provide valved water supplies, waste and vent lines, and, unless noted otherwise, make final connections after fixtures is in place.

2.1 LAVATORY FAUCETS (P-3, P-3A)

- A. Lavatory Faucets:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, equal to American Standard 6055.205 with 605XTMV mixing valve:
 - a. Chicago Faucets.
 - b. Delta Faucet Company.
 - c. Kohler Co.
 - 2. Description: Electronic faucet. Coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.
 - a. Body Material: Commercial, solid brass
 - b. Finish: Polished chrome plate.
 - c. Maximum Flow Rate: 0.5 gpm.
 - d. Centers: Single hole.
 - e. Mounting: Deck.
 - f. Valve Handle(s): Not applicable.
 - g. Inlet(s): NPS 3/8 tubing, plain end.
 - h. Spout Outlet: Aerator.
 - i. Operation: Lithium battery.
 - j. Drain: Grid.

2.2 LAVATORY FAUCETS (P-3B, P-3C)

- A. Lavatory Faucets:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, equal to American Standard 7402.172V15:
 - a. Chicago Faucets.
 - b. Delta Faucet Company.
 - c. Kohler Co.

Description: Two-handle centerset lavatory faucet with gooseneck spout and factory installed handles. Durable cast brass construction. 1/4 turn washerless ceramic disc valve cartridges. One-half inch male inlet shanks with brass coupling nuts and shank nuts. Vandal-resistant faucets feature vandal-resistant aerators and index buttons on

- 2. factory-installed handles. 1.5 gpm/5.7L/min. maximum flow rate.
 - a. Body Material: Commercial, solid brass
 - b. Finish: Polished chrome plate.
 - c. Maximum Flow Rate: 1.5 gpm.
 - d. Centers: 4 inch.
 - e. Mounting: Deck.

- f. Valve Handle(s): wrist blade.
- g. Inlet(s): ¹/₂" O.D. slip connections.
- h. Spout: Rigid, gooseneck type.
- i. Spout Outlet: Aerator.
- j. Operation: Pop-up.
- k. Drain: Grid.

2.3 SINK FAUCETS (P-4)

- A. Sink Faucets:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, equal to American Standard 4275.550:
 - a. Chicago Faucets.
 - b. Delta Faucet Company.
 - c. Kohler Co.
 - d. Moen, Inc.
 - 2. Description: Two-Handle kitchen faucet with brass gooseneck spout. Two handle kitchen faucet shall feature brass construction with all brass inlet shanks and coupling nuts. Brass gooseneck swivel spout. Shall also feature 1/4 turn washerless ceramic disc valve cartridges that are reversible for use on either "hot" or "cold" side.
 - a. Body Material: Commercial, solid brass.
 - b. Finish: Polished chrome plate.
 - c. Maximum Flow Rate: 2.2 gpm, unless otherwise indicated.
 - d. Centers: 8".
 - e. Mounting: Deck.
 - f. Handle(s): lever.
 - g. Inlet(s): NPS 1/2 male inlet shanks.
 - h. Spout Type: Swing gooseneck.
 - i. Spout Outlet: Aerator.
 - j. Vacuum Breaker: Required.
 - k. Drain: Grid.

2.4 SINK FAUCETS (P-5)

- A. Sink Faucets:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, equal to American Standard 4275.551:
 - a. Chicago Faucets.
 - b. Delta Faucet Company.
 - c. Kohler Co.
 - d. Moen, Inc.

- 2. Description: Two-Handle kitchen faucet with brass gooseneck spout. Two handle kitchen faucet shall feature brass construction with all brass inlet shanks and coupling nuts. Brass gooseneck swivel spout. Shall also feature 1/4 turn washerless ceramic disc valve cartridges that are reversible for use on either "hot" or "cold" side. With handspray.
 - a. Body Material: Commercial, solid brass.
 - b. Finish: Polished chrome plate.
 - c. Maximum Flow Rate: 2.2 gpm, unless otherwise indicated.
 - d. Centers: 8".
 - e. Mounting: Deck.
 - f. Handle(s): lever.
 - g. Inlet(s): NPS 1/2 male inlet shanks.
 - h. Spout Type: Swing gooseneck.
 - i. Spout Outlet: Aerator.
 - j. Vacuum Breaker: Required.
 - k. Drain: Grid.

2.5 SHOWER FAUCET (P-8)

- A. Shower Faucets Handles and Shower Head
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, equal to American Standard T675.507 with R120SS valve:
 - a. Chicago Faucets
 - b. Delta Faucet Company
 - c. Kohler Co.
 - d. Moen, Inc.
 - 2. Description: Single handle shower faucet control with single "colony" handle and shower head. Bath/shower fitting shall feature water saving showerhead with Max. 1.5gpm/5.7L/min. flow rate. Shall feature a cast brass valve body. Shall feature ceramic disc valve cartridge which allows user to control both water temperature and volume. Fitting shall be equipped with pressure balancing cartridge engineered to eliminate cross flow and avoid failure due to mineral deposits. Shall also feature a hot limit safety stop.

2.6 URINAL FLUSH VALVE

A. Refer to urinal section.

2.7 TOILET SEATS

- A. Toilet Seats:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Kohler Co.

- b. Church Seats.
- c. Olsonite Corp.
- 2. Description: Toilet seat for water-closet-type fixture.
 - a. Material: Molded, solid plastic with antimicrobial agent.
 - b. Configuration: Open front without cover.
 - c. Size: Elongated.
 - d. Hinge Type: SS, self-sustaining.
 - e. Class: Standard commercial.
 - f. Color: White.

2.8 PROTECTIVE SHIELDING GUARDS

- A. Protective Shielding Pipe Covers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. McGuire Manufacturing Co., Inc.
 - b. TRUEBRO, Inc.
 - c. Zurn Plumbing Products Group; Tubular Brass Plumbing Products Operation.
 - 2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.
- B. Protective Shielding Piping Enclosures:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. TRUEBRO, Inc.
 - 2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and coldwater supplies and trap and drain piping. Comply with ADA requirements.

2.9 FIXTURE SUPPORTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Josam Company.
 - 2. MIFAB Manufacturing Inc.
 - 3. Smith, Jay R. Mfg. Co.
- B. Water-Closet Supports:
 - 1. Description: Combination carrier designed for accessible mounting height of wallmounting, water-closet-type fixture. Include single or double, vertical or horizontal, hub-

and-spigot or hubless waste fitting as required for piping arrangement; faceplates; couplings with gaskets; feet; and fixture bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space.

- C. Urinal Supports:
 - 1. Description: Type I, urinal carrier with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture for wall-mounting, urinal-type fixture. Include steel uprights with feet.
 - 2. Accessible-Fixture Support: Include rectangular steel uprights.
- D. Lavatory Supports:
 - 1. Description: Type III, lavatory carrier with hanger plate and tie rod] for wall-mounting, lavatory-type fixture. Include steel uprights with feet.
 - 2. Accessible-Fixture Support: Include rectangular steel uprights.
- E. Sink Supports:
 - 1. Description: Type I, sink carrier with exposed arms and tie rods for sink-type fixture. Include steel uprights with feet.
- 2.10 WATER CLOSETS (P-1, P1A)
 - A. Water Closets:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following equal to American Standard 3351.001 1.28 GPF:
 - a. Crane Plumbing, L.L.C./Fiat Products.
 - b. Eljer.
 - c. Kohler Co.
 - 2. Description: Accessible, Flushometer Toilet.
 - a. Supply: NPS 1 ¹/₂" inlet spud.
 - b. Flush Valve: American Standard 6065.121.002, battery operated
 - c. Style: Flushometer valve.
 - 1) Bowl Type: Elongated with siphon-jet design.
 - 2) Design Consumption: 1.28 gal. flush.
 - 3) Color: White.
 - d. Toilet Seat: Refer to other sections.
 - e. Fixture Support: Wall mounted.
 - 3. P-1a shall be mounted for the handicapped.

- A. Urinals:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following equal to American Standard, Waterless Urinal, 6150.100:
 - a. Crane Plumbing, L.L.C./Fiat Products.
 - b. Zurn.
 - c. Kohler Co.
 - 2. Description: Accessible, wall-mounting, back-outlet, vitreous-china fixture.
 - a. Type: Waterless.
 - b. Strainer or Trapway: Separate vandal resistant removable strainer with integral trap.
 - c. Color: White.
 - d. Supply Spud Size: N/A.
 - e. Outlet Size: NPS 3.
 - f. Flushing Mechanism: N/A.
 - g. Fixture Support: Urinal carrier.
 - h. Flush Valve: N/A.

2.12 LAVATORIES (P-3, P-3A, P-3B)

- A. Lavatories:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following equal to American Standard, Roxalyn, Wall-Hung, 0195.073:
 - a. Crane Plumbing, L.L.C./Fiat Products.
 - b. Eljer.
 - c. Kohler Co.
 - 2. Description: Accessible, Wall Hung, enameled, vitreous china fixture.
 - a. Type: Self-rimming.
 - b. Rectangular Lavatory Size: 20" wide x 18" deep (front to back).
 - c. Faucet Hole Punching: Three hole.
 - d. Faucet Hole Location: Top.
 - e. Color: White.
 - f. Faucet: American Standard, Selectronic 6055.205, 0.5 gpm, battery powered.
 - g. Supplies: NPS 3/8 chrome-plated copper with stops.
 - h. Drain: Grid.
 - i. Drain Piping: NPS 1-1/4 by NPS 1-1/2 chrome-plated, cast-brass P-trap; thick tubular brass waste to wall; and wall escutcheon.
 - j. Hair Interceptor: Required.
 - k. Protective Shielding Guard(s): Required.
 - 1. Fixtures P-3A and P-3B shall be ADA mounted.

2.13 LAVATORIES (P-3C)

- A. Lavatories:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following equal to American Standard, Aqualyn, Countertop Sink, 0476.028:
 - a. Crane Plumbing, L.L.C./Fiat Products.
 - b. Eljer.
 - c. Kohler Co.
 - 2. Description: Counter mounting, enameled, vitreous china fixture.
 - a. Type: Self-rimming.
 - b. Rectangular Lavatory Size: 20" wide x 18" deep Oval (front to back).
 - c. Faucet Hole Punching: Three hole.
 - d. Faucet Hole Location: Top.
 - e. Color: White.
 - f. Faucet: American Standard, Heritage 7402.172H, 1.5 gpm, wrist blades.
 - g. Supplies: NPS 1/2 slip connections.
 - h. Drain: Grid.
 - i. Drain Piping: NPS 1-1/4 by NPS 1-1/2 chrome-plated, cast-brass P-trap; thick tubular brass waste to wall; and wall escutcheon.
 - j. Drain Piping: Schedule 40 PVC P-trap; NPS 1-1/2, tubular waste to wall; and wall escutcheon.
 - k. Hair Interceptor: Required.
 - 1. Protective Shielding Guard(s): Required.

2.14 SINK (P-4)

- A. Lavatories:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following equal to American Standard, 15SB.252283.073:
 - a. Crane Plumbing, L.L.C./Fiat Products.
 - b. Eljer.
 - c. Kohler Co.
 - 2. Description: Accessible, Counter-mounting, stainless steel, single bowl.
 - a. Type: Self-rimming.
 - b. Lavatory Size: 25"x22"x8".
 - c. Faucet Hole Punching: Three.

- d. Faucet Hole Location: Top.
- e. Color: Stainless Steel.
- f. Faucet: American Standard, Colony Soft, 4275.550.F15, 1.5gpm.
- g. Supplies: NPS ¹/₂ slip connections.
- h. Drain: Grid.
- i. Drain Piping: NPS 1-1/4 by NPS 1-1/2 chrome-plated, cast-brass P-trap; thick tubular brass waste to wall; and wall escutcheon.
- j. Drain Piping: Schedule 40 PVC P-trap; NPS 1-1/2, tubular waste to wall; and wall escutcheon.
- k. Hair Interceptor: Not required.
- 1. Protective Shielding Guard(s): Required.

2.15 SINK (P-5)

- A. Lavatories:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following equal to American Standard, 17DB.332283.073:
 - a. Crane Plumbing, L.L.C./Fiat Products.
 - b. Eljer.
 - c. Kohler Co.
 - 2. Description: Accessible, Counter-mounting, stainless steel, double bowl.
 - a. Type: Self-rimming.
 - b. Lavatory Size: 33"x22"x8".
 - c. Faucet Hole Punching: Three.
 - d. Faucet Hole Location: Top.
 - e. Color: Stainless Steel.
 - f. Faucet: American Standard, Colony Soft, 4275.550.F15, 1.5gpm.
 - g. Supplies: NPS ¹/₂ slip connections.
 - h. Drain: Grid.
 - i. Drain Piping: NPS 1-1/4 by NPS 1-1/2 chrome-plated, cast-brass P-trap; thick tubular brass waste to wall; and wall escutcheon.
 - j. Drain Piping: Schedule 40 PVC P-trap; NPS 1-1/2, tubular waste to wall; and wall escutcheon.
 - k. Hair Interceptor: Not required.
 - 1. Protective Shielding Guard(s): Required.

2.16 MOP SINKS (P-6)

A. Service Basins:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following equal to Fiat, SB-2424:
 - a. Acorn Engineering Company.
 - b. Crane Plumbing, L.L.C./Fiat Products.
 - c. Elkay.
- 2. Description: Flush-to-wall, floor-mounting, precast molded stone fixture with rim guard.
 - a. Shape: Square.
 - b. Size: 24 by 24 inches.
 - c. Height: 6 inches.
 - d. Tiling Flange: On two sides.
 - e. Rim Guard: On all top surfaces, vinyl.
 - f. Color: White.
 - g. Faucet: Fiat 830-AA, wall mounted, vacuum breaker, integral stops, spout with pail hook and wall brace, ³/₄" hose threaded on spout.
 - h. Drain: Grid with NPS 3 outlet.

2.17 MOP SINKS (P-6A)

- A. Service Basins:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following equal to Fiat, SB-3624:
 - a. Acorn Engineering Company.
 - b. Crane Plumbing, L.L.C./Fiat Products.
 - c. Elkay.
 - 2. Description: Flush-to-wall, floor-mounting, precast molded stone fixture with rim guard.
 - a. Shape: Square.
 - b. Size: 24 by 24 inches.
 - c. Height: 6 inches.
 - d. Tiling Flange: On two sides.
 - e. Rim Guard: On all top surfaces, vinyl.
 - f. Color: White.
 - g. Faucet: Fiat 830-AA, wall mounted, vacuum breaker, integral stops, spout with pail hook and wall brace, ³/₄" hose threaded on spout.
 - h. Drain: Grid with NPS 3 outlet.

- A. Laundry Sink:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following equal to Zurn, MS2622:
 - a. Acorn Engineering Company.
 - b. Crane Plumbing, L.L.C./Fiat Products.
 - c. Elkay.
 - 2. Description: Flush-to-wall, floor-mounting, precast molded stone fixture with rim guard.
 - a. Shape: Square.
 - b. Size: 26 by 22 inches.
 - c. Height: 34 inches.
 - d. Color: White.
 - e. Faucet: Fiat 830-AA, wall mounted, vacuum breaker, integral stops, spout with pail hook and wall brace, ³/₄" hose threaded on spout.
 - f. Drain: Grid with NPS 3 outlet.

2.19 SHOWER FIXTURE (P-8)

- A. Fixture:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following equal to American Standard Colony Soft, T675.507.R120SS, Chrome Plated:
 - a. American Standard Companies, Inc.
 - b. Crane Plumbing, LLC
 - c. Eljer
 - d. Kohler Co.
 - 2. Description: Single handle shower only control, chrome plated, 1.5gpm

2.20 ELECTRIC WATER COOLER (P-9):

Fixture:	Elkay Model VRCGRN8, wall mounted water cooler, barrier
	free, easy touch controls
Remarks:	8.8 gallons per hour at seventy (70) degrees Fahrenheit inlet
	water and eighty (80) degrees Fahrenheit ambient temperature,
	barrier free, color selected by Architect. Push button activation

2.21 ELECTRIC WATER COOLER (P-10):

Fixture: Elkay Model VRCHDTL8SC, wall mounted water cooler,

Remarks:barrier free, easy touch controlsRemarks:8.8 gallons per hour at seventy (70) degrees Fahrenheit inletwater and eighty (80) degrees Fahrenheit ambient temperature,
barrier free, color selected by Architect. Push button activation

2.22 SCULLERY SINK (P-11)

- A. Sink:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following equal to Elkay, SS8354LR:
 - a. Acorn Engineering Company.
 - b. Crane Plumbing, L.L.C./Fiat Products.
 - c. American Standard
 - 2. Description: floor-mounted, triple compartment, stainless steel sink.
 - a. Shape: Rectangle.
 - b. Size: 102"x28"x36" High.
 - c. Faucet: Elkay, LK940 Arc Tube, wall mounted, integral stops.
 - d. Drain: Grid with NPS 3 outlets.

2.23 SINK (P-12)

- A. Sink:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following equal to Elkay, CHSB1716C:
 - a. Acorn Engineering Company.
 - b. Crane Plumbing, L.L.C./Fiat Products.
 - c. American Standard.
 - 2. Description: wall-mounted, single compartment, stainless steel sink.
 - a. Shape: Square.
 - b. Size: 16"x16"x6" High.
 - c. Faucet: Elkay, LKB400 Chrome Plated, integral stops.
 - d. Drain: Grid with NPS 2 outlet.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.

- B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions. Contractor shall connect all plumbing fixtures including Owner furnished fixtures.
- B. All exposed metal parts of all fixtures, including all trim and fittings shall be brass.
- C. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.
 - 1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
 - 2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
 - 3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.
 - 4. No wood grounds, wood plugs, or expansion bolts shall be permitted for fixture support.
- D. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.
- E. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.
- F. Install wall-mounting fixtures with tubular waste piping attached to supports.
- G. Install floor-mounting, back-outlet water closets attached to building floor substrate and wall bracket and onto waste fitting seals.
- H. Install counter-mounting fixtures in and attached to casework.
- I. Install fixtures level and plumb according to roughing-in drawings.
- J. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation. All nipples shall be chrome plated brass.
 - 1. Exception: Use ball, gate, or globe valves if supply stops are not specified with fixture. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
- K. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
- L. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
- M. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.

- N. Install toilet seats on water closets.
- O. Install trap-seal liquid in dry urinals.
- P. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- Q. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.
- R. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- S. Install shower flow-control fittings with specified maximum flow rates in shower arms.
- T. Install traps on fixture outlets.
 - 1. Exception: Omit trap on fixtures with integral traps.
 - 2. Exception: Omit trap on indirect wastes, unless otherwise indicated.
- U. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 22 Section "Common Work Results for Plumbing."
- V. Set service basins in leveling bed of cement grout. Grout is specified in Division 22 Section "Common Work Results for Plumbing."
- W. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."
- X. All faucet handles, where possible, shall have color coded "indexes" identifying the service used.
- Y. Water supplies for handicapped lavatories and sinks shall be insulated. Waste lines for handicapped lavatories and sinks shall be offset and insulated.
- Z. Water supplies for handicapped water closets shall be roughed-in for flush valve handle to be operated from the accessible side of the water closet. Contractor shall coordinate and provide flush handle on the accessible side of all tank type handicapped water closets.
- AA. Provide backflow devices on all faucets and fittings requiring backflow prevention. Devices may be inline type when not provided integral with the faucet.
- BB. All serrated or slip hose connection spout outlets shall have Allen wrench operated volume controls to control splashing of water as it hits sink bottom.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

- B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.
- B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.
- C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.
- D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.
- E. Install fresh batteries in sensor-operated mechanisms. Provide three (3) set of extra batteries for each of the mechanisms.

3.5 ADJUSTING

- A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
- B. Adjust water pressure at faucets and flushometer valves to produce proper flow and stream.
- C. Replace washers and seals of leaking and dripping faucets and stops.
- D. Install fresh batteries in sensor-operated mechanisms.

3.6 CLEANING

- A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:
 - 1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
 - 2. Remove sediment and debris from drains.
- B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.
- A. Provide protective covering for installed fixtures and fittings.
- B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224000

SECTION 230500 – MECHANICAL AND ELECTRICAL GENERAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including General and Supplementary Conditions and General Requirements, apply to the work specified in this Section.

1.2 SCOPE

A. This Section describes the general provisions for the fire protection, plumbing, mechanical and electrical work. This section applies to all sections of Divisions 210000, 220000, 230000, 260000 and 280000.

1.3 RESPONSIBILITY

- A. The General Contractor shall be responsible for all work included in the Mechanical and Electrical Divisions. The delegation of work to Subcontractors shall not relieve him of this responsibility. Subcontractors who perform work under these Sections shall be responsible to the General Contractor. The term "Contractor" is used throughout this Division and shall mean the General Contractor, although the actual performance of the work may be by a Subcontractor.
- B. Within thirty (30) days after award of the contract, the Contractor shall submit to the Architect, for approval a list of all subcontractors' names he proposes to use.
- C. The Contractor shall carefully review all divisions of the project specifications. Where conflicts exist between divisions and/or sections of the specifications the most stringent requirement as determined by the Architect shall apply.

1.4 REFERENCES AND DEFINITIONS

Following are definitions of terms and expressions used in the Mechanical and Electrical Sections:

Provide	- furnish and install
Directed	- directed by the (Architect/Engineer)
Indicated	- indicated in Contract Documents
Concealed	- hidden from normal sight; includes items in shafts, above
	ceilings, and within return air plenums
Exposed	- non concealed - Work within Equipment Rooms shall be
	considered exposed.
Piping	- includes pipes, fittings, valves, hangers, and accessories
	comprising a system
Ductwork	- includes ducts, fittings, housings, dampers, hangers, air
	devices, and accessories comprising a system.

1.5 STANDARD SPECIFICATIONS

- A. See Division 1 General Requirements.
- B. References to catalogs, standards, codes, specifications, and regulations apply to the latest edition in effect at the date of the invitation to bid.

1.6 CODES, REGULATIONS, AND PERMITS:

- A. Give all necessary notices, obtain all permits, and pay all fees and other costs, including those for utility connections or extensions in connection with the work. File all necessary plans, prepare all documents, and obtain all necessary approvals of all governmental departments having jurisdiction. Obtain all required certificates of inspection and deliver same to the Architect before request for acceptance and final payment for the work.
- B. All materials furnished and all work installed shall comply with the latest rules, regulations, and recommendations of the following bodies:

2009 International Building Code 2009 International Existing Building Code 2009 International Fire Code 2006 International Energy Conservation Code 2009 International Fuel Gas Code 2009 International Mechanical Code 2009 International Plumbing Code National Electrical Code NFPA 70, 2008 Edition National Electrical Safety Code, ANSI-C2-2007 Edition Icc/ANSI-A117.1-2003, Accessible And Usable Buildings And Facilities State Fire Marshal Rules, Regulations And Policies, Latest Revision South Carolina Elevator Code And Regulations And ASME A17.1 Local Utility Companies Underwriters Laboratories **Owner's Insurance Underwriter Standards Environmental Protection Agency**

1.7 MATERIALS LIST AND SHOP DRAWINGS

- A. See Division 1, GENERAL REQUIREMENTS for Additional Requirements related to submittals and shop drawings.
- B. Within thirty (30) days after award of the Contract, the Contractor shall submit to the Architect, for approval, a list of manufacturers' names of material and equipment he proposes to provide. In the event any items of material or equipment contained in the list fail to comply with the specification requirements, such items will be rejected. If, prior to the expiration of the thirty (30) day period or any duly authorized extension thereof, the Contractor fails to submit a schedule of acceptable material and equipment covering the items, the Architect will select the items and such selection will be final and binding upon the Contractor as a condition of the contract. Rejected items shall be resubmitted within

fifteen (15) days. The Architect will select materials and equipment not submitted in such time.

- C. After receiving approval of equipment manufacturers and prior to delivery of any material or equipment to the job site; submit for approval, dimensioned drawings or cuts showing construction size, arrangement, operating clearances, performance characteristics, and capacity of material or equipment. Each item of equipment proposed shall be a standard catalog product of the approved manufacturer. Submittals shall be received early in the construction period to allow the Architect ample time for review and checking for compliance with the contract documents. The Architect will be expected to process a maximum of ten (10) submittals in a five (5) day working period. The Contractor shall carefully schedule the submission time of all submittals to insure that approvals will be received to meet the critical path of the construction project.
- D. If the Contractor's submittals, upon review by the Architect, do not conform to the requirements of the contract documents, the contractor shall be required to resubmit with modification, within fifteen (15) working days of receipt of the Architect's notification and comments to the Contractor. The Contractor shall be responsible for the extra expenses for subsequent review of rejected or revised submittals necessitated by the Contractor's failure to provide a complete and accurate submittal meeting the requirements of the contract documents. Such extra fees shall be deducted by the Owner from payments to the Contractor.
- E. Samples, drawings, specifications, catalogs, etc., submitted for approval shall be properly labeled indicating specific item, model number, and service for which material or equipment shall be used. Section and article number of specifications governing, Contractor's name, name of job, and date and also be clearly indicated on all submittals. Submittals that are not properly labeled or identified will be returned marked "Not Reviewed".
- F. Catalogs, pamphlets, or other documents submitted to describe items on which approval is being requested shall be specific. Identification in catalog, pamphlet, etc., of item submitted shall be clearly made in ink. Data of a general nature will not be accepted.
- G. If material or equipment is installed prior to receipt by the Contractor of pertinent shop drawings marked "No Exceptions Taken" or "Comments Noted", the Contractor shall be liable for its removable replacement at no extra charge to the Owner.
- H. Prepare and submit shop drawings for all specifically fabricated items, modifications to standards items, specially designed systems where detailed design is not shown on the contract drawings, or where the proposed installation differs from that shown on contract drawings.
- I. Identify all shop drawings by the name of the item and system and applicable specification paragraph number.
- J. Contractor, additionally, shall submit for approval any other shop drawings as requested by the Architect. No item shall be delivered to the site, or installed, until approved. After the proposed materials have been approved, no substitution will be permitted

except where approved by the (Architect/Engineer).

1.8 EQUIPMENT START-UP AND INITIAL OPERATION

- A. No equipment shall be operated, for testing or trial use, before full compliance with the equipment manufacturers' specifications and instructions for the lubrication, alignment, direction of rotation, balance, and other applicable considerations.
- B. Particular care shall be taken to see that all equipment is completely assembled, properly lubricated, and all grease and oil cases and reservoirs have been filled to the correct level with the recommended lubricants.
- C. It is the Contractor's responsibility to place each item of equipment, installed by him, in operating condition. This responsibility includes all auxiliaries, piping, wiring, etc., the start up of each unit, and a check of its performance.

1.9 GUARANTEE

A. The Contractor guarantees, by his acceptance of the Contract, that all work installed, by him or his subcontractors, will be free from defects, in workmanship and materials, for a period of one (1) year after the date of certification of completion and acceptance of work. Any defects in workmanship, materials or performance which appear within the guarantee period shall be corrected by the Contractor, without cost to the Owner, within a reasonable time to be specified in notice from the (Architect/Engineer). In default thereof, Owner may have such work done and charge the cost of same to the Contractor.

1.10 SITE VISIT

A. Prior to preparing the bid, the Contractor and subcontractors shall visit the site and familiarize themselves with all existing conditions, make all necessary investigations as to locations of utilities, and all other matters which can affect the work. No additional compensation will be made to the Contractor as a result of his failure to familiarize himself with the existing conditions under which the work must be performed.

1.11 DRAWINGS

A. The Contract Drawings are diagrammatic and indicate the general arrangement of systems and work included in the Contract. Any offsets, rises, or transitions not shown on the drawings and required to provide a complete system shall be provided at no additional contract cost. Do not scale the drawings. Consult the Architectural and Structural drawings and details for exact location of structure and equipment; where same are not definitely located, obtain this information from the Architect.

1.12 RECORD DRAWINGS

A. Contractor shall keep accurate records of all deviations in work, as actually installed, from work indicated.

- B. When work is complete, make two (2) complete "Record" sets of marked-up prints, certify the accuracy of each print by endorsement and signature thereon. Deliver same to the Architect who will, after approval, deliver these two (2) sets to the Owner.
- C. All underground work shall be accurately located on record drawings by plan dimension and elevation. Such work shall include utilities, storage tanks, plumbing pipes, etc.

1.13 OPERATING AND MAINTENANCE INSTRUCTIONS

- A. Upon completion of all work and all tests, Contractor shall furnish the necessary skilled labor and helpers for operating the systems and equipment for a minimum period of four (4) days of eight (8) hours each, or as otherwise specified. During this period, Contractor shall instruct the Owner's representative fully in the operation, adjustment, and maintenance of all equipment furnished. At least forty-eight (48) hours in advance written notice shall be given to the Owner.
- B. Contractor shall furnish to the Architect four (4) complete bound sets of typewritten or blueprinted instructions for operating and maintaining all systems and equipment included in this Contract. Operating and maintenance manuals shall include all construction test reports, final balancing reports, valve tag schedule, final inspection certificates, and occupancy permits. Also provide two (2) complete bound sets of approved shop drawings for all items of equipment utilized on the project. All instructions shall be submitted in draft for approval prior to final issue. Manufacturers' advertising literature or catalogs will not be acceptable for operating and maintenance instructions.
- C. Instructions shall include a general description of each system and specific instructions describing routine and emergency procedures required of the building personnel for operating and maintaining each system. The instructions shall include the name or label, location, and function of all operating equipment and controls, such as start-stop switches, time clocks, and safety and temperature controllers. Operating modes and the procedures for indexing each mode shall be clearly described. A listing of names, addresses, and phone numbers of the service organizations for each item of equipment and a typewritten maintenance schedule for same shall be included.
- D. The instructor shall be thoroughly familiar with all parts of the installation on which he is to give instruction. The instructor shall be trained in operating theory as well as practical operation and maintenance work. Employ factory trained instructors for automatic temperature control systems and wherever else necessary, as determined by the Architect.
- E. During the guarantee period, the Contractor shall service and maintain all equipment, excluding filter replacement, provided under this contract. Prior to the start of guarantee period, the Contractor shall provide the Owner with a schedule of required maintenance operations for each system and items of equipment. Contractor shall submit schedule to the Architect for approval. Thereafter, monthly reports shall be submitted to the Owner describing actual service provided. Forty-eight (48) hours advance notice shall be given to the Owner, prior to work required under this Section.

1.14 ELECTRICAL WORK

- A. Under Division 22 PLUMBING and 23 MECHANICAL, provide the following items of electrical work which shall conform with the applicable requirements of the Electrical Division:
 - 1. Temperature control wiring.
 - 2. Interlock wiring for mechanical equipment and devices.
- B. Under Division 26 ELECTRICAL, provide:
 - 1. Power wiring, complete from power source to motor or equipment junction box, including power wiring through motor starters, power factor correction devices, and line reactors. Power factor correction devices shall be provided under Divisions 22and 23 and installed under Division 26.
 - 2. Motor control centers or motor starter, panelboards.
 - 3. All miscellaneous individual motor starters, unless noted or specified otherwise.

1.15 FIRE PROTECTION

A. As a minimum, one (1) ten (10) pound ABC extinguisher shall be provided with each work crew, at all times when working within the building.

1.16 SINGULAR NUMBER

A. Where any device or part of equipment is herein referred to in the singular number (such as "valve"), such reference applies to as many such devices as are required to complete the installation as shown on the drawings.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. All materials shall be new, the best of their respective kinds, suitable for the conditions and duties imposed on them at the building, and shall be of reputable manufacturers'. The description, characteristics, and requirements of materials to be used shall be in accordance with qualifying conditions established in the sections following.
- B. See General Requirements. All component parts of each items of equipment or device shall bear the manufacturers' name plate; giving name of manufacturer, description, size, type, serial or model number, electrical characteristics, etc., in order to facilitate the maintenance or replacement. The name plate of a subcontractor or distributor will not be acceptable. Where Underwriters' Laboratories standards apply, material and equipment shall be approved by them and shall bear the UL Label.
- C. In specifying materials, three (3) general procedures are used. The three (3) classifications are as follows:

GROUP 1: When material or equipment is specified by name or other identifying information and one (1) brand name only is used, it is considered that the use of that particular item is essential to the project. The Contractor shall base his bid proposal on the cost of that item. When a material or equipment is specified by brand name or other identifying information and two (2) or more brands are named it is considered that any one (1) of the brands so named will perform as desired, and the Contractor shall base his proposal on one (1) of the named brands. The first brand named shall be used as a standard. The other brands named shall be equal to the specified brand in all respects. If one (1) of the other brands named is used it shall be the Contractor's responsibility to verify proper clearances and fit of the substituted equipment.

GROUP 2: When the material or equipment is specified with the phrase "...or approved equal..." after a brand name and other identifying information, it is intended that the brand name is used for the purpose of establishing a minimum acceptable standard of quality and performance and Contractor may base his bid proposal on any item which is in all respects equal to that specified and presents essentially the same appearance. It shall be the Contractor's responsibility to ensure proper fit and clearances of all substituted equipment.

GROUP 3: When material is specified as complying with the requirements of published "Standard Specification" of trade associations, American Society of Testing and Materials, government specifications, etc. the Contractor shall base his proposal on any item which can be shown to comply in all respects to the referred "Standard Specification".

- 1. It is distinctly understood: (1) that the Architect will use his own judgment in determining whether or not any materials, equipment or methods offered in substitution are equal to those specified; (2) that the decision of the Architect on all such questions of equality is final; and (3) that all substitutions will be made at no increase in cost to the Owner.
- 2. Upon receipt of written approval from Architect, Contractor may proceed with substitution providing Contractor assumes full responsibility for, and makes, at his own expense, any changes or adjustments in construction or connection with other work that may be required by the substitution of such materials, equipment or methods. In the event of any adverse decisions by the Architect no claim of any sort shall be made or allowed against the Owner.

2.2 INSTALLATION AND COORDINATION DRAWINGS

- A. Prepare, submit and use composite installation and coordination drawings to assure proper coordination and installation of work. Drawings shall include, but not be limited to, the following:
 - 1. Complete Floor Plans
 - 2. Mechanical Rooms
 - 3. Mechanical Shafts
 - 4. Trench drains, sumps, pits, pipe sleeves, pads, etc.
- B. Draw plans to a scale not less than 1/4 inch equals one (1) foot. Include plans, sections, and elevations of proposed work, showing all equipment, piping and ductwork in areas involved. Fully dimension all work horizontally and vertically. Show coordination with other work including sprinklers, lighting fixtures, conduits, pullboxes, panelboards, and

other electrical work, walls, doors, ceilings, columns, beams, joists and other architectural and structural work.

- C. Identify all equipment and devices on wiring diagrams and schematics. Where field connections are shown to be factory-wired terminals, include manufacturer's literature showing internal wiring.
- D. Installation and coordination drawings shall be produced on an AutoCad format. Reproduction of any portion of the mechanical and electrical contract drawings for resubmittal as a shop drawing is strictly prohibited. Shop drawings produced in such a manner will be rejected and returned not reviewed. Installation and coordination drawings shall be to scale reflecting actual equipment sizes purchased for the project.

2.3 PIPING, CONDUITS, AND SUPPORTS, GENERALLY

- A. Piping and conduits, except electrical conduits run in floor construction, shall be run parallel with the lines of the building, unless otherwise shown or noted on the drawings. Electrical conduits shall not be hung on hangers with any other service pipes. The different service pipes, valves, and fittings shall be so installed that after the covering is applied there will not be less than 1/2 inch clear space between the finished covering and other work and between the finished covering and parallel adjacent pipes. Hangers on different service lines, running parallel with each other and nearly together, shall be in line with each other and parallel to the lines of the building. Exact location of sprinklers, electrical outlets, piping, ducts, and conduits shall be coordinated among the trades so that there will be no interference between lighting fixtures, piping, ducts, and conduits. Where conflicts between the trades result, they shall be resolved by the Contractor to the (Architect's/Engineer's) satisfaction and at no expense to the Owner.
- B. Hangers shall be spaced to prevent sag and permit proper drainage. A hanger shall be placed within one (1) foot of each horizontal elbow. See drawings for additional hanger requirements.
- C. Vertical runs of pipe and conduit less than fifteen (15) feet long shall be supported by hangers placed one (1) foot or less from the elbows on the connecting horizontal runs. Vertical runs of pipe and conduit over fifteen (15) feet long, but not over sixty (60) feet long, and not over six (6) inches in size, shall be supported by heavy steel clamps. Clamps shall be bolted tightly around the pipes and conduits and shall rest securely on the building structure without blocking. Clamps may be welded to the pipes or placed below coupling.
- D. Unless otherwise specified, or indicated on the drawings, pipe and conduit hangers and hanger supports shall conform with the following Grinnell figures.
 - 1. Hangers generally shall be Figs. 65, 104, 212, 260 and 295.
 - 2. Hanger Figs. 212 and 295 shall be provided with turnbuckles and eye rods or rods with eye nuts.
 - 3. Turnbuckles shall be Figs. 114 or 230, shall have not less than 1-1/2 inches of adjustment, and shall be provided with locknuts.
 - 4. Brackets Figs. 194, 195, and 199 shall be used for support of pipe hangers on lines

larger than four (4) inches run along walls near floors.

- 5. Riser clamps shall be Figs. 261 or CT-121.
- 6. Roller hangers Figs. 171, 175, 177 and 181 shall be used for steam and condensate piping two (2) inches and larger and wherever the movement of pipe due to expansion exceeds 3/4 inch per foot of hanger rod lengths.
- 7. Roller supports shall be adjustable, Grinnell Fig. 274 for installation of hot service piping over two (2) inches in size and installed in racks or on trapeze hangers.
- 8. Concrete inserts shall be Figs. 281 or 282.
- 9. On copper pipes, hangers in contact with pipe shall be copper plated.
- E. In lieu of individual hangers, multiple (trapeze) hangers may be used for water pipes having same elevation and slope and for electrical conduits as specified hereinafter:
 - 1. Horizontal members shall consist of 1-1/2 inch by 1-1/2 inch twelve (12) gauge, cold formed, lipped channels designed to accept special, springheld, hardened steel nuts for securing hanger rods and other attachments. Two (2) or more such channels may be welded together forming horizontal members of greater strength than single channels. Members shall be Kindorf, Unistrut, or equal. Horizontal members made of Kindorf, Unistrut, or similar products shall be limited to a maximum length of eight (8) feet. Structural steel members shall be used for horizontal members exceeding eight (8) feet in length.
 - 2. Each multiple hanger shall be designed to support a load equal to the sum of the weights of the pipes, conduits, wire, and water, the weight of the hanger itself, and 200 pounds. The size of the hanger rods shall be such that the stress at the roof of the thread will not be over 10,000 pounds per square inch at the design load. No rod shall be smaller than 3/8 inch. The size of the horizontal members shall be such that the maximum stress will not be over 15,000 pounds per square inch at design load.
 - 3. Horizontal runs of piping and conduits along walls, four (4) inches and smaller, exposed or concealed, shall be secured to Kindorf or Unistrut support members as specified hereinbefore. Provide appropriate clamps, brackets and similar attachments to secure piping and conduits to vertical members in accordance with applicable sections of the specification.
 - 4. Refer to architectural and laboratory design drawings and specifications for additional requirements related to supports using Kindorf or Unistrut type systems.
- F. Hanger attachments shall be suitable for each type of hanger and shall be compatible with the building materials to which it is secured. The types of attachments which shall be used for the various types of building construction encountered shall conform with the following Grinnell figures:
 - 1. Concrete (new) Inserts Figs. 281 or 282. Power driven fasteners may be used for light loading as hereinafter specified.
 - 2. Concrete (existing) Figs. 47, 49 or 52 attachments. Refer to drawings for specific application of individual types.
 - 3. Steel beams Figs. 66, 92, and 93 attachments. Refer to drawings for specific application of individual types.
 - 4. Bar joists Figs. 60 or 225.
 - 5. Brick or block walls Figs. 194, 195, 199, or 202 fastened as follows: For light duty, self-drilling anchors in brick and toggle bolts in block; for heavy duty,

through bolts with backing plates.

- G. Welded attachments for securing hangers to piping or to structural steel may be provided in lieu of other attachments specified. Welded attachments shall be designed so that the fiber stress at any point in the weld or attachment will not exceed the fiber stress in the hanger rod.
- H. On insulated piping, provide Pipe Shields, Inc. Model No. A3000 and A5000 for use on warm systems and Model No. A4000 and A6000 for use on cold systems. Contractor shall select appropriate shield for support application.
- I. In no case shall wire or perforated strap be used for pipe or conduit support.
- J. All piping, ductwork, and equipment shall be suspended from the structure above unless otherwise indicated or noted on the drawings. The Contractor shall obtain prior approval from the Architect for floor supports of piping, ductwork, and equipment. Provide structural steel members consisting of angles, channels, and beams as required to hang piping, ductwork, and equipment.

2.4 SLEEVES AND PLATES

- A. All pipe sleeves shall be constructed of one (1) piece Schedule 40 steel pipe, unless otherwise indicated on the drawings.
- B. Where watertight sleeves are indicated, provide Link Seal rubber seals, as manufactured by Thunderline Corporation, between pipes and sleeves.
- C. Escutcheon plates shall be provided for all exposed pipes passing through walls, floors, and ceilings in finished areas. Plates shall be chrome plated brass, split ring type, and sized to match the pipe or insulation where installed. Where plates are provided for pipes passing through sleeves which extend above the floor surface, provide deep recessed plates to conceal the pipe sleeves.
- D. Provide twenty-four (24) gauge galvanized sheet metal sleeves for all exposed ductwork passing through floors, walls, or ceilings and all ductwork passing through fire-rated or smoke partitions. Duct sleeves shall be large enough to pass duct with insulation and shall have 2 (two) inch flanges returned against floor, wall, partition, or ceiling. Where fire dampers are required, provide sleeves as detailed on the drawings and as required by the damper manufacturer.
- E. At all sleeves, where noise can be transmitted and at fire rated separations, seal all openings between pipes and ducts and corresponding sleeve to prevent sound transmission and maintain fire rating of the wall, floor or ceiling. Submit method of sealing sleeves for approval. U.L. assembly rating of fire walls and floors shall be maintained at all times. All sleeves installed in masonry or concrete construction shall be grouted in place.

2.5 FIRE RATED PENETRATION SYSTEMS

- A. Provide UL Listed fire penetration systems in openings in rated floors, walls, and other elements of construction. Provide UL listed fire penetration systems at all new and existing pipe penetrations of new and existing rated construction within the area of work. Coordinate work of this section with all other trades necessary for the proper installation of the fire rated penetration systems.
- B. Submit shop drawings showing each condition requiring penetration seals in dictating proposed UL systems materials, anchorage, methods of installation, and actual adjacent construction. Submit a copy of UL illustration of each proposed system indicating manufacturer approved modifications. Submit copies of manufacturer's specifications, recommendations, inspection requirements, installation instructions, and maintenance data for each type of material required. Include letter indicating that each material complies with the requirements and is recommended for the applications shown.
- C. All fire penetration systems shall reference ASTM E814/UL 1479 Fire Test of Through Penetration Fire Stops.
- D. All systems shall be UL tested and listed in the UL Fire Resistance Directory.
- E. Submit copies of written guarantee agreeing to repair or replace joint sealers which fail in joint adhesion, cohesion, abrasion resistance, weather resistance, extrusion resistance, migration resistance, stain resistance, general durability or appear to deteriorate in any other manner not clearly specified by submitted manufacturer's data as an inherent quality of the material for the exposure indicated. The guarantee period shall be one (1) year from date of substantial completion.
- F. Provide systems as listed in the System and Application Schedule in paragraph 2.6.15 of this section. 3M products have been specified as the basis of design. Other manufacturer's systems are acceptable providing they meet the requirements set forth in this specification. The fire rated penetration systems shall be the products of one manufacturer to the maximum extent possible. The products of more than one manufacturer shall not be used as a combined seal.
- G. Provide materials classified by UL to provide fire stopping equal to time rating, both "F" and "T" ratings, of construction being penetrated. Provide asbestos free materials that comply with applicable codes and have been tested under positive pressure in accordance with UL 1479 or ASTM E814. Systems shall be smoke and air tight.
- H. Deliver material undamaged in manufacturer's clearly labeled, unopened containers identified with brand, type, grade, and UL label where applicable. Coordinate delivery with scheduled installation date to allow minimum storage time at site. Store material in clean, dry ventilated location. Protect from soiling, abuse, and moisture. Follow manufacturer's instruction.
- I. Verify existing conditions and substrates before starting work. Correct unsatisfactory conditions before proceeding. Proceed with installation only after penetrations of the substrate and supporting brackets have been installed.

- J. Furnish adequate ventilation if using solvent. Furnish forced air ventilation during installation if required by manufacturer. Keep flammable materials away from sparks or flame. Provide masking and drop cloths to prevent contamination of adjacent surfaces by fire stopping resistance.
- K. Clean surfaces to be in contact with penetration seal materials, of dirt, grease, oil, loose, materials, rust, or other substances that may affect proper fitting, adhesion of the required fire resistance.
- L. Install penetration seal materials in accordance with printed instructions of the UL Fire Resistance Directory and in accordance with manufacturer's instructions. Seal holes or voids made by penetrations to ensure an effective smoke barrier. Where floor openings without penetrating items are more than four (4) inches in width and subject to traffic or loading, install fire stopping materials capable of supporting same loading as floor. Protect materials from damages on surfaces subject to traffic.
- M. Clean up spills of liquid components. Neatly cut and trim materials as required. Remove equipment, materials, and debris, leaving area in undamaged, clean condition.
- N. Examine penetration sealed areas to ensure proper installation before concealing or enclosing areas. Keep areas of work accessible until inspection by applicable code authorities. Perform under this section patching and repairing of fire stopping caused by cutting or penetration by local inspectors and other trades.
- O. Systems and Application Schedule:

Construction Condition	UL System Designation No.
Metal Pipe or Conduit Concrete Opening	49, 95, 138, 161, 202, 319, 321
Insulated Metal Pipe Through Round Concrete Opening	91, 152, 203
Metal Pipes or Conduits Through Large Opening	49, 63, 93, 94, 137, 233, 234, 319, 321
Metal Pipe or Conduit Through Gypsum Board Wall	147, 322
Insulated Metal Pipe Through Gypsum Board Wall	147

2.6 DRIVES FOR MACHINERY

A. Equip each motor driven machine with a V-belt drive except those which are specified as direct drive. Where factory designed and assembled belt drives which do not conform to the following are proposed to be furnished, such non-conformity must be noted on the shop drawings submittals and may be cause for rejection of the item.

- B. Provide OSHA approved guards, for all belt drives, constructed in accordance with SMACNA standards. Submit shop drawings for approval.
- C. Select each drive according to the ratings and recommendations of the manufacturer for the service with which used, giving proper allowance for sheave diameter, center distance, and arc of contact less than one hundred eighty degrees. Size the motor driving a centrifugal fan, with forward curved blades, to have a nameplate rating of not less than five (5) percent above the total of actual fan brake horsepower and drive loss at specified capacity, if the wheel is of other than the forward curved blade type. Size motor not less than fifty (50) percent above the total of actual fan brake horsepower and drive loss at specified capacity, if the wheel is of the forward curved blade type.
- D. Belts shall be constructed of endless reinforced cords of long staple cotton, nylon, rayon, or other suitable textile fibers imbedded in rubber. Use belt with correct cross section to fit properly the sheave grooves. Carefully match belts for each drive.
- E. Sheaves for motors under fifteen (15) HP shall be adjustable pitch type, selected so that the required fan rotational speed will be obtained with the motor sheave set approximately in mid-position and have the specified pitch diameter in that position.
- F. Sheaves for motors fifteen (15) HP and larger shall be fixed pitch type. Provide any changes to the sheaves, belts and pulleys (drive package) to obtain the specified airflow, if required. Any changes shall be installed under Section 15800.
- G. Select the motor of a capacity needed to operate the equipment at the specified midposition operating condition. Where non-overloading motors are specified, select the motor capacity rating at the most closed position of the motor sheave. In no case shall motors be a smaller size than those indicated on the drawings.
- H. Do not select fan sheave smaller in diameter than thirty (30) percent of the fan wheel diameter.
- I. Construct sheaves of cast iron or steel, bored to fit properly on the shafts, and secured with key ways of proper size (not set screws). Key ways may be omitted for sheaves having 1/2 inch or smaller bores where set screws may be used.

PART 3 - EXECUTION

3.1 WORKMANSHIP

- A. Each Subcontractor shall furnish the services of an experienced superintendent who shall be constantly in charge of the installation of the work.
- B. The quality of workmanship required, for each trade, in the execution of work shall be the finest and highest obtainable in that trade working with the materials specified. Workmanship shall be satisfactory to the (Architect/Engineer) and his decision as to acceptable quality is final.

C. Workmanship proven to be of poor quality or unsatisfactory in the commissioning phase of the project as deemed by the (Architect/Engineer) shall be removed and replaced to the satisfaction of the (Architect/Engineer).

3.2 EQUIPMENT PERFORMANCE

- A. All equipment, devices, controls, and hardware shall be proven to operate successfully throughout the guarantee period. Systems shall be proven during all weather seasons and be demonstrated to affect the design conditions at times. System components or equipments items that fail to consistently deliver the design conditions shall be removed and replaced as directed by the Architect. The cost of required equipment replacements shall be borne by the Contractor.
- B. All equipment shall be tested after installation and be proven to deliver the manufacturers quoted design capacity. When capacity is in question as deemed by the Architect, the Contractor shall perform a detailed and comprehensive field performance test to certify the equipment capacity. System effect or installed performance factors may not be applied to performance ratings unless they were previously included when the equipment was submitted for approval. Equipment that fails to deliver manufacturers quoted design capacity shall be removed and replaced at the Contractors expense.
- C. Workmanship proven to be of poor quality or unsatisfactory in the commissioning phase of the project as deemed by the Architect shall be removed and replaced to the satisfaction of the Architect.

3.3 EQUIPMENT CONNECTIONS

A. All equipment shall be installed and connected in accordance with the best engineering practice and in accordance with manufacturer's instructions and recommendations. Auxiliary piping, piping specialties, water seals, valves, and electric connections recommended by the manufacturer, required by code or required for proper operation shall be provided.

3.4 WATERPROOFING

A. Under no circumstances shall waterproofing be damaged or penetrated. Should conditions arise which indicate such necessity, notify the (Architect/Engineer).

3.5 CUTTING AND PATCHING

- A. Cutting and patching associated with the work in the existing structure shall be performed in a neat and workmanlike manner. Existing surfaces, which are damaged by the Contractor, shall be repaired or provided with new materials. All patching shall be done with materials and methods similar to existing adjacent work, subject to approval of the Architect. Structural members shall not be cut or penetrated. Holes cut through concrete and/or masonry to accommodate new work shall be cut by reciprocating or rotary, nonpercussive methods.
- B. The Contractor shall submit to the Architect for approval dimensioned drawings showing

all penetrations through structural slabs or walls required for mechanical and electrical work. Drawings shall clearly show opening size, plan location, and/or elevation as applicable. All openings shall be approved by the (Architect/Engineer) prior to starting work.

C. Patching of areas disturbed by installation of new work shall match existing adjacent surfaces in material, texture, and color.

3.6 INTERRUPTION OF EXISTING UTILITIES

A. Notify the Owner in writing at least seven (7) days in advance of any required shutdown of water, sewage, gas, electrical service or other utility. Upon written receipt of approval from Owner, shutdowns shall be performed between the hours of six (6) p.m. and six (6) a.m. including clean-up or as directed otherwise and shall be accomplished at no additional cost.

3.7 PROTECTION OF EXISTING WORK

A. When working in and around the existing building, extreme care shall be exercised with regard to protection of the existing structure and mechanical and electrical services. Repair or replace, to the satisfaction of the Architect, any existing work damaged in the performance of the new work.

3.8 SURVEYS AND MEASUREMENTS

- A. Base all measurements (both horizontal and vertical) from established bench marks. All work shall agree with these established lines and levels. Verify all measurements at site and check correctness of same as related to the work. Verify locations of existing utilities and inverts of same prior to the start of any systems shown connecting to existing utilities.
- B. Should the Contractor discover any discrepancy between actual measurements or conditions, and those indicated, which prevent following good practice or the intent of the drawings and specifications, he shall notify the Architect and shall not proceed with his work until he has received instruction from the Architect.

3.9 WELDING

- A. Welding shall conform to current standards and recommendations of the National Certified Pipe Welding Bureau, with Fire Prevention Code Requirements, and NFPA Standard 241 including provision of appropriate portable fire extinguishers.
- B. Before assigning any welders to work covered by this specification, the Contractor shall provide the Architect with the names of pipe welders to be employed for the work, together with each welder's assigned number, letter, or symbol which shall be used to identify the work of that welder and which shall be affixed immediately upon completion of each weld. Contractor shall also submit, with the list of names, copies of each welder's certified qualification tests prescribed by the National Certified Welding Bureau or by other reputable testing laboratory using procedures covered in the American Society of

Mechanical Engineers Building Construction Code, Section IX, "Qualification Standard Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators". Welders must be certified for all positions.

- C. If requested by the Architect, the Contractor shall submit identifying stenciled test coupons made by any welder in question. The Contractor shall require any welder to retake the tests when, in the opinion of the Architect, the work of the welder creates a reasonable doubt as to his proficiency. Tests, when required, shall be conducted at no additional expense to the Owner; and the welder in question shall not be permitted to work as a welder on this project until he has been recertified. Recertification of the welder shall be made to the Architect only after the welder has taken and passed the required test; welder must pass the test without benefit of retests in order to resume work as a welder on this project.
- D. Welding shall conform to the ANSI Code for Pressure Piping ANSI B31.9, Building Services Piping. The Contractor shall be responsible for the quality of welding and shall repair or replace any work not in accordance with these specifications. Contractor shall, without cost to the Owner, check welds by radiograph, ultrasonic testing, sectioning or a combination of these methods wherever there is a question raised by the Architect as to the quality of a weld. Examination of the questionable weld shall be in addition to other system tests specified. Welds shall have penetration complete to the inside diameter of the pipe. The recommended spacing and levels between ends of pipes prior to welding shall be used in all cases to assure full penetration.

3.10 HANDLING AND STORAGE OF MATERIAL

- A. Proper and suitable tools, equipment and appliances for the safe and convenient handling and placing of all materials and equipment shall be used. During loading, unloading, and placing, care shall be taken in handling the equipment and materials so that no equipment or materials are damaged.
- B. All mechanical and/or electrical equipment delivered to the job site shall be stored on pedestals, above the ground and under roof or other approved covering. All enclosures for equipment shall be weatherproof. All motors, drives, switchgear, panels, etc. which are not totally enclosed, that are involved in the work, shall be stored in a heated, dry, water protected area with a minimum temperature of fifty degrees (50) Fahrenheit. All valves shall be stored under roof on wood pedestals, above ground. All insulation shall be stored under roof or in trailers, adequately protected from the weather. The Contractor shall follow all written instructions and recommendations of the manufacturer and all requirements of the Architect in oiling, protection and maintenance of equipment during storage. It shall be the Contractor's complete responsibility for the storage and care of the equipment and materials.
- C. If any equipment and/or materials are found to be in poor condition at the time of installation the Architect may, at his discretion, order the Contractor to furnish and install new equipment and/or material at no cost to the Owner.

3.11 COOPERATION WITH OTHER TRADES

Mechanical and Electrical trades shall give full cooperation to other trades and shall furnish in writing, with copies to Architect any information necessary to permit the work of all trades to be installed satisfactorily and with least possible interference or delay. Exact location of all mechanical and electrical equipment, devices, etc. in finished spaces shall be coordinated with Architectural reflected ceiling plans, elevations and details.

3.12 CLEANING AND PAINTING

- A. Thoroughly clean all exposed surfaces of equipment and material and leave in a neat, clean condition ready for painting. Restore and touch-up factory finishes which have been damaged during construction. Finished painting will be performed under another Division.
- B. Miscellaneous requirements include:
 - 1. Touch-up threads of zinc coated screwed pipe with Rust-O-Leum primer and one (1) coat of enamel conforming with painting specification.
 - 2. Paint behind grilles and registers in finished areas with two (2) coats of flat black paint following the proper surface preparation of the zinc coated metal.

3.13 ACCESSIBILITY

A. Locate all equipment which must be serviced, operated, or maintained, in fully accessible positions. Equipment shall include, but not be limited to, valves, clean-outs, motors, controllers, dampers, drain points, etc. Where required and where directed, provide fourteen (14) gauge steel access panels, Milcor or equal, to suit material in which installed. Doors installed in fire rated walls or shafts shall be labeled and shall match rating of the construction. Doors shall be of sufficient size to allow access to all components; minimum size shall be twelve (12) inches by sixteen (16) inches. Doors in Toilet Rooms shall be Type 304 stainless steel or have chrome plated finish. Equipment deemed inaccessible by the Architect shall be reworked by the Contractor at no expense to the Owner. All doors shall have cylinder locks operable from same key. Submit shop drawings for approval.

3.14 EXCAVATION AND BACKFILL:

A. Excavation:

- 1. See civil sections for additional requirements.
- 2. Trenches shall be excavated to the necessary width and depth as shown on the drawings. The trench subgrade shall be such as to allow the bedding of the utility with a uniform and continuous bearing on solid, undisturbed earth for the full length of each pipe, except for that portion at the bell holes. The subgrade shall be graded with sufficient accuracy to assure this minimum. The bottom portion of all trenches from the subgrade to a point two (2) feet above the crown or top of the utility shall be as nearly vertical as practicable and at the minimum width.
- 3. Trenches in fill areas shall not be excavated until embankment construction has

been completed to a point at least two (2) feet above the crown or top of the utility being placed.

- 4. Any part of the bottom of the trench excavated below the specified subgrade shall be backfilled, at the Contractor's expense, with bedding materials as hereinafter specified. Whenever wet, or otherwise unstable, subgrade is encountered below the elevation of the original ground surface which existed prior to the time of construction, such soil shall be removed to the depth and extent direct by the Architect and the trench backfilled to the proper grade with bedding material as hereinafter specified. Reimbursement for extra work performed by the Contractor shall be in accordance with the General Conditions. Whenever the Architect requires the removal of wet or otherwise unstable subgrade from the fill material previously placed by the Contractor, the cost of all removal of unstable soil, together with backfilling of the trench as herein specified shall be borne by the Contractor.
- 5. Excavation for manholes and similar structures shall be of sufficient size to leave a minimum of twelve (12) inches and a maximum of twenty-four (24) inches clearance on all sides. Any over-depth excavation shall be filled with concrete as directed and at the expense of the Contractor.
- 6. Provide shoring and sheet piling necessary for excavation and for the safety of personnel and property as directed. Unless otherwise directed, the sides of all excavations over four (4) feet deep must be braced. All shoring, bracing, sheet piling, etc., must be solidly installed heavy timber suitable for the purpose. No lumber shall be buried when excavations are backfilled, except by authority of the Architect.
- B. Backfill:
 - 1. See civil sections for additional requirements.
 - 2. No backfill and/or bedding shall be placed until the construction adjacent thereto or the utility to be backfilled has been inspected, tested and approved. Notify the Architect when inspections are required.
 - 3. Backfill material shall be earth materials only, free from perceptible amounts of wood, debris, or topsoil and shall not contain marble or other elements which tend to keep it in a plastic state. The material shall be free of frost at the time of placement. Backfill for plastic pipe shall be clean sand, free of foreign materials.
 - 4. Bedding material, for use where trench subgrade is excavated below specified depth of for use at Contractor's option, shall be crushed stone or gravel, meeting the requirements of S.R.C. No. 6 aggregate or crusher run S.R.C. Cr-6 and shall be free of frost at the time of placing.
 - 5. Mechanical tampers, for compacting backfill, shall be tampers capable of exerting a blow equal to 250 foot-pounds per square foot (FT^2) of area of the tamping face.
 - 6. Work broken or ruptured by improperly placed backfill shall be removed and replaced by the Contractor at no additional cost to the Owner.
 - 7. Following inspection as specified above, approved backfill material shall be deposited in the trench with hand shovels, not by means of wheelbarrows, carts, trucks, bulldozers, or similar equipment, in four (4) inch layers and compacted by mechanical tampers until the pipe has a cover of not less than two (2) feet. The remainder of the backfill material shall then be deposited in the trench in eight (8) inch layers and compacted. Any trenches improperly backfilled shall be reopened, then refilled and compacted to the required grade and smoothed off. Backfill shall

be placed and tamped to achieve ninety-five (95) percent (percent of dry weight) compaction.

8. Field density tests may be required by the Architect in areas where, in his opinion, a question exists with respect to compliance with compaction requirements. These tests will be paid for at standard rates by the Owner, where the test results indicate compliance with the compaction requirements, and by the Contractor where the test results indicate non-compliance with compaction requirements. Density tests shall be performed by the methods specified in A.A.S.H.O. Designation T-147, the Field Determination of Density of Soil-In-Place.

3.15 EQUIPMENT BASES AND SUPPORTS

- A. All exterior concrete bases, curbs, and supports will be furnished and installed under Section 3, CONCRETE. All interior concrete bases, curbs, and supports will be furnished and installed under this Division and shall be in accordance with Section 3, CONCRETE.
- B. The Subcontractors shall furnish, to the General Contractor, all required foundation sizes, bolts, washers, sleeves, plates and templates for equipment.
- C. The size of the foundation bolts shall be as recommended by the manufacturer.
- D. All equipment shall be set on the foundations, shimmed level with steel shims, and grouted up under base for uniform bearing by the Subcontractor.
- E. Under this Section, provide all equipment supports; consisting of inertia pads, platforms, gratings, structural members and related materials required for the mechanical and electrical work.
- F. The type and size of the supporting channels and supplementary steel shall be determined by the Subcontractor and shall be of sufficient strength and size to allow only a minimum deflection in conformance with the manufacturer's requirements for loading.

3.16 SLEEVES AND PLATES

- A. Sleeves shall be provided by the trade installing the pipes or ducts for which sleeves are to be used. The sleeves shall be carefully located in advance of the construction of walls and floors, where new construction is involved. All cutting and patching necessary to set sleeves which are not placed prior to construction shall be the responsibility of the trade providing the sleeves.
- B. Sleeves shall be provided for all piping, conduits, and ducts passing through all floor slabs and concrete, masonry, tile, and gypsum wall construction.
- C. Fasten sleeves securely in floors and walls so that they will not become displaced when concrete is poured or when other construction is built around them. Take precautions to prevent concrete, plaster or other materials from being forced into space between pipe and sleeve during construction.

- D. Where pipe motion due to expansion and contraction will occur, make sleeves of sufficient diameter to permit free movement of pipe. Where insulated pipes and ducts pass through sleeves, the sleeves shall be large enough to pass the pipe or duct and the insulation. Check floor and wall construction to determine proper length for various locations; make actual lengths to suit the following:
 - 1. Terminate sleeves flush with walls, partitions, and ceilings.
 - 2. Terminate sleeves two (2) inches above finished floors. Fill all voids between sleeves and structures with an approved sealant or grout as determined by the Architect. Refer to Architectural drawings and specifications for sealing requirements of sleeves in floor.
- E. Submit, for approval, shop drawings showing size, type, and location of all sleeves and penetrations through poured concrete walls or existing structure. Sleeves installed in load bearing concrete or masonry construction shall be completely grouted in place. See Architectural drawings for extent and location of such walls. Single and multiple pipe or conduit penetrations, as well as duct openings, shall be accurately located by field measurements and indicated on the drawings. The drawings shall be prepared sufficiently in advance for approval by the Architect and shall be prepared at a minimum scale of 1/8 inch equals one (1) foot.
- F. Structural members shall not be cut or penetrated. Notify the Architect where penetrations of structural members are required. Holes cut through concrete and/or masonry, to accommodate new work, shall be cut by reciprocating or rotary, non-percussive methods.

3.17 FLASHING

- A. Openings for pipes and ducts through waterproofed floors and roof areas shall be flashed. Vent pipes through roof shall be flashed with spun aluminum base having a minimum of five (5) inch roof surface flange. Base shall extend five (5) inches above roof surface.
- B. Roof ventilator and fan bases shall be provided with prefabricated curbs as specified elsewhere in this Division. Flash ventilators with .032 aluminum or twenty-six (26) gauge Type 304 stainless steel.

3.18 DEMOLITION

- A. All existing piping, conduit, equipment, ductwork, and materials not required for re-use or re-installation shall be removed. Any existing materials and equipment which are removed and are desired by the Owner, or are indicated to remain the property of the Owner, shall be delivered to him on the premises by the Contractor where directed by the Architect. All other materials and equipment which are removed shall become the property of the Contractor and shall be removed by him from the premises.
- B. Existing piping that remains concealed, buried, or otherwise contained in the remaining slabs and walls shall be capped, plugged, or otherwise sealed. All pipes shall be cut so that their capped or plugged ends will be below the finished floors or behind finished surfaces.

C. Existing wiring, where possible, shall be removed or pulled through conduits. Wiring remaining shall be cut back behind the termination of conduits so that conduits can be adequately capped, plugged, or sealed.

3.19 CONNECTIONS AND ALTERATIONS TO EXISTING WORK

- A. When existing mechanical and electrical work is removed, all pipes, valves, ducts, and materials shall be removed to a point below the finished floors or behind finished walls and capped. Such points shall be far enough behind finished surfaces to allow for the installation of the normal thickness of finished material.
- B. When the work specified hereinafter connects to existing equipment, piping, or ductwork, the Contractor shall perform all necessary alterations, cuttings, or fitting of existing work as may be necessary or required to make satisfactory connections between the new and existing work and to leave the completed work in a finished and workmanlike condition, to the entire satisfaction of the Architect.
- C. When the work specified hereinafter or under other divisions of the contract necessitates relocation of existing equipment, piping, or ductwork, the Contractor shall perform all work and make all necessary changes to existing work as may be required to leave the completed work in a finished and workmanlike condition, to the satisfaction of the Architect. All work resulting in an extra to the contract shall be approved by the Owner and Architect before proceeding.
- D. All cutting and patching necessary for the installation of the mechanical work shall be done under this Division. Any damage done to the work already in place shall be repaired at the Contractor's expense. Patching shall be uniform in appearance and shall match the surrounding surface.

3.20 INTERRUPTION OF EXISTING UTILITIES

- A. Interruptions during periods of normal building occupancy shall be kept to a minimum. Interruptions shall only occur after a schedule of proposed outage times is submitted to and approved by the Architect.
- B. At the end of each interruption, all services shall be restored so that normal use of the building can continue.

3.21 REMOVAL

- A. Underground piping to be removed shall be limited to piping in the areas to be occupied by the new construction and five (5) feet beyond the new walls.
- B. See drawings for full extent of removal work.

3.22 SEQUENCE OF CONSTRUCTION:

END OF SECTION 235000

SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.3 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 - 1. Motor controllers.
 - 2. Torque, speed, and horsepower requirements of the load.
 - 3. Ratings and characteristics of supply circuit and required control sequence.
 - 4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with NEMA MG 1 unless otherwise indicated.
- B. Comply with IEEE 841 for severe-duty motors.
- C. All motor efficiency shall comply with ASHRAE Standard 90.1 2004 or later.

2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Energy efficient, as defined in NEMA MG 1.
- C. Service Factor: 1.15.
- D. Multispeed Motors: Variable torque.
 - 1. For motors with 2:1 speed ratio, consequent pole, single winding.
 - 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- E. Multispeed Motors: Separate winding for each speed.
- F. Rotor: Random-wound, squirrel cage.
- G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- H. Temperature Rise: Match insulation rating.
- I. Insulation: Class F.
- J. Code Letter Designation:
 - 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
 - 2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
- K. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

- A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
 - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
 - 2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
 - 3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
 - 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
- C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

2.5 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
 - 1. Permanent-split capacitor.
 - 2. Split phase.
 - 3. Capacitor start, inductor run.
 - 4. Capacitor start, capacitor run.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- D. Motors 1/20 HP and Smaller: Shaded-pole type.
- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 230513

SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Metal pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Fiberglass pipe hangers.
 - 4. Metal framing systems.
 - 5. Fiberglass strut systems.
 - 6. Thermal-hanger shield inserts.
 - 7. Fastener systems.
 - 8. Pipe stands.
 - 9. Equipment supports.
- B. Related Sections:
 - 1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
 - 2. Section 230548 "Vibration and Seismic Controls for HVAC Piping and Equipment" for vibration isolation devices.
 - 3. Section 233113 "Metal Ducts" for duct hangers and supports.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

- 1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
- 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- 3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following; include Product Data for components:
 - 1. Trapeze pipe hangers.
 - 2. Metal framing systems.
 - 3. Fiberglass strut systems.
 - 4. Pipe stands.
 - 5. Equipment supports.
- C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Detail fabrication and assembly of trapeze hangers.
 - 2. Design Calculations: Calculate requirements for designing trapeze hangers.

1.6 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.7 QUALITY ASSURANCE

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:
 - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 - 2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.

- 3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
- 4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
- 5. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.
- B. Stainless-Steel Pipe Hangers and Supports:
 - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 - 2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
 - 3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.
- C. Copper Pipe Hangers:
 - 1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
 - 2. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

2.2 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type, stainless-steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.4 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbonsteel shapes.

2.5 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.

2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
 - 2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Fiberglass Pipe-Hanger Installation: Comply with applicable portions of MSS SP-69 and MSS SP-89. Install hangers and attachments as required to properly support piping from building structure.
- D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
- E. Fiberglass Strut System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled fiberglass struts.
- F. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- G. Fastener System Installation:
 - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- H. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- I. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- J. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

- K. Install lateral bracing with pipe hangers and supports to prevent swaying.
- L. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- M. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- N. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

3.2 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches

3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports and metal framing systems and attachments for general service applications.
- F. Use stainless-steel pipe hangers and stainless-steel attachments for hostile environment applications.
- G. Use copper-plated pipe hangers and stainless-steel attachments for copper piping and tubing.
- H. Use padded hangers for piping that is subject to scratching.
- I. Use thermal-hanger shield inserts for insulated piping and tubing.
- J. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- K. Use powder-actuated fasteners instead of building attachments where required in concrete construction.

END OF SECTION 230529

University of South Carolina Softball Stadium Construction BID SET

SECTION 230548 - VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Isolation pads.
 - 2. Isolation mounts.
 - 3. Restrained elastomeric isolation mounts.
 - 4. Restrained spring isolators.
 - 5. Spring hangers with vertical-limit stops.
 - 6. Seismic snubbers.
 - 7. Restraining braces and cables.
 - 8. Steel and inertia, vibration isolation equipment bases.

1.3 DEFINITIONS

- A. IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.
- C. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.4 PERFORMANCE REQUIREMENTS

- A. Seismic-Restraint Loading:
 - 1. Site Class as Defined in the IBC: C.
 - 2. Assigned Seismic Use Group or Building Category as Defined in the IBC: II.
 - a. Component Importance Factor: 1.0.
 - b. Component Response Modification Factor: 1.5
 - c. Component Amplification Factor: 1.0.
 - 3. Design Spectral Response Acceleration at Short Periods (0.2 Second): 0.558
 - 4. Design Spectral Response Acceleration at 1-Second Period: 0.150

1.5 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
 - 2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
 - a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
 - b. Annotate to indicate application of each product submitted and compliance with requirements.
 - 3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.
- B. Delegated-Design Submittal: For vibration isolation and seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic forces required to select vibration isolators, seismic restraints, and for designing vibration isolation bases.
 - a. Coordinate design calculations with wind load calculations required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.
 - 2. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system has been examined for excessive stress and that none will exist.
 - 3. Vibration Isolation Base Details: Detail overall dimensions, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads.
 - 4. Seismic-Restraint Details:
 - a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
 - b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
 - c. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.
d. Preapproval and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

1.6 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Show coordination of seismic bracing for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and seismic restraints.
- B. Qualification Data: For professional engineer and testing agency.
- C. Welding certificates.
- D. Field quality-control test reports.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air-mounting systems to include in operation and maintenance manuals.

1.8 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
- B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code Steel."
- D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

University of South Carolina Softball Stadium Construction BID SET

- 1. Ace Mountings Co., Inc.
- 2. Amber/Booth Company, Inc.
- 3. California Dynamics Corporation.
- 4. Isolation Technology, Inc.
- 5. Kinetics Noise Control.
- 6. Mason Industries.
- 7. Vibration Eliminator Co., Inc.
- 8. Vibration Isolation.
- 9. Vibration Mountings & Controls, Inc.
- B. Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.
 - 1. Resilient Material: Oil- and water-resistant neoprene.
- C. Mounts: Double-deflection type, with molded, oil-resistant rubber, hermetically sealed compressed fiberglass, or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.
 - 1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
 - 2. Neoprene: Shock-absorbing materials compounded according to the standard for bridgebearing neoprene as defined by AASHTO.
- D. Restrained Mounts: All-directional mountings with seismic restraint.
 - 1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
 - 2. Neoprene: Shock-absorbing materials compounded according to the standard for bridgebearing neoprene as defined by AASHTO.
- E. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic or limit-stop restraint.
 - 1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled baseplate bonded to 1/4-inch-thick, neoprene or rubber isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
 - 2. Restraint: Seismic or limit stop as required for equipment and authorities having jurisdiction.
 - 3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - 4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - 5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 - 6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

- F. Spring Hangers with Vertical-Limit Stop: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression and with a vertical-limit stop.
 - 1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
 - 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 - 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 - 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
 - 7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
 - 8. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

2.2 VIBRATION ISOLATION EQUIPMENT BASES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Amber/Booth Company, Inc.
 - 2. California Dynamics Corporation.
 - 3. Isolation Technology, Inc.
 - 4. Kinetics Noise Control.
 - 5. Mason Industries.
 - 6. Vibration Eliminator Co., Inc.
 - 7. Vibration Isolation.
 - 8. Vibration Mountings & Controls, Inc.
- B. Steel Base: Factory-fabricated, welded, structural-steel bases and rails.
 - 1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
 - a. Include supports for suction and discharge elbows for pumps.
 - 2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
 - 3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
- C. Inertia Base: Factory-fabricated, welded, structural-steel bases and rails ready for placement of cast-in-place concrete.

- 1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
 - a. Include supports for suction and discharge elbows for pumps.
- 2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
- 3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
- 4. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

2.3 SEISMIC-RESTRAINT DEVICES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Amber/Booth Company, Inc.
 - 2. California Dynamics Corporation.
 - 3. Cooper B-Line, Inc.; a division of Cooper Industries.
 - 4. Hilti, Inc.
 - 5. Kinetics Noise Control.
 - 6. Loos & Co.; Cableware Division.
 - 7. Mason Industries.
 - 8. TOLCO Incorporated; a brand of NIBCO INC.
 - 9. Unistrut; Tyco International, Ltd.
- B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.
 - 1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.
- C. Snubbers: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.
 - 1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
 - 2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
 - 3. Maximum 1/4-inch air gap, and minimum 1/4-inch-thick resilient cushion.
- D. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.

- E. Restraint Cables: ASTM A 492 stainless-steel cables with end connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.
- F. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.
- G. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.
- H. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.
- I. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.
- J. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.
- K. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.4 FACTORY FINISHES

- A. Finish: Manufacturer's standard prime-coat finish ready for field painting.
- B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
 - 1. Powder coating on springs and housings.
 - 2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
 - 3. Baked enamel or powder coat for metal components on isolators for interior use.
 - 4. Color-code or otherwise mark vibration isolation and seismic[- and wind]-control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.

- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.
- B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Equipment Restraints:
 - 1. Install seismic snubbers on HVAC equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
 - 2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch
 - 3. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.
- B. Piping Restraints:
 - 1. Comply with requirements in MSS SP-127.
 - 2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
 - 3. Brace a change of direction longer than 12 feet.
- C. Install cables so they do not bend across edges of adjacent equipment or building structure.
- D. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.
- E. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- F. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- G. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

- H. Drilled-in Anchors:
 - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
 - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 - 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
 - 4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
 - 5. Set anchors to manufacturer's recommended torque, using a torque wrench.
 - 6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Section 232113 "Hydronic Piping" for piping flexible connections.

3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
 - 2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
 - 3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
 - 4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
 - 5. Test to 90 percent of rated proof load of device.
 - 6. Measure isolator restraint clearance.
 - 7. Measure isolator deflection.
 - 8. Verify snubber minimum clearances.
 - 9. Air-Mounting System Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

- 10. Air-Mounting System Operational Test: Test the compressed-air leveling system.
- 11. Test and adjust air-mounting system controls and safeties.
- 12. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.
- C. Remove and replace malfunctioning units and retest as specified above.
- D. Prepare test and inspection reports.

3.6 ADJUSTING

- A. Adjust isolators after piping system is at operating weight.
- B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
- C. Adjust air-spring leveling mechanism.
- D. Adjust active height of spring isolators.
- E. Adjust restraints to permit free movement of equipment within normal mode of operation.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air-mounting systems. Refer to Section 017900 "Demonstration and Training."

END OF SECTION 230548

SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Pipe labels.
 - 4. Duct labels.
 - 5. Stencils.
 - 6. Valve tags.
 - 7. Warning tags.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve numbering scheme.
- E. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

2.1 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
 - 1. Material and Thickness: Stainless steel, 0.025-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 - 3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 - 4. Fasteners: Stainless-steel rivets.
 - 5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Plastic Labels for Equipment:
 - 1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
 - 2. Letter Color: Black.
 - 3. Background Color: White.
 - 4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
 - 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 - 6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 - 7. Fasteners: Stainless-steel rivets.
 - 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.
- D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: Red.

- C. Background Color: Black.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 inches high.

2.4 DUCT LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: Black.
- C. Background Color: White.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 inches high.

2.5 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
 - 1. Tag Material: Stainless steel, 0.025-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. Fasteners: Brass beaded chain.
- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
 - 1. Valve-tag schedule shall be included in operation and maintenance data.

2.6 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
 - 1. Size: Approximately 4 by 7 inches.
 - 2. Fasteners: Brass grommet and wire.
 - 3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
 - 4. Color: Yellow background with black lettering.

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

- A. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- B. Pipe Label Color Schedule:
 - 1. Refrigerant Piping:
 - a. Background Color: Yellow.
 - b. Letter Color: Black.

3.4 DUCT LABEL INSTALLATION

- A. Install self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:
 - 1. Blue: For cold-air supply ducts.
 - 2. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
 - 3. ASME A13.1 Colors and Designs: For hazardous material exhaust.

- B. Stenciled Duct Label Option: Stenciled labels, showing service and flow direction, may be provided instead of plastic-laminated duct labels, at Installer's option, if lettering larger than 1 inch high is needed for proper identification because of distance from normal location of required identification.
- C. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.5 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
 - 1. Valve-Tag Size and Shape:
 - a. Refrigerant: 1-1/2 inches, round.
 - 2. Valve-Tag Color:
 - a. Refrigerant: Natural.
 - 3. Letter Color:
 - a. Refrigerant: Black.

3.6 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 230553

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Balancing Air Systems:
 - a. Constant-volume air systems.
 - b. Variable-air-volume systems.

1.3 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An entity engaged to perform TAB Work.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB contractor and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Contract Documents Examination Report: Within 30 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.
- C. Strategies and Procedures Plan: Within 30 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.
- D. Certified TAB reports.
- E. Sample report forms.

- F. Instrument calibration reports, to include the following:
 - 1. Instrument type and make.
 - 2. Serial number.
 - 3. Application.
 - 4. Dates of use.
 - 5. Dates of calibration.

1.5 QUALITY ASSURANCE

- A. TAB Contractor Qualifications: Engage a TAB entity certified by NEBB or TABB.
 - 1. TAB Field Supervisor: Employee of the TAB contractor and certified by NEBB or TABB.
 - 2. TAB Technician: Employee of the TAB contractor and who is certified by NEBB or TABB as a TAB technician.
- B. TAB Conference: Meet with Architect, Owner, Construction Manager and Commissioning Authority on approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Require the participation of the TAB field supervisor and technicians. Provide seven days' advance notice of scheduled meeting time and location.
 - 1. Agenda Items:
 - a. The Contract Documents examination report.
 - b. The TAB plan.
 - c. Coordination and cooperation of trades and subcontractors.
 - d. Coordination of documentation and communication flow.
- C. Certify TAB field data reports and perform the following:
 - 1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
 - 2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.
- D. TAB Report Forms: Use standard TAB contractor's forms approved by Architect.
- E. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."
- F. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 "Air Balancing."
- G. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 "System Balancing."

1.6 PROJECT CONDITIONS

- A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.
- B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.7 COORDINATION

- A. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.
- B. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.
- PART 2 PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
- B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine equipment performance data including fan and pump curves.
 - 1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
 - 2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems Duct Design." Compare results with the design data and installed conditions.

- F. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- G. Examine test reports specified in individual system and equipment Sections.
- H. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- I. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.
- J. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.
- K. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.
- L. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- M. Examine system pumps to ensure absence of entrained air in the suction piping.
- N. Examine operating safety interlocks and controls on HVAC equipment.
- O. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
- B. Complete system-readiness checks and prepare reports. Verify the following:
 - 1. Permanent electrical-power wiring is complete.
 - 2. Hydronic systems are filled, clean, and free of air.
 - 3. Automatic temperature-control systems are operational.
 - 4. Equipment and duct access doors are securely closed.
 - 5. Balance, smoke, and fire dampers are open.
 - 6. Isolating and balancing valves are open and control valves are operational.
 - 7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
 - 8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance", ASHRAE 111, NEBB's "Procedural

Standards for Testing, Adjusting, and Balancing of Environmental Systems", SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.

- 1. Comply with requirements in ASHRAE 62.1, Section 7.2.2 "Air Balancing."
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
 - 1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
 - 2. After testing and balancing, install test ports and duct access doors that comply with requirements in Section 233300 "Air Duct Accessories."
 - 3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 230713 "Duct Insulation," Section 230716 "HVAC Equipment Insulation," and Section 230719 "HVAC Piping Insulation."
- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. For variable-air-volume systems, develop a plan to simulate diversity.
- D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.
- F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- G. Verify that motor starters are equipped with properly sized thermal protection.
- H. Check dampers for proper position to achieve desired airflow path.
- I. Check for airflow blockages.
- J. Check condensate drains for proper connections and functioning.
- K. Check for proper sealing of air-handling-unit components.

L. Verify that air duct system is sealed as specified in Section 233113 "Metal Ducts."

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
 - 1. Measure total airflow.
 - a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.
 - 2. Measure fan static pressures as follows to determine actual static pressure:
 - a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
 - b. Measure static pressure directly at the fan outlet or through the flexible connection.
 - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
 - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
 - 3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
 - a. Report the cleanliness status of filters and the time static pressures are measured.
 - 4. Measure static pressures entering and leaving other devices, such as sound traps, heatrecovery equipment, and air washers, under final balanced conditions.
 - 5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
 - 6. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
 - 7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
 - 1. Measure airflow of submain and branch ducts.

- a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
- 2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
- 3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
- C. Measure air outlets and inlets without making adjustments.
 - 1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
- D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.
 - 1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
 - 2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.6 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

- A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a minimum set-point airflow with the remainder at maximum-airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.
- B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
 - 1. Set outdoor-air dampers at minimum, and set return- and exhaust-air dampers at a position that simulates full-cooling load.
 - 2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
 - 3. Measure total system airflow. Adjust to within indicated airflow.
 - 4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
 - 5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.

- a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.
- 6. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
 - a. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.
- 7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
- 8. Record final fan-performance data.

3.7 PROCEDURES FOR CONDENSING UNITS

- A. Verify proper rotation of fans.
- B. Measure entering- and leaving-air temperatures.
- C. Record compressor data.

3.8 PROCEDURES FOR HEAT-TRANSFER COILS

- A. Measure, adjust, and record the following data for each water coil:
 - 1. Entering- and leaving-water temperature.
 - 2. Water flow rate.
 - 3. Water pressure drop.
 - 4. Dry-bulb temperature of entering and leaving air.
 - 5. Wet-bulb temperature of entering and leaving air for cooling coils.
 - 6. Airflow.
 - 7. Air pressure drop.
- B. Measure, adjust, and record the following data for each electric heating coil:
 - 1. Nameplate data.
 - 2. Airflow.
 - 3. Entering- and leaving-air temperature at full load.
 - 4. Voltage and amperage input of each phase at full load and at each incremental stage.
 - 5. Calculated kilowatt at full load.
 - 6. Fuse or circuit-breaker rating for overload protection.
- C. Measure, adjust, and record the following data for each refrigerant coil:
 - 1. Dry-bulb temperature of entering and leaving air.
 - 2. Wet-bulb temperature of entering and leaving air.
 - 3. Airflow.
 - 4. Air pressure drop.

5. Refrigerant suction pressure and temperature.

3.9 TOLERANCES

- A. Set HVAC system's air flow rates and water flow rates within the following tolerances:
 - 1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
 - 2. Air Outlets and Inlets: Plus or minus 10 percent.
 - 3. Cooling-Water Flow Rate: Plus or minus 10 percent.

3.10 REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.
- B. Status Reports: Prepare weekly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.11 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
 - 1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
 - 2. Include a list of instruments used for procedures, along with proof of calibration.
- B. Final Report Contents: In addition to certified field-report data, include the following:
 - 1. Pump curves.
 - 2. Fan curves.
 - 3. Manufacturers' test data.
 - 4. Field test reports prepared by system and equipment installers.
 - 5. Other information relative to equipment performance; do not include Shop Drawings and product data.
- C. General Report Data: In addition to form titles and entries, include the following data:
 - 1. Title page.
 - 2. Name and address of the TAB contractor.
 - 3. Project name.
 - 4. Project location.

- 5. Architect's name and address.
- 6. Engineer's name and address.
- 7. Contractor's name and address.
- 8. Report date.
- 9. Signature of TAB supervisor who certifies the report.
- 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
- 11. Summary of contents including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
- 12. Nomenclature sheets for each item of equipment.
- 13. Data for terminal units, including manufacturer's name, type, size, and fittings.
- 14. Notes to explain why certain final data in the body of reports vary from indicated values.
- 15. Test conditions for fans and pump performance forms including the following:
 - a. Settings for outdoor-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Face and bypass damper settings at coils.
 - e. Fan drive settings including settings and percentage of maximum pitch diameter.
 - f. Inlet vane settings for variable-air-volume systems.
 - g. Settings for supply-air, static-pressure controller.
 - h. Other system operating conditions that affect performance.
- D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
 - 1. Quantities of outdoor, supply, return, and exhaust airflows.
 - 2. Water and steam flow rates.
 - 3. Duct, outlet, and inlet sizes.
 - 4. Pipe and valve sizes and locations.
 - 5. Terminal units.
 - 6. Balancing stations.
 - 7. Position of balancing devices.
- E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:
 - 1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Unit arrangement and class.
 - g. Discharge arrangement.
 - h. Sheave make, size in inches, and bore.

- i. Center-to-center dimensions of sheave, and amount of adjustments in inches.
- j. Number, make, and size of belts.
- k. Number, type, and size of filters.
- 2. Motor Data:
 - a. Motor make, and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches, and bore.
 - f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
- 3. Test Data (Indicated and Actual Values):
 - a. Total air flow rate in cfm.
 - b. Total system static pressure in inches wg.
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg.
 - e. Filter static-pressure differential in inches wg.
 - f. Preheat-coil static-pressure differential in inches wg.
 - g. Cooling-coil static-pressure differential in inches wg.
 - h. Heating-coil static-pressure differential in inches wg.
 - i. Outdoor airflow in cfm.
 - j. Return airflow in cfm.
 - k. Outdoor-air damper position.
 - 1. Return-air damper position.
 - m. Vortex damper position.
- F. Apparatus-Coil Test Reports:
 - 1. Coil Data:
 - a. System identification.
 - b. Location.
 - c. Coil type.
 - d. Number of rows.
 - e. Fin spacing in fins per inch o.c.
 - f. Make and model number.
 - g. Face area in sq. ft.
 - h. Tube size in NPS.
 - i. Tube and fin materials.
 - j. Circuiting arrangement.
 - 2. Test Data (Indicated and Actual Values):
 - a. Air flow rate in cfm.
 - b. Average face velocity in fpm.
 - c. Air pressure drop in inches wg.
 - d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
 - e. Return-air, wet- and dry-bulb temperatures in deg F.

- f. Entering-air, wet- and dry-bulb temperatures in deg F.
- g. Leaving-air, wet- and dry-bulb temperatures in deg F.
- h. Water flow rate in gpm.
- i. Water pressure differential in feet of head or psig.
- j. Entering-water temperature in deg F.
- k. Leaving-water temperature in deg F.
- 1. Refrigerant expansion valve and refrigerant types.
- m. Refrigerant suction pressure in psig.
- n. Refrigerant suction temperature in deg F.
- o. Inlet steam pressure in psig.
- G. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:
 - 1. Unit Data:
 - a. System identification.
 - b. Location.
 - c. Coil identification.
 - d. Capacity in Btu/h.
 - e. Number of stages.
 - f. Connected volts, phase, and hertz.
 - g. Rated amperage.
 - h. Air flow rate in cfm.
 - i. Face area in sq. ft.
 - j. Minimum face velocity in fpm.
 - 2. Test Data (Indicated and Actual Values):
 - a. Heat output in Btu/h
 - b. Air flow rate in cfm.
 - c. Air velocity in fpm.
 - d. Entering-air temperature in deg F.
 - e. Leaving-air temperature in deg F.
 - f. Voltage at each connection.
 - g. Amperage for each phase.
- H. Fan Test Reports: For supply, return, and exhaust fans, include the following:
 - 1. Fan Data:
 - a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and size.
 - e. Manufacturer's serial number.
 - f. Arrangement and class.
 - g. Sheave make, size in inches, and bore.
 - h. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 - 2. Motor Data:

- a. Motor make, and frame type and size.
- b. Horsepower and rpm.
- c. Volts, phase, and hertz.
- d. Full-load amperage and service factor.
- e. Sheave make, size in inches, and bore.
- f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
- g. Number, make, and size of belts.
- 3. Test Data (Indicated and Actual Values):
 - a. Total airflow rate in cfm.
 - b. Total system static pressure in inches wg.
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg.
 - e. Suction static pressure in inches wg.
- I. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
 - 1. Report Data:
 - a. System and air-handling-unit number.
 - b. Location and zone.
 - c. Traverse air temperature in deg F.
 - d. Duct static pressure in inches wg.
 - e. Duct size in inches.
 - f. Duct area in sq. ft..
 - g. Indicated air flow rate in cfm.
 - h. Indicated velocity in fpm.
 - i. Actual air flow rate in cfm.
 - j. Actual average velocity in fpm.
 - k. Barometric pressure in psig.
- J. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:
 - 1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Service.
 - d. Make and size.
 - e. Model number and serial number.
 - f. Water flow rate in gpm.
 - g. Water pressure differential in feet of head or psig.
 - h. Required net positive suction head in feet of head or psig.
 - i. Pump rpm.
 - j. Impeller diameter in inches.
 - k. Motor make and frame size.
 - 1. Motor horsepower and rpm.
 - m. Voltage at each connection.

- n. Amperage for each phase.
- o. Full-load amperage and service factor.
- p. Seal type.
- 2. Test Data (Indicated and Actual Values):
 - a. Static head in feet of head or psig.
 - b. Pump shutoff pressure in feet of head or psig.
 - c. Actual impeller size in inches.
 - d. Full-open flow rate in gpm.
 - e. Full-open pressure in feet of head or psig.
 - f. Final discharge pressure in feet of head or psig.
 - g. Final suction pressure in feet of head or psig.
 - h. Final total pressure in feet of head or psig.
 - i. Final water flow rate in gpm.
 - j. Voltage at each connection.
 - k. Amperage for each phase.
- K. Instrument Calibration Reports:
 - 1. Report Data:
 - a. Instrument type and make.
 - b. Serial number.
 - c. Application.
 - d. Dates of use.
 - e. Dates of calibration.

3.12 INSPECTIONS

- A. Initial Inspection:
 - 1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.
 - 2. Check the following for each system:
 - a. Measure airflow of at least 10 percent of air outlets.
 - b. Measure water flow of at least 5 percent of terminals.
 - c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
 - d. Verify that balancing devices are marked with final balance position.
 - e. Note deviations from the Contract Documents in the final report.
- B. Final Inspection:
 - 1. After initial inspection is complete and documentation by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Architect and Commissioning Authority.

- 2. The TAB contractor's test and balance engineer shall conduct the inspection in the presence of Architect and Commissioning Authority.
- 3. Architect and Commissioning Authority shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
- 4. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
- 5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
- C. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:
 - 1. Recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
 - 2. If the second final inspection also fails, Owner may contract the services of another TAB contractor to complete TAB Work according to the Contract Documents and deduct the cost of the services from the original TAB contractor's final payment.
- D. Prepare test and inspection reports.

3.13 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION 230593

SECTION 230713 - DUCT INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes insulating the following duct services:
 - 1. Indoor, concealed supply and outdoor air.
 - 2. Indoor, exposed supply and outdoor air.
 - 3. Indoor, concealed return located in unconditioned space.
 - 4. Indoor, exposed return located in unconditioned space.
 - 5. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
 - 6. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
- B. Related Sections:
 - 1. Section 233113 "Metal Ducts" for duct liners.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
 - 3. Detail application of field-applied jackets.
 - 4. Detail application at linkages of control devices.
- C. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use. Sample sizes are as follows:
 - 1. Sheet Form Insulation Materials: 12 inches square.
 - 2. Sheet Jacket Materials: 12 inches square.
 - 3. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- C. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.
- C. Mockups: Before installing insulation, build mockups for each type of insulation and finish listed below to demonstrate quality of insulation application and finishes. Build mockups in the location indicated or, if not indicated, as directed by Architect. Use materials indicated for the completed Work.
 - 1. Ductwork Mockups:
 - a. One 10-foot section each of rectangular and round straight duct.
 - b. One each of a 90-degree mitered round and rectangular elbow, and one each of a 90-degree radius round and rectangular elbow.
 - c. One rectangular branch takeoff and one round branch takeoff from a rectangular duct. One round tee fitting.
 - d. One rectangular and round transition fitting.
 - e. Four support hangers for round and rectangular ductwork.
 - f. Each type of damper and specialty.
 - 2. For each mockup, fabricate cutaway sections to allow observation of application details for insulation materials, adhesives, mastics, attachments, and jackets.
 - 3. Notify Architect seven days in advance of dates and times when mockups will be constructed.
 - 4. Obtain Architect's approval of mockups before starting insulation application.

- 5. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
- 6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
- 7. Demolish and remove mockups when directed.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

1.8 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor Duct and Plenum Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. CertainTeed Corp.; SoftTouch Duct Wrap.
 - b. Johns Manville; Microlite.
 - c. Knauf Insulation; Friendly Feel Duct Wrap.
 - d. Manson Insulation Inc.; Alley Wrap.
 - e. Owens Corning; SOFTR All-Service Duct Wrap.
- G. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. CertainTeed Corp.; Commercial Board.
 - b. Fibrex Insulations Inc.; FBX.
 - c. Johns Manville; 800 Series Spin-Glas.
 - d. Knauf Insulation; Insulation Board.
 - e. Manson Insulation Inc.; AK Board.
 - f. Owens Corning; Fiberglas 700 Series.
- H. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied FSK jacket complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. CertainTeed Corp.; CrimpWrap.
 - b. Johns Manville; MicroFlex.
 - c. Knauf Insulation; Pipe and Tank Insulation.
 - d. Manson Insulation Inc.; AK Flex.
 - e. Owens Corning; Fiberglas Pipe and Tank Insulation.

2.2 FIRE-RATED INSULATION SYSTEMS

- A. Fire-Rated Board: Structural-grade, press-molded, xonolite calcium silicate, fireproofing board suitable for operating temperatures up to 1700 deg F. Comply with ASTM C 656, Type II, Grade 6. Tested and certified to provide a 2-hour fire rating by an NRTL acceptable to authorities having jurisdiction.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Johns Manville; Super Firetemp M.
- B. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested and certified to provide a 2-hour fire rating by an NRTL acceptable to authorities having jurisdiction.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. CertainTeed Corp.; FlameChek.
 - b. Johns Manville; Firetemp Wrap.
 - c. Nelson Fire Stop Products; Nelson FSB Flameshield Blanket.
 - d. Thermal Ceramics; FireMaster Duct Wrap.
 - e. 3M; Fire Barrier Wrap Products.
 - f. Unifrax Corporation; FyreWrap.

2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.Eagle Bridges - Marathon Industries; 22-25.
 - b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.Mon-Eco Industries, Inc.; 22-25.
 - 2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

- 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
 - b. Eagle Bridges Marathon Industries; 225.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.Mon-Eco Industries, Inc.; 22-25.
- 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.4 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
 - 1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
 - b. Vimasco Corporation; 749.
 - 2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
 - 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 - 4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
 - 5. Color: White.
- C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-30.
 - b. Eagle Bridges Marathon Industries; 501.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-35.
 - d. Mon-Eco Industries, Inc.; 55-10.
- 2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
- 3. Service Temperature Range: 0 to 180 deg F.
- 4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
- 5. Color: White.
- D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Encacel.
 - b. Eagle Bridges Marathon Industries; 570.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 60-95/60-96.
 - 2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
 - 3. Service Temperature Range: Minus 50 to plus 220 deg F.
 - 4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
 - 5. Color: White.
- E. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
 - b. Eagle Bridges Marathon Industries; 550.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
 - d. Mon-Eco Industries, Inc.; 55-50.
 - e. Vimasco Corporation; WC-1/WC-5.
 - 2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
 - 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 - 4. Solids Content: 60 percent by volume and 66 percent by weight.
 - 5. Color: White.

2.5 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
 - 1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-50 AHV2.Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-36.
- b. Vimasco Corporation; 713 and 714.
- 3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct insulation.
- 4. Service Temperature Range: 0 to plus 180 deg F.
- 5. Color: White.

2.6 SEALANTS

- A. FSK and Metal Jacket Flashing Sealants:
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.Eagle Bridges - Marathon Industries; 405.
 - b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
 - c. Mon-Eco Industries, Inc.; 44-05.
 - 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 - 3. Fire- and water-resistant, flexible, elastomeric sealant.
 - 4. Service Temperature Range: Minus 40 to plus 250 deg F.
 - 5. Color: Aluminum.
 - 6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.7 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
 - 1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
 - 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
 - 3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
 - 4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.
 - 5. Vinyl Jacket: White vinyl with a permeance of 1.3 perms when tested according to ASTM E 96/E 96M, Procedure A, and complying with NFPA 90A and NFPA 90B.

2.8 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
- C. Metal Jacket:
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.
 - b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
 - c. RPR Products, Inc.; Insul-Mate.
 - 2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
 - a. Sheet and roll stock ready for shop or field sizing.
 - b. Finish and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Indoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
 - d. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.

2.9 TAPES

- A. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABI, Ideal Tape Division; 491 AWF FSK.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
 - c. Compac Corporation; 110 and 111.
 - d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.
 - 2. Width: 3 inches.
 - 3. Thickness: 6.5 mils.
 - 4. Adhesion: 90 ounces force/inch in width.
 - 5. Elongation: 2 percent.
 - 6. Tensile Strength: 40 lbf/inch in width.
 - 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- B. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- a. ABI, Ideal Tape Division; 488 AWF.
- b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
- c. Compac Corporation; 120.
- d. Venture Tape; 3520 CW.
- 2. Width: 2 inches.
- 3. Thickness: 3.7 mils.
- 4. Adhesion: 100 ounces force/inch in width.
- 5. Elongation: 5 percent.
- 6. Tensile Strength: 34 lbf/inch in width.

2.10 SECUREMENTS

A. Bands:

- 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ITW Insulation Systems; Gerrard Strapping and Seals.
 - b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.
- 2. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick 3/4 inch wide with wing seal or closed seal.
- 3. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.
- B. Insulation Pins and Hangers:
 - 1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch-diameter shank, length to suit depth of insulation indicated.
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) AGM Industries, Inc.; CWP-1.
 - 2) GEMCO; CD.
 - 3) Midwest Fasteners, Inc.; CD.
 - 4) Nelson Stud Welding; TPA, TPC, and TPS.
 - 2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch-diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) AGM Industries, Inc.; CHP-1.
 - 2) GEMCO; Cupped Head Weld Pin.
 - 3) Midwest Fasteners, Inc.; Cupped Head.

- 4) Nelson Stud Welding; CHP.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.
- D. Wire: 0.062-inch soft-annealed, stainless steel.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. C & F Wire.

2.11 CORNER ANGLES

- A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.
- B. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14.
- C. Stainless-Steel Corner Angles: 0.024 inch thick, minimum 1 by 1 inch, stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
 - 1. Verify that systems to be insulated have been tested and are free of defects.
 - 2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.
- B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.

DUCT INSULATION

- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Keep insulation materials dry during application and finishing.
- G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- H. Install insulation with least number of joints practical.
- I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
 - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.
- L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 - 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 - 4. Seal jacket to wall flashing with flashing sealant.
- C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
- E. Insulation Installation at Floor Penetrations:
 - 1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
 - 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 INSTALLATION OF MINERAL-FIBER INSULATION

A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

DUCT INSULATION

- 1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
- 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
- 3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitordischarge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 - e. Impale insulation over pins and attach speed washers.
 - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
- 4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vaporbarrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.
- 5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
- 6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
- 7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.
- B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
 - 1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
 - 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.

- 3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitordischarge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 - e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
- 4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vaporbarrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.
- 5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
- 6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.6 FIELD-APPLIED JACKET INSTALLATION

- A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
 - 1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
 - 2. Embed glass cloth between two 0.062-inch-thick coats of lagging adhesive.
 - 3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- B. Where FSK jackets are indicated, install as follows:

- 1. Draw jacket material smooth and tight.
- 2. Install lap or joint strips with same material as jacket.
- 3. Secure jacket to insulation with manufacturer's recommended adhesive.
- 4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
- 5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
 - 1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.7 FIRE-RATED INSULATION SYSTEM INSTALLATION

- A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.
- B. Insulate duct access panels and doors to achieve same fire rating as duct.
- C. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Section 078413 "Penetration Firestopping."

3.8 FINISHES

- A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
 - 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

3.9 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.
- B. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.10 DUCT INSULATION SCHEDULE, GENERAL

- A. Plenums and Ducts Requiring Insulation:
 - 1. Indoor, concealed supply and outdoor air.
 - 2. Indoor, exposed supply and outdoor air.
 - 3. Indoor, concealed return located in unconditioned space.
 - 4. Indoor, exposed return located in unconditioned space.
 - 5. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
 - 6. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
 - 7. Outdoor, concealed supply and return.
 - 8. Outdoor, exposed supply and return.
- B. Items Not Insulated:
 - 1. Fibrous-glass ducts.
 - 2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
 - 3. Factory-insulated flexible ducts.
 - 4. Factory-insulated plenums and casings.
 - 5. Flexible connectors.
 - 6. Vibration-control devices.
 - 7. Factory-insulated access panels and doors.

3.11 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Concealed, round and flat-oval, supply-air duct insulation shall be the following:
 - 1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.
- B. Concealed, round and flat-oval, return-air duct insulation shall be the following:
 - 1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.
- C. Concealed, round and flat-oval, outdoor-air duct insulation shall be the following:
 - 1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.

- D. Concealed, round and flat-oval, exhaust-air duct insulation shall be the following:
 - 1. Mineral-Fiber Blanket: 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.
- E. Concealed, rectangular, supply-air duct insulation shall be the following:
 - 1. Mineral-Fiber Board: 2 inches thick and 3-lb/cu. ft. nominal density.
- F. Concealed, rectangular, return-air duct insulation shall be the following:
 - 1. Mineral-Fiber Board: 2 inches thick and 3-lb/cu. ft. nominal density.
- G. Concealed, rectangular, outdoor-air duct insulation shall be the following:
 - 1. Mineral-Fiber Board: 2 inches thick and 3-lb/cu. ft. nominal density.
- H. Concealed, rectangular, exhaust-air duct insulation between isolation damper and penetration of building exterior shall be the following:
 - 1. Mineral-Fiber Board: 1-1/2 inches thick and 2-lb/cu. ft. nominal density.
- I. Exposed, round and flat-oval, supply-air duct insulation shall be the following:
 - 1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.
- J. Exposed, round and flat-oval, return-air duct insulation shall be the following:
 - 1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.
- K. Exposed, round and flat-oval, outdoor-air duct insulation shall be the following:
 - 1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.
- L. Exposed, round and flat-oval, exhaust-air duct insulation shall be the following:
 - 1. Mineral-Fiber Blanket: 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.
- M. Exposed, rectangular, supply-air duct insulation shall be the following:
 - 1. Mineral-Fiber Board: 2 inches thick and 3-lb/cu. ft. nominal density.
- N. Exposed, rectangular, return-air duct insulation shall be the following:
 - 1. Mineral-Fiber Board: 2 inches thick and 3-lb/cu. ft. nominal density.
- O. Exposed, rectangular, outdoor-air duct insulation shall be the following:
 - 1. Mineral-Fiber Board: 2 inches thick and 3-lb/cu. ft. nominal density.
- P. Exposed, rectangular, exhaust-air duct insulation shall be the following:
 - 1. Mineral-Fiber Board: 1-1/2 inches thick and 2-lb/cu. ft. nominal density.

3.12 ABOVEGROUND, OUTDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Insulation materials and thicknesses are identified below. If more than one material is listed for a duct system, selection from materials listed is Contractor's option.
- B. Concealed, round and flat-oval, supply-air duct insulation shall be the following:
 - 1. Mineral-Fiber Blanket: 3 inches thick and 3-lb/cu. ft. nominal density.
- C. Concealed, round and flat-oval, return-air duct insulation shall be the following:
 - 1. Mineral-Fiber Blanket: 3 inches thick and 3-lb/cu. ft. nominal density.
- D. Concealed, round and flat-oval, outdoor-air duct insulation shall be the following:
 - 1. Mineral-Fiber Blanket: 3 inches thick and 3-lb/cu. ft. nominal density.
- E. Concealed, rectangular, supply-air duct insulation shall be the following:
 - 1. Mineral-Fiber Board: 3 inches thick and 3-lb/cu. ft. nominal density.
- F. Concealed, rectangular, return-air duct insulation shall be the following:
 - 1. Mineral-Fiber Board: 3 inches thick and 3-lb/cu. ft. nominal density.
- G. Exposed, round and flat-oval, supply-air and return duct insulation shall be the following:
 - 1. Mineral-Fiber Blanket: 3 inches thick and 3-lb/cu. ft. nominal density.
- H. Exposed, rectangular, supply-air duct insulation shall be the following:
 - 1. Mineral-Fiber Board: 3 inches thick and 3-lb/cu. ft. nominal density.
- I. Exposed, rectangular, return-air duct insulation shall be the following:
 - 1. Mineral-Fiber Board: 3 inches thick and 3-lb/cu. ft. nominal density.

3.13 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. Ducts and Plenums, Concealed:
 - 1. FSK.
- C. Ducts and Plenums, Exposed:
 - 1. FSK.

University of South Carolina Softball Stadium Construction BID SET END OF SECTION 230713 Architect's Project No. 11.122.00 State Project No. H27-6088-MJ 03/16/12

SECTION 230910 – AUTOMATIC TEMPERATURE CONTROL INSTRUMENTATION

PART 1 - GENERAL

1.1 Related Documents

- A. All work of this Division shall be coordinated and provided by the single Central Control and Monitoring System (CCMS) Contractor.
- B. The work of this Division shall be scheduled, coordinated, and interfaced with the associated work of other trades. Reference the Division 23 Sections for details.
- C. The work of this Division shall be as required by the Specifications, Point Schedules and Drawings.

1.2 Scope

- A. This section includes the controls, instrumentation and associated piping and wiring required to make the mechanical systems provided under Division 23 perform as described in these specifications and as shown. Provide a complete system of automatic temperature control of the direct digital type. The system shall be complete in all respects including all labor, materials, equipment, and service necessary, and shall be installed by personnel in the direct employ of the manufacturer. Provide a distributed process network control system complete with all necessary hardware and software including all programming. The DDC systems for USC Softball Stadium shall be compatible with the existing USC campus wide control system network in all respects. The existing control system network is Johnson Controls Metasys.
- B. Provide a complete and operational Central Control and Monitoring System (CCMS) including all devices and software necessary to perform the functions herein described or indicated on the drawings.
- C. The CMMS shall be a Web based system communicating over the building owners Local Area Network (LAN). Contractor shall be responsible for coordination with the owner's IT staff to ensure that the CMMS will perform in the owner's environment without disruption to any of the other activities taking place on that LAN. TCP/IP connections and addresses shall be provided by the owner for connection of supervisory panels to the USC network.
- D. The primary desktop and laptop interface will be via a standard Web Browser such as Internet Explorer or Netscape. CMMS contractor shall provide software license(s) for CMMS access for a minimum of twenty concurrent users.
- E. Utilize the existing CMMS server for the purpose of providing a location for archiving system configuration data, graphics and historical data such as trend data and operator transactions.
- F. The primary focus of the Central Control and Monitoring System (CCMS) will be to monitor and control the new HVAC system components, air handling units, fans, chillers, boilers, coils,

valves, pumps, variable speed drives, trending, graphic functions, etc. The system shall be expandable to serve future equipment, systems, and auxiliary field devices.

- G. CCMS contactor shall provide all DDC panels, power supplies, wiring, conduit, solenoid valves, relays, differential pressure transmitters, differential pressure switches, RTDS, pressure sensors, etc. necessary for a complete and operable automatic control system and DDC field panels and connecting LAN.
- H. The systems engineering phase shall include the selection and integration of components into a complete system which will meet the performance and prescriptive requirements of the Contract, together with drawings, specifications, descriptions of operation, diagrams including system architecture and other materials listed under "Submittals" paragraph of this Section. The successful contractor shall be responsible for all systems engineering.

1.3 Quality Assurance

- A. Quality assurance for automatic control systems includes a multi-step program consisting of a pre-qualification procedure for manufacturer and installation specialist; a system engineering, products and shop drawing phase; installation; testing and adjusting; reporting; commissioning testing and verifications; operating instruction and training; and the submission of maintenance and operating manuals.
- B. CMMS Contractor
 - 1. The Central Control and Monitoring System (CMMS) herein specified shall be fully integrated and installed as a complete package by the Central Control and Monitoring System contractor. The System shall include all wiring, piping, installation supervision, calibration, adjustments, and checkout necessary for a complete and fully operational system.
 - 2. The CMMS Contractor shall be a factory owned branch office that is regularly engaged in the engineering, programming, installation and service of CMMSs of similar size and complexity. Bids by wholesalers, mechanical contractors, franchised dealers, applied partners or any other firm whose principal business is not that of manufacturing and installing automatic temperature control systems shall not be acceptable.
 - 3. The CMMS Contractor shall have a minimum of ten years experience with the complete, turnkey installation of CMMSs of similar size and technical complexity.
 - 4. The CMMS shall be complete in all respects and shall be provided, installed and commissioned by the CMMS equipment manufacturer. Equipment manufacturer shall be responsible for and warrant the proper installation and operation of the CMMS and control system equipment.
 - 5. The following CMMS contractors are approved to provide and install the CMMS for this project subject to their ability to meet all requirements of this specification:

Johnson Controls, Inc 14 Woodcross Drive Columbia, SC 29212

6. Bid approval does not imply nor suggest compliance of specification requirements.

- C. CMMS Products Manufacturer:
 - 1. The CMMS architecture shall consist of the products of a manufacturer regularly engaged in the production of CMMSs, and shall be the manufacturer's latest standard of design. Controllers and DDC (Direct Digital Control) system components shall be current production products.
 - 2. All other equipment shall be the products of the CMMS manufacturers or of an approved manufacturer regularly engaged in production of specialized CMMS materials or equipment.
 - 3. Following is a list of acceptable CMMS products manufacturers:

Johnson Controls, Inc 14 Woodcross Drive Columbia, SC 29212

- 4. Bid approval does not imply nor suggest compliance of specification requirements.
- 1.4 Work Included and Interface Requirements
 - A. Installation of Central Control and Monitoring System (CMMS)
 - 1. The CMMS contractor shall provide all necessary hardware and software to integrate the new control system with the existing USC campus CMMS. Integration means the ability to monitor, override, change setpoints, and provide real-time bi-directional dynamic data exchange between the new control system and the existing CMMS hardware and software.
 - 2. The existing USC campus CMMS is a Johnson Controls Metasys system. The CMMS is comprised of multiple supervisory controllers, monitoring and communicating with various building control systems over the USC campus Ethernet LAN system. The new building control system will be connected to, and communicate with, the existing campus CMMS over the USC campus Ethernet LAN
 - 3. All new control points, monitoring points and software points shall be added to the existing USC CMMS database and shall be available for monitoring and adjustment at any computer, with current copy of Microsoft Internet Explorer software that is connected to the USC LAN.
 - 4. All new building software and databases shall be archived on the hard drive at the USC CMMS server. In the event that any building controller should lose its program that controller's archived software program shall be downloaded across the CMMS network from the CMMS server to the respective building controller.
 - 5. The CMMS contractor will provide all necessary hardware, software, and labor to allow communication with all any computer, with current copy of Microsoft Internet Explorer (Release 6.0 or later), that is connected to the USC LAN.
 - 6. Integrity of the existing CMMS shall be maintained during installation.
 - 7. The new building control system shall be compatible in every respect with the existing Metasys CMMS hardware and software. All new controllers shall be compatible with Metasys database and Metasys software development tools.

1.5 Submittals

- A. Shop Drawings, Product Data, and Samples
 - 1. Submittals shall be in defined packages. Each package shall be complete and shall only reference itself and previously submitted packages. The packages shall be as approved by the Architect and Engineer for Contract compliance.
 - 2. Prepare an index of all submittals and shop drawings for the installation. Index shall include a shop drawing identification number, Contract Documents reference and item description.
 - 3. The CCMS Contractor shall correct any errors or omissions noted in the first review.
 - 4. At a minimum, submit the following:
 - a. CCMS network architecture diagrams including all nodes and interconnections.
 - b. Systems schematics, sequences and flow diagrams.
 - c. Points schedule for each point in the CCMS, including: Point Type, Object Name, Expanded ID, Display Units, Controller type, and Address.
 - d. Samples of Graphic Display screen types and associated menus.
 - e. Detailed Bill of Material list for each system or application, identifying quantities, part numbers, descriptions, and optional features.
 - f. Control Damper Schedule including a separate line for each damper provided under this section and a column for each of the damper attributes, including: Code Number, Fail Position, Damper Type, Damper Operator, Duct Size, Damper Size, Mounting, and Actuator Type.
 - g. Control Valve Schedules including a separate line for each valve provided under this section and a column for each of the valve attributes: Code Number, Configuration, Fail Position, Pipe Size, Valve Size, Body Configuration, Close off Pressure, Capacity, Valve CV, Design Pressure, and Actuator Type.
 - h. Room Schedule including a separate line for each VAV box and/or terminal unit indicating location and address
 - i. Details of all CCMS interfaces and connections to the work of other trades.
 - j. Product data sheets or marked catalog pages including part number, photo and description for all products including software.

1.6 1.6 Record Documentation

- A. Operation and Maintenance Manuals
 - 1. Three (3) copies of the Operation and Maintenance Manuals shall be provided to the Owner's Representative upon completion of the project. The entire Operation and Maintenance Manual shall be furnished on Compact Disc media, and include the following for the CCMS provided:
 - a. Table of contents.
 - b. As-built system record drawings. Computer Aided Drawings (CAD) record drawings shall represent the as-built condition of the system and incorporate all information supplied with the approved submittal.
 - c. Manufacturers product data sheets or catalog pages for all products including software.
 - d. System Operator's manuals.

- e. Archive copy of all site-specific databases and sequences.
- f. CCMS network diagrams.
- g. Interfaces to all third-party products and work by other trades.
- 2. The Operation and Maintenance Manual CD shall be self-contained, and include all necessary software required to access the product data sheets. A logically organized table of contents shall provide dynamic links to view and print all product data sheets. Viewer software shall provide the ability to display, zoom, and search all documents.
- 1.7 Warranty
 - A. Standard Material and Labor Warranty:
 - 1. Provide a one-year labor and material warranty on the CCMS.
 - 2. If within twelve (12) months from the date of acceptance of product, upon written notice from the owner, it is found to be defective in operation, workmanship or materials, it shall be replaced, repaired or adjusted at the option of the CCMS Contractor at the cost of the CCMS Contractor.
 - 3. Maintain an adequate supply of materials within 100 miles of the Project site such that replacement of key parts and labor support, including programming. Warranty work shall be done during CCMS Contractor's normal business hours.

PART 2 - PRODUCTS

- 2.1 Large
- 2.2 General Description
 - A. The Building Management System (CCMS) shall use an open architecture. The system shall be designed for use on the Internet, or intranets using off the shelf, industry standard technology compatible with other owner provided networks.
 - B. The Building Management System shall consist of the following:
 - 1. Standalone Network Automation Engine(s)
 - 2. Field Equipment Controller(s)
 - 3. Input/Output Module(s)
 - 4. Local Display Device(s)
 - 5. Distributed User Interface(s)
 - 6. Network processing, data storage and communications equipment
 - 7. Other components required for a complete and working CCMS
 - C. The system shall be modular in nature, and shall permit expansion of both capacity and functionality through the addition of sensors, actuators, controllers and operator devices, while re-using existing controls equipment.

- D. System architectural design shall eliminate dependence upon any single device for alarm reporting and control execution. The failure of any single component or network connection shall not interrupt the execution of control strategies at other operational devices.
- 2.3 CCMS Architecture
 - A. Automation Network
 - 1. The CCMS shall network multiple user interface clients, automation engines, system controllers and application-specific controllers. Provide application and data server(s) as required for systems operation.
 - 2. The automation network shall be capable of operating at a communication speed of 100 Mbps, with full peer-to-peer network communication.
 - 3. Network Automation Engines (NAE) shall reside on the automation network.
 - 4. The automation network will be compatible with other campus-wide networks. Where indicated, the automation network shall be connected to the campus network and share resources with it by way of standard networking devices and practices.
 - B. Control Network
 - 1. Network Automation Engines shall provide supervisory control over the control network.
 - 2. Control networks shall provide either "Peer-to-Peer," Master-Slave, or Supervised Token Passing communications, and shall operate at a minimum communication speed of 9600 baud.
 - 3. DDC Controllers shall reside on the control network.
 - C. Distributed Web Based User Interface
 - 1. All features and functions of the dedicated user interface previously defined in this document shall be available on any computer connected directly or via a wide area or virtual private network (WAN/VPN) to the automation network and conforming to the following specifications.
 - 2. Alarms
 - a. Alarms shall be routed directly from Network Automation Engines to PCs and servers. It shall be possible for specific alarms from specific points to be routed to specific PCs and servers. The alarm management portion of the user interface shall, at the minimum, provide the following functions:
 - 1) Log date and time of alarm occurrence.
 - 2) Generate a "Pop-Up" window, with audible alarm, informing a user that an alarm has been received.
 - 3) Allow a user, with the appropriate security level, to acknowledge, temporarily silence, or discard an alarm.
 - 4) Provide an audit trail on hard drive for alarms by recording user acknowledgment, deletion, or disabling of an alarm. The audit trail shall include the name of the user, the alarm, the action taken on the alarm, and a time/date stamp.
 - 5) Provide the capability to direct alarms to an e-mail address or alphanumeric pager. This must be provided in addition to the pop up window described

above. Systems that use e-mail and pagers as the exclusive means of annunciating alarms are not acceptable.

- 6) Any attribute of any object in the system may be designated to report an alarm.
- b. The FMS shall annunciate diagnostic alarms indicating system failures and nonnormal operating conditions
- 3. Reports and Summaries
 - a. Reports and Summaries shall be generated and directed to the user interface displays, with subsequent assignment to printers, or disk. As a minimum, the system shall provide the following reports:
 - 1) All points in the CCMS
 - 2) All points in each CCMS application
 - 3) All points in a specific controller
 - 4) All points in a user-defined group of points
 - 5) All points currently in alarm
 - 6) All points locked out
 - 7) All CCMS schedules
 - 8) All user defined and adjustable variables, schedules, interlocks and the like.
 - b. Summaries and Reports shall be accessible via standard UI functions and not dependent upon custom programming or user defined HTML pages.
 - c. Selection of a single menu item, tool bar item, or tool bar button shall print any displayed report or summary on the system printer for use as a building management and diagnostics tool.
 - d. The system shall allow for the creation of custom reports and queries via a standard web services XML interface and commercial off-the-shelf software such as Microsoft Access, Microsoft Excel, or Crystal Reports.
- 4. Schedules
 - a. A graphical display for time-of-day scheduling and override scheduling of building operations shall be provided. At a minimum, the following functions shall be provided:
 - 1) Weekly schedules
 - 2) Exception Schedules
 - 3) Monthly calendars.
 - b. Weekly schedules shall be provided for each group of equipment with a specific time use schedule.
 - c. It shall be possible to define one or more exception schedules for each schedule including references to calendars
- 5. Password

- a. Multiple-level password access protection shall be provided to allow the user/manager to user interface control, display, and database manipulation capabilities deemed appropriate for each user, based on an assigned password.
- b. A minimum of five levels of access shall be supported individually or in any combination as follows:
 - 1) Level 1 = View Data
 - 2) Level 2 = Command
 - 3) Level 3 = Operator Overrides
 - 4) Level 4 = Database Modification
 - 5) Level 5 = Database Configuration
 - 6) Level 6 = All privileges, including Password Add/Modify
- c. Operators shall be able to perform only those commands available for their respective passwords. Display of menu selections shall be limited to only those items defined for the access level of the password used to log-on.
- 6. Dynamic Color Graphics
 - a. The graphics application program shall be supplied as an integral part of the User Interface. Browser or Workstation applications that rely only upon HTML pages shall not be acceptable.
 - b. The graphics applications shall include a create/edit function and a runtime function. The system architecture shall support an unlimited number of graphics documents (graphic definition files) to be generated and executed.
 - c. The graphics shall be able to display and provide animation based on real-time data that is acquired, derived, or entered.
- 7. Historical trending and data collection
 - a. Each Automation Engine shall store trend and point history data for all analog and digital inputs and outputs, as follows:
 - Any point, physical or calculated, may be designated for trending. Three methods of collection shall be allowed: Defined time interval Upon a change of value
 - 2) Each Automation Engine shall have the capability to store multiple samples for each physical point and software variable based upon available memory, including an individual sample time/date stamp. Points may be assigned to multiple history trends with different collection parameters.
 - b. The system shall provide a configurable data storage subsystem for the collection of historical data. Data can be stored in either Microsoft Access or SQL database format.
- 8. Trend data viewing and analysis
 - a. Provide a trend viewing utility that shall have access to all database points.

- b. It shall be possible to retrieve any historical database point for use in displays and reports by specifying the point name and associated trend name.
- c. The trend viewing utility shall have the capability to define trend study displays to include multiple trends
- d. Displays shall be able to be single or stacked graphs with on-line selectable display characteristics, such as ranging, color, and plot style.
- e. Display magnitude and units shall both be selectable by the operator at any time without reconfiguring the processing or collection of data. This is a zoom capability.
- f. Display magnitude shall automatically be scaled to show full graphic resolution of the data being displayed.
- g. Trend studies shall be capable of calculating and displaying calculated variables including highest value, lowest value and time based accumulation.
- 2.4 Network Automation Engines (NAE)
 - A. Network Automation Engine (NAE)
 - 1. Provide new NAE's as required. Existing NAE shall be relocated as shown on drawings.
 - 2. The Network Automation Engine (NAE) shall be a fully user-programmable, supervisory controller. The NAE shall monitor the network of distributed application-specific controllers, provide global strategy and direction, and communicate on a peer-to-peer basis with other Network Automation Engines.
 - 3. Automation network The NAE shall reside on the automation network and shall support a subnet of system controllers.
 - 4. Processor The NAE shall be microprocessor-based with a minimum word size of 32 bits. The NAE shall be a multi-tasking, multi-user, and real-time digital control processor. Standard operating systems shall be employed. NAE size and capability shall be sufficient to fully meet the requirements of this Specification.
 - 5. Memory Each NAE shall have sufficient memory to support its own operating system, databases, and control programs, and to provide supervisory control for all control level devices.
 - 6. Diagnostics The NAE shall continuously perform self-diagnostics, communication diagnosis, and diagnosis of all panel components. The Network Automation Engine shall provide both local and remote annunciation of any detected component failures, low battery conditions, or repeated failures to establish communication.
 - 7. Power Failure In the event of the loss of normal power, The NAE shall continue to operate for a user adjustable period of up to 10 minutes after which there shall be an orderly shutdown of all programs to prevent the loss of database or operating system software.
 - a. During a loss of normal power, the control sequences shall go to the normal system shutdown conditions. All critical configuration data shall be saved into Flash memory.
 - b. Upon restoration of normal power and after a minimum off-time delay, the controller shall automatically resume full operation without manual intervention through a normal soft-start sequence.

- 2.5 DDC System Controllers
 - A. Field Equipment Controller (FEC)
 - 1. The Field Equipment Controller (FEC) shall be a fully user-programmable, digital controller that communicates via BACnet MS/TP protocol.
 - 2. Controllers shall be factory programmed with a continuous adaptive tuning algorithm that senses changes in the physical environment and continually adjusts loop tuning parameters appropriately. Controllers that require manual tuning of loops or perform automatic tuning on command only shall not be acceptable.
 - 3. The FEC shall be assembled in a plenum-rated housing with flammability rated to UL94-5VB.
 - 4. The FEC shall include a removable base to allow pre-wiring without the controller.
 - 5. The FEC shall accommodate the direct wiring of analog and binary I/O field points.
 - 6. The FEC shall support the following types of inputs and outputs:
 - a. Universal Inputs shall be configured to monitor any of the following:
 - 1) Analog Input, Voltage Mode
 - 2) Analog Input, Current Mode
 - 3) Analog Input, Resistive Mode
 - 4) Binary Input, Dry Contact Maintained Mode
 - 5) Binary Input, Pulse Counter Mode
 - b. Binary Inputs shall be configured to monitor either of the following:
 - 1) Dry Contact Maintained Mode
 - 2) Pulse Counter Mode
 - c. Analog Outputs shall be configured to output either of the following
 - 1) Analog Output, Voltage Mode
 - 2) Analog Output, current Mode
 - d. Binary Outputs shall output the following:
 - 1) 24 VAC Triac
 - e. Configurable Outputs shall be capable of the following:
 - 1) Analog Output, Voltage Mode
 - 2) Binary Output Mode
 - 7. The FEC shall have the ability to reside on a Field Controller Bus (FC Bus).
 - a. The FC Bus shall be a Master-Slave/Token-Passing (MS/TP) Bus supporting BACnet Standard protocol SSPC-135, Clause 9.
 - b. The FC Bus shall support communications between the FECs and the NAE.
 - c. The FC Bus shall support a minimum of 100 IOMs and FEC in any combination.
 - d. The FC Bus shall operate at a maximum distance of 15,000 Ft. between the FEC and the furthest connected device.

- 8. The FEC shall have the ability to monitor and control a network of sensors and actuators over a Sensor-Actuator Bus (SA Bus).
 - a. The SA Bus shall be a Master-Slave/Token-Passing (MS/TP) Bus supporting BACnet Standard protocol SSPC-135, Clause 9.
 - b. The SA Bus shall support a minimum of 10 devices per trunk.
 - c. The SA Bus shall operate at a maximum distance of 1,200 Ft. between the FEC and the furthest connected device.
- 9. The FEC shall support, but not be limited to, the following:
 - a. Hot water, chilled water/central plant applications
 - b. Built-up air handling units for special applications
 - c. Terminal units
 - d. Special programs as required for systems control
- 2.5 Field Devices
 - A. Input/Output Module (IOM)
 - 1. The Input/Output Module (IOM) provides additional inputs and outputs for use in the FEC.
 - 2. The IOM shall communicate with the FEC over either the FC Bus or the SA Bus using BACnet Standard protocol SSPC-135, Clause 9.
 - B. Networked Thermostat (TEC)
 - 1. The Networked Thermostats shall be capable of controlling the following:
 - a. A four pipe fan coil system with multi-speed fan control.
 - b. A two pipe fan coil with a single speed fan.
 - c. The Networked Thermostat shall support remote read/write and parameter adjustment from the web based User Interfaceable through a Network Automation Engine.
 - 2. The Networked Thermostat shall include an intuitive User Interface providing plain text messages.
 - a. Two line, 8 character backlit display
 - b. LED indicators for Fan, Heat, and Cool status
 - c. Five (5) User Interface Keys
 - 1) Mode
 - 2) Fan
 - 3) Override
 - 4) Degrees C/F
 - 5) Up/Down
 - 3. The Networked Thermostats shall provide the flexibility to support the following inputs:
 - a. Integral Indoor Air Temperature Sensor

- b. Duct Mount Air Temperature Sensor
- c. Remote Indoor Air Temperature Sensor with Occupancy Override and LED Indicator.
- d. Two configurable binary inputs
- 4. The Networked Thermostats shall provide the flexibility to support the following outputs:
 - a. Three Speed Fan Control
 - b. On/Off Control
 - c. Floating Control
 - d. Proportional (0 to 10V) Control
- C. Network Sensors (NS)
 - 1. The Network Sensors (NS) shall have the ability to monitor the following variables as required by the systems sequence of operations:
 - a. Zone Temperature
 - b. Zone humidity
 - c. Zone setpoint
 - 2. The NS shall transmit the zone information back to the controller on the Sensor-Actuator Bus (SA Bus) using BACnet Standard protocol SSPC-135, Clause 9.
 - 3. The Network Sensors shall include the following items:
 - a. A backlit Liquid Crystal Display (LCD) to indicate the Temperature, Humidity and Setpoint.
 - b. An LED to indicate the status of the Override feature.
 - c. A button to toggle the temperature display between Fahrenheit and Celsius.
 - d. A button to initiate a timed override command
 - 4. The NS shall be available with either screw terminals or phone jack.
 - 5. The NS shall be available in either surface mount or wall mount styles.

2.6 Input Devices

- A. General Requirements
 - 1. Installation, testing, and calibration of all sensors, transmitters, and other input devices shall be provided to meet the system requirements.
- B. Temperature Sensors
 - 1. General Requirements:
 - a. Sensors and transmitters shall be provided, as outlined in the input/output summary and sequence of operations.
 - b. The temperature sensor shall be of the resistance type, and shall be either two-wire 1000 ohm nickel RTD, or two-wire 1000 ohm platinum RTD.

- c. The following point types (and the accuracy of each) are required, and their associated accuracy values include errors associated with the sensor, lead wire, and A to D conversion:
- 2. Room Temperature Sensors
 - a. Room sensors shall be constructed for either surface or wall box mounting.
 - b. Room sensors shall have the following options when specified:
 - 1) Setpoint reset slide switch providing a ± 3 degree (adjustable) range.
 - 2) Individual heating/cooling setpoint slide switches.
 - 3) A momentary override request push button for activation of after-hours operation.
- 3. Thermo wells
 - a. When thermo wells are required, the sensor and well shall be supplied as a complete assembly, including wellhead and Greenfield fitting.
 - b. Thermo wells shall be pressure rated and constructed in accordance with the system working pressure.
 - c. Thermo wells and sensors shall be mounted in a threadolet or 1/2" NFT saddle and allow easy access to the sensor for repair or replacement.
 - d. Thermo wells shall be constructed of 316 stainless steel.
- 4. Outside Air Sensors
 - a. Outside air sensors shall be designed to withstand the environmental conditions to which they will be exposed. They shall also be provided with a solar shield.
 - b. Sensors exposed to wind velocity pressures shall be shielded by a perforated plate that surrounds the sensor element.
 - c. Temperature transmitters shall be of NEMA 3R construction and rated for ambient temperatures.
- 5. Duct Mount Sensors
 - a. Duct mount sensors shall mount in an electrical box through a hole in the duct, and be positioned so as to be easily accessible for repair or replacement.
 - b. Duct sensors shall be insertion type and constructed as a complete assembly, including lock nut and mounting plate.
 - c. For outdoor air duct applications, a weatherproof mounting box with weatherproof cover and gasket shall be used.
- 6. Averaging Sensors
 - a. For ductwork greater in any dimension that 48 inches and/or where air temperature stratification exists, an averaging sensor with multiple sensing points shall be used.
 - b. For plenum applications, such as mixed air temperature measurements, a string of sensors mounted across the plenum shall be used to account for stratification and/or air turbulence. The averaging string shall have a minimum of 4 sensing points per 12-foot long segment.

- c. Capillary supports at the sides of the duct shall be provided to support the sensing string.
- 7. Acceptable Manufacturers: Johnson Controls, Setra.
- C. Humidity Sensors
 - 1. The sensor shall be a solid-state type, relative humidity sensor of the Bulk Polymer Design. The sensor element shall resist service contamination.
 - 2. The humidity transmitter shall be equipped with non-interactive span and zero adjustments, a 2-wire isolated loop powered, 4-20 mA, 0-100% linear proportional output.
 - 3. The humidity transmitter shall meet the following overall accuracy, including lead loss and Analog to Digital conversion. 3% between 20% and 80% RH @ 77 Deg F unless specified elsewhere.
 - 4. Outside air relative humidity sensors shall be installed with a rain proof, perforated cover. The transmitter shall be installed in a NEMA 3R enclosure with sealtite fittings and stainless steel bushings.
 - 5. A single point humidity calibrator shall be provided, if required, for field calibration. Transmitters shall be shipped factory pre-calibrated.
 - 6. Duct type sensing probes shall be constructed of 304 stainless steel, and shall be equipped with a neoprene grommet, bushings, and a mounting bracket.
 - 7. Acceptable Manufacturers: Johnson Controls, Veris Industries, and Mamac.
- D. Differential Pressure Transmitters
 - 1. General Air and Water Pressure Transmitter Requirements:
 - a. Pressure transmitters shall be constructed to withstand 100% pressure over-range without damage, and to hold calibrated accuracy when subject to a momentary 40% over-range input.
 - b. Pressure transmitters shall transmit a 0 to 5 VDC, 0 to 10 VDC, or 4 to 20 mA output signal.
 - c. Differential pressure transmitters used for flow measurement shall be sized to the flow sensing device, and shall be supplied with Tee fittings and shut-off valves in the high and low sensing pick-up lines to allow the balancing Contractor and Owner permanent, easy-to-use connection.
 - d. A minimum of a NEMA 1 housing shall be provided for the transmitter. Transmitters shall be located in accessible local control panels wherever possible.
 - 2. Low Differential Water Pressure Applications (0" 20" w.c.)
 - a. The differential pressure transmitter shall be of industrial quality and transmit a linear, 4 to 20 mA output in response to variation of flow meter differential pressure or water pressure sensing points.
 - b. The differential pressure transmitter shall have non-interactive zero and span adjustments that are adjustable from the outside cover and meet the following performance specifications:
 - 1) .01-20" w.c. input differential pressure range.
 - 2) 4-20 mA output.

- 3) Maintain accuracy up to 20 to 1 ratio turndown.
- 4) Reference Accuracy: +0.2% of full span.
- c. Acceptable Manufacturers: Setra and Mamac.
- 3. Medium to High Differential Water Pressure Applications (Over 21" w.c.)
 - a. The differential pressure transmitter shall meet the low pressure transmitter specifications with the following exceptions:
 - 1) Differential pressure range 10" w.c. to 300 PSI.
 - 2) Reference Accuracy: $\pm 1\%$ of full span (includes non-linearity, hysteresis, and repeatability).
 - b. Standalone pressure transmitters shall be mounted in a bypass valve assembly panel. The panel shall be constructed to NEMA 1 standards. The transmitter shall be installed in the panel with high and low connections piped and valved. Air bleed units, bypass valves, and compression fittings shall be provided.
 - c. Acceptable Manufacturers: Setra and Mamac.
- 4. Water Flow Monitoring
 - a. Water flow meters shall be electromagnetic type with integral microprocessor-Based electronics. The meter shall have an accuracy of 0.25%.
 - b. Acceptable manufacturers: Onicon
- E. Smoke Detectors
 - 1. Ionization type air duct detectors shall be furnished as specified elsewhere in Division 26 for installation under Division 23. All wiring for air duct detectors shall be provided under Division 26, Fire Alarm System.
- F. Status and Safety Switches
 - 1. General Requirements
 - a. Switches shall be provided to monitor equipment status, safety conditions, and generate alarms at the CCMS when a failure or abnormal condition occurs. Safety switches shall be provided with two sets of contacts and shall be interlock wired to shut down respective equipment.
 - 2. Current Sensing Switches
 - a. The current sensing switch shall be self-powered with solid-state circuitry and a dry contact output. It shall consist of a current transformer, a solid state current sensing circuit, adjustable trip point, solid state switch, SPDT relay, and an LED indicating the on or off status. A conductor of the load shall be passed through the window of the device. It shall accept over-current up to twice its trip point range.
 - b. Current sensing switches shall be used for run status for fans, pumps, and other miscellaneous motor loads.

- c. Current sensing switches shall be calibrated to show a positive run status only when the motor is operating under load. A motor running with a broken belt or coupling shall indicate a negative run status.
- d. Acceptable manufacturers: Veris Industries
- 3. Air Filter Status Switches
 - a. Differential pressure switches used to monitor air filter status shall be of the automatic reset type with SPDT contacts rated for 2 amps at 120VAC.
 - b. A complete installation kit shall be provided, including: static pressure tops, tubing, fittings, and air filters.
 - c. Provide appropriate scale range and differential adjustment for intended service.
 - d. Acceptable manufacturers: Johnson Controls, Cleveland Controls
- 4. Air Flow Switches
 - a. Differential pressure flow switches shall be bellows actuated mercury switches or snap acting micro-switches with appropriate scale range and differential adjustment for intended service.
 - b. Acceptable manufacturers: Johnson Controls, Cleveland Controls
- 5. Air Pressure Safety Switches
 - a. Air pressure safety switches shall be of the manual reset type with SPDT contacts rated for 2 amps at 120VAC.
 - b. Pressure range shall be adjustable with appropriate scale range and differential adjustment for intended service.
 - c. Acceptable manufacturers: Johnson Controls, Cleveland Controls
- 6. Water Flow Switches
 - a. Water flow switches shall be equal to the Johnson Controls P74.
- 7. Low Temperature Limit Switches
 - a. The low temperature limit switch shall be of the manual reset type with Double Pole/Single Throw snap acting contacts rated for 16 amps at 120VAC.
 - b. The sensing element shall be a minimum of 15 feet in length and shall react to the coldest 18-inch section. Element shall be mounted horizontally across duct in accordance with manufacturers recommended installation procedures.
 - c. For large duct areas where the sensing element does not provide full coverage of the air stream, additional switches shall be provided as required to provide full protection of the air stream.
 - d. The low temperature limit switch shall be equal to Johnson Controls A70.

2.7 Output Devices

A. Actuators

- 1. General Requirements
 - a. Damper and valve actuators shall be electronic, as specified in the System Description section.
- 2. Electronic Damper Actuators
 - a. Electronic damper actuators shall be direct shaft mount.
 - b. Modulating and two-position actuators shall be provided as required by the sequence of operations. Damper sections shall be sized Based on actuator manufacturer's recommendations for face velocity, differential pressure and damper type. The actuator mounting arrangement and spring return feature shall permit normally open or normally closed positions of the dampers, as required. All actuators (except terminal units) shall be furnished with mechanical spring return unless otherwise specified in the sequences of operations. All actuators shall have external adjustable stops to limit the travel in either direction, and a gear release to allow manual positioning.
 - c. Modulating actuators shall accept 24 VAC or VDC power supply, consume no more than 15 VA, and be UL listed. The control signal shall be 2-10 VDC or 4-20 mA, and the actuator shall provide a clamp position feedback signal of 2-10 VDC. The feedback signal shall be independent of the input signal and may be used to parallel other actuators and provide true position indication. The feedback signal of one damper actuator for each separately controlled damper shall be wired back to a terminal strip in the control panel for trouble-shooting purposes.
 - d. Two-position or open/closed actuators shall accept 24 or 120 VAC power supply and be UL listed. Isolation, smoke, exhaust fan, and other dampers, as specified in the sequence of operations, shall be furnished with adjustable end switches to indicate open/closed position or be hard wired to start/stop associated fan. Twoposition actuators, as specified in sequences of operations as "quick acting," shall move full stroke within 20 seconds. All smoke damper actuators shall be quick acting.
 - e. Acceptable manufacturers: Johnson Controls, Mamac.
- 3. Electronic Valve Actuators
 - a. Electronic valve actuators shall be manufactured by the valve manufacturer.
 - b. Each actuator shall have current limiting circuitry incorporated in its design to prevent damage to the actuator.
 - c. Modulating and two-position actuators shall be provided as required by the sequence of operations. Actuators shall provide the minimum torque required for proper valve close-off against the system pressure for the required application. The valve actuator shall be sized Based on valve manufacturer's recommendations for flow and pressure differential. All actuators shall fail in the last position unless specified with mechanical spring return in the sequence of operations. The spring return feature shall permit normally open or normally closed positions of the valves, as required. All direct shaft mount rotational actuators shall have external adjustable stops to limit the travel in either direction.
 - d. Modulating Actuators shall accept 24 VAC or VDC and 120 VAC power supply and be UL listed. The control signal shall be 2-10 VDC or 4-20 mA and the actuator shall provide a clamp position feedback signal of 2-10 VDC. The feedback signal shall be independent of the input signal, and may be used to

parallel other actuators and provide true position indication. The feedback signal of each valve actuator (except terminal valves) shall be wired back to a terminal strip in the control panel for trouble-shooting purposes.

- Two-position or open/closed actuators shall accept 24 or 120 VAC power supply e. and be UL listed. Butterfly isolation and other valves, as specified in the sequence of operations, shall be furnished with adjustable end switches to indicate open/closed position or be hard wired to start/stop the associated pump or chiller. f.
 - Acceptable manufacturers: Johnson Controls
- B. **Control Relays**
 - 1. **Control Pilot Relays**
 - Control pilot relays shall be of a modular plug-in design with retaining springs or a. clips.
 - b. Mounting Bases shall be snap-mount.
 - DPDT, 3PDT, or 4PDT relays shall be provided, as appropriate for application. с.
 - Contacts shall be rated for 10 amps at 120VAC. d.
 - Relays shall have an integral indicator light and check button. e.
 - f. Acceptable manufacturers: Johnson Controls, Lectro
- C. **Control Valves**
 - 1. All automatic control valves shall be fully proportioning and provide near linear heat transfer control. The valves shall be quiet in operation and fail-safe open, closed, or in their last position. All valves shall operate in sequence with another valve when required by the sequence of operations. All control valves shall be sized by the control manufacturer, and shall be guaranteed to meet the heating and cooling loads, as specified. All control valves shall be suitable for the system flow conditions and close against the differential pressures involved. Body pressure rating and connection type (sweat, screwed, or flanged) shall conform to the pipe schedule elsewhere in this Specification.
 - 2. Ball valves shall be used for hot and chilled water applications, water terminal reheat coils, radiant panels, unit heaters, package air conditioning units, and fan coil units except those described hereinafter.
 - 3. Modulating plug water valves of the single-seat type with equal percentage flow characteristics shall be used for all special applications as indicated on the valve schedule. Valve discs shall be composition type. Valve stems shall be stainless steel.
 - 4. Butterfly valves shall be acceptable for modulating large flow applications greater than modulating plug valves, and for all two-position, open/close applications. In-line and/or three-way butterfly valves shall be heavy-duty pattern with a body rating comparable to the pipe rating, replaceable lining suitable for temperature of system, and a stainless steel vane. Valves for modulating service shall be sized and travel limited to 50 degrees of full open. Valves for isolation service shall be the same as the pipe. Valves in the closed position shall be bubble-tight.
 - 5. Acceptable manufacturers: Johnson Controls
- 2.8 **Miscellaneous Devices**
 - Local Control Panels A.

- 1. All control panels shall be factory constructed, incorporating the CCMS manufacturer's standard designs and layouts. All control panels shall be UL inspected and listed as an assembly and carry a UL 508 label listing compliance. Control panels shall be fully enclosed, with perforated sub-panel, hinged door, and slotted flush latch.
- 2. In general, the control panels shall consist of the DDC controller(s), display module as specified and indicated on the plans, and I/O devices—such as relays, transducers, and so forth—that are not required to be located external to the control panel due to function. Where specified the display module shall be flush mounted in the panel face unless otherwise noted.
- 3. All I/O connections on the DDC controller shall be provide via removable or fixed screw terminals.
- 4. Low and line voltage wiring shall be segregated. All provided terminal strips and wiring shall be UL listed, 300-volt service and provide adequate clearance for field wiring.
- 5. All wiring shall be neatly installed in plastic trays or tie-wrapped.
- 6. A convenience 120 VAC duplex receptacle shall be provided in each enclosure, fused on/off power switch, and required transformers.
- B. Power Supplies
 - 1. DC power supplies shall be sized for the connected device load. Total rated load shall not exceed 75% of the rated capacity of the power supply.
 - 2. Input: 120 VAC +10%, 60Hz.
 - 3. Output: 24 VDC.
 - 4. Line Regulation: +0.05% for 10% line change.
 - 5. Load Regulation: +0.05% for 50% load change.
 - 6. Ripple and Noise: 1 mV rms, 5 mV peak to peak.
 - 7. An appropriately sized fuse and fuse block shall be provided and located next to the power supply.
 - 8. A power disconnect switch shall be provided next to the power supply.
- C. Thermostats
 - 1. Electric room thermostats of the heavy-duty type shall be provided for unit heaters, cabinet unit heaters, and ventilation fans, where required. All these items shall be provided with concealed adjustment. Finish of covers for all room-type instruments shall match and, unless otherwise indicated or specified, covers shall be manufacturer's standard finish.

PART 3 - PERFORMANCE / EXECUTION

- 3.1 CCMS Specific Requirements
 - A. Graphic Displays
 - 1. Provide a color graphic system flow diagram display for each system with all points as indicated on the point list. All terminal unit graphic displays shall be from a standard design library.
 - 2. User shall access the various system schematics via a graphical penetration scheme and/or menu selection.

- B. Actuation / Control Type
 - 1. Primary Equipment
 - a. Controls shall be provided by equipment manufacturer as specified herein.
 - b. All damper and valve actuation shall be electric.
 - 2. Air Handling Equipment
 - a. All air handers shall be controlled with a HVAC-DDC Controller
 - b. All damper and valve actuation shall be electric.
 - 3. Terminal Equipment:
 - a. Terminal Units (VAV, UV, etc.) shall have electric damper and valve actuation.
 - b. All Terminal Units shall be controlled with HVAC-DDC Controller)

3.2 Installation Practices

- A. CCMS Wiring
 - 1. All conduit, wiring, accessories and wiring connections required for the installation of the Building Management System, as herein specified, shall be provided by the CCMS Contractor unless specifically shown on the Electrical Drawings under Division 16 Electrical. All wiring shall comply with the requirements of applicable portions of Division 16 and all local and national electric codes, unless specified otherwise in this section.
 - 2. All CCMS wiring materials and installation methods shall comply with CCMS manufacturer recommendations.
 - 3. The sizing, type and provision of cable, conduit, cable trays, and raceways shall be the design responsibility of the CCMS Contractor. If complications arise, however, due to the incorrect selection of cable, cable trays, raceways and/or conduit by the CCMS Contractor, the Contractor shall be responsible for all costs incurred in replacing the selected components.
 - 4. Class 2 Wiring
 - a. All Class 2 (24VAC or less) wiring shall be installed in conduit unless otherwise specified.
 - b. Conduit is not required for Class 2 wiring in concealed accessible locations. Class 2 wiring not installed in conduit shall be supported every 5' from the building structure utilizing metal hangers designed for this application. Wiring shall be installed parallel to the building structural lines. All wiring shall be installed in accordance with local code requirements.
 - 5. Class 2 signal wiring and 24VAC power can be run in the same conduit. Power wiring 120VAC and greater cannot share the same conduit with Class 2 signal wiring.
 - 6. Provide for complete grounding of all applicable signal and communications cables, panels and equipment so as to ensure system integrity of operation. Ground cabling and conduit at the panel terminations. Avoid grounding loops.

B. CCMS Raceway

- 1. All wiring shall be installed in conduit or raceway except as noted elsewhere in this specification. Minimum control wiring conduit size 1/2".
- 2. Where it is not possible to conceal raceways in finished locations, surface raceway (Wiremold) may be used as approved by the Architect.
- 3. All conduits and raceways shall be installed level, plumb, at right angles to the building lines and shall follow the contours of the surface to which they are attached.
- 4. Flexible Metal Conduit shall be used for vibration isolation and shall be limited to 3 feet in length when terminating to vibrating equipment. Flexible Metal Conduit may be used within partition walls. Flexible Metal Conduit shall be UL listed.
- C. Penetrations
 - 1. Provide fire stopping for all penetrations used by dedicated CCMS conduits and raceways.
 - 2. All openings in fire proofed or fire stopped components shall be closed by using approved fire resistive sealant.
 - 3. All wiring passing through penetrations, including walls shall be in conduit or enclosed raceway.
 - 4. Penetrations of floor slabs shall be by core drilling. All penetrations shall be plumb, true, and square.
- D. CCMS Identification Standards
 - 1. Node Identification. All nodes shall be identified by a permanent label fastened to the enclosure. Labels shall be suitable for the node location.
 - 2. Cable types specified in Item A shall be color coded for easy identification and troubleshooting.
- E. CCMS Panel Installation
 - 1. The CCMS panels and cabinets shall be located as indicated at an elevation of not less than 2 feet from the bottom edge of the panel to the finished floor. Each cabinet shall be anchored per the manufacturer's recommendations.
 - 2. The CCMS contractor shall be responsible for coordinating panel locations with other trades and electrical and mechanical contractors.
- F. Input Devices
 - 1. All Input devices shall be installed per the manufacturer recommendation
 - 2. Locate components of the CCMS in accessible local control panels wherever possible.
- G. HVAC Input Devices General
 - 1. All Input devices shall be installed per the manufacturer recommendation
 - 2. Locate components of the CCMS in accessible local control panels wherever possible.
 - 3. The mechanical contractor shall install all in-line devices such as temperature wells, pressure taps, airflow stations, etc.
 - 4. Input Flow Measuring Devices shall be installed in strict compliance with ASME guidelines affecting non-standard approach conditions.

- 5. Outside Air Sensors
 - a. Sensors shall be mounted on the North wall to minimize solar radiant heat impact or located in a continuous intake flow adequate to monitor outside air conditions accurately.
 - b. Sensors shall be installed with a rain proof, perforated cover.
- 6. Water Differential Pressure Sensors
 - a. Differential pressure transmitters used for flow measurement shall be sized to the flow-sensing device.
 - b. Differential pressure transmitters shall be supplied with tee fittings and shut-off valves in the high and low sensing pick-up lines.
 - c. The transmitters shall be installed in an accessible location wherever possible.
- 7. Medium to High Differential Water Pressure Applications (Over 21" w.c.):
 - a. Air bleed units, bypass valves and compression fittings shall be provided.
- 8. Building Differential Air Pressure Applications (-1" to +1" w.c.):
 - a. Transmitters exterior sensing tip shall be installed with a shielded static air probe to reduce pressure fluctuations caused by wind.
 - b. The interior tip shall be inconspicuous and located as shown on the drawings.
- 9. Duct Temperature Sensors:
 - a. Duct mount sensors shall mount in an electrical box through a hole in the duct and be positioned so as to be easily accessible for repair or replacement.
 - b. The sensors shall be insertion type and constructed as a complete assembly including lock nut and mounting plate.
 - c. For ductwork greater in any dimension than 48 inches or where air temperature stratification exists such as a mixed air plenum, utilize an averaging sensor.
 - d. The sensor shall be mounted to suitable supports using factory approved element holders.
- 10. Space Sensors:
 - a. Shall be mounted per ADA requirements.
 - b. Provide lockable tamper-proof covers in public areas and/or where indicated on the plans.
- 11. Low Temperature Limit Switches:
 - a. Install on the discharge side of the first water or steam coil in the air stream.
 - b. Mount element horizontally across duct in a serpentine pattern insuring each square foot of coil is protected by 1 foot of sensor.
 - c. For large duct areas where the sensing element does not provide full coverage of the air stream, provide additional switches as required to provide full protection of the air stream.
- 12. Air Differential Pressure Status Switches:
 - a. Install with static pressure tips, tubing, fittings, and air filter.
- 13. Water Differential Pressure Status Switches:
 - a. Install with shut off valves for isolation.
- H. HVAC Output Devices
 - 1. All output devices shall be installed per the manufacturers recommendation. The mechanical contractor shall install all in-line devices such as control valves, dampers, airflow stations, pressure wells, etc.
 - 2. Actuators: All control actuators shall be sized capable of closing against the maximum system shut-off pressure. The actuator shall modulate in a smooth fashion through the entire stroke. When any pneumatic actuator is sequenced with another device, pilot positioners shall be installed to allow for proper sequencing.
 - 3. Control Dampers: Shall be opposed blade for modulating control of airflow. Parallel blade dampers shall be installed for two position applications.
 - 4. Control Valves: Shall be sized for proper flow control with equal percentage valve plugs. The maximum pressure drop for water applications shall be 5 PSI. The maximum pressure drop for steam applications shall be 7 PSI.
 - 5. Electronic Signal Isolation Transducers: Whenever an analog output signal from the Building Management System is to be connected to an external control system as an input (such as a chiller control panel), or is to receive as an input a signal from a remote system, provide a signal isolation transducer. Signal isolation transducer shall provide ground plane isolation between systems. Signals shall provide optical isolation between systems
- 3.3 Training
 - A. The CCMS contractor shall provide the following training services:
 - 1. One day of on-site orientation by a system technician who is fully knowledgeable of the specific installation details of the project. This orientation shall, at a minimum, consist of a review of the project as-built drawings, the CCMS software layout and naming conventions, and a walk through of the facility to identify panel and device locations.
- 3.4 Commissioning
 - A. Fully commission all aspects of the Building Management System work.
 - B. Acceptance Check Sheet
 - 1. Prepare a check sheet that includes all points for all functions of the CCMS as indicated on the point list included in this specification.
 - 2. Submit the check sheet to the Engineer for approval
 - 3. The Engineer will use the check sheet as the basis for acceptance with the CCMS Contractor.

C. Promptly rectify all listed deficiencies and submit to the Engineer that this has been done.

END OF SECTION 230910

SECTION 232300 - REFRIGERANT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes refrigerant piping used for air-conditioning applications.

1.3 PERFORMANCE REQUIREMENTS

- A. Line Test Pressure for Refrigerant R-410A:
 - 1. Suction Lines for Heat-Pump Applications: Per Manufacturers Requirements.
 - 2. Hot-Gas and Liquid Lines: Per Manufacturers Requirements.

1.4 ACTION SUBMITTALS

- A. Shop Drawings: Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, oil traps, double risers, wall and floor penetrations, and equipment connection details. Show interface and spatial relationships between piping and equipment.
 - 1. Shop Drawing Scale: 1/4 inch equals 1 foot.
 - 2. Refrigerant piping indicated on Drawings is schematic only. Size piping and design actual piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.

1.5 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Field quality-control test reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
- B. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."
- C. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."
- D. Refer to VRF Manufactures written instructions for installation, type and application of all refrigerant piping, refrigerant system valves and devices.

1.8 PRODUCT STORAGE AND HANDLING

A. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

- A. Copper Tube: ASTM B 88, Type K or L.
- B. Wrought-Copper Fittings: ASME B16.22.
- C. Wrought-Copper Unions: ASME B16.22.
- D. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.
- E. Brazing Filler Metals: AWS A5.8.
- F. Flexible Connectors:
 - 1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
 - 2. End Connections: Socket ends.
 - 3. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inchlong assembly.
 - 4. Pressure Rating: Factory test at minimum 500 psig.
 - 5. Maximum Operating Temperature: 250 deg F.

2.2 STEEL PIPE AND FITTINGS

2.3 REFRIGERANTS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Atofina Chemicals, Inc.
 - 2. DuPont Company; Fluorochemicals Div.
 - 3. Honeywell, Inc.; Genetron Refrigerants.
 - 4. INEOS Fluor Americas LLC.
- B. ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS FOR REFRIGERANT R-410A

- A. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications]:
 - 1. All Pipe Sizes: Copper, Type K, L, drawn-temper tubing and wrought-copper fittings with 95-5 tin-antimony soldered joints.

3.2 VALVE AND SPECIALTY APPLICATIONS

- A. Refer to VRF Manufactures written instructions for installation and application of all refrigerant piping, refrigerant system valves and devices.
- B. Install service valves for gage taps at inlet and outlet of hot-gas bypass valves and strainers if they are not an integral part of valves and strainers.
- C. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.
- D. Install a full-sized, three-valve bypass around filter dryers.
- E. Install solenoid valves upstream from each expansion valve and hot-gas bypass valve. Install solenoid valves in horizontal lines with coil at top.
- F. Install thermostatic expansion valves as close as possible to distributors on evaporators.
 - 1. Install valve so diaphragm case is warmer than bulb.
 - 2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
 - 3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.

- G. Install safety relief valves where required by ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside according to ASHRAE 15.
- H. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.
- I. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for device being protected:
 - 1. Solenoid valves.
 - 2. Thermostatic expansion valves.
 - 3. Hot-gas bypass valves.
 - 4. Compressor.
- J. Install filter dryers in liquid line between compressor and thermostatic expansion valve, and in the suction line at the compressor.
- K. Install receivers sized to accommodate pump-down charge.
- L. Install flexible connectors at compressors.

3.3 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.
- B. Install refrigerant piping according to ASHRAE 15.
- C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping adjacent to machines to allow service and maintenance.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Select system components with pressure rating equal to or greater than system operating pressure.

- J. Refer to Section 230900 "Instrumentation and Control for HVAC" and Section 230993 "Sequence of Operations for HVAC Controls" for solenoid valve controllers, control wiring, and sequence of operation.
- K. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
- L. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Section 083113 "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.
- M. Install refrigerant piping in protective conduit where installed belowground.
- N. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.
- O. Slope refrigerant piping as follows:
 - 1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
 - 2. Install horizontal suction lines with a uniform slope downward to compressor.
 - 3. Install traps and double risers to entrain oil in vertical runs.
 - 4. Liquid lines may be installed level.
- P. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.
- Q. Before installation of steel refrigerant piping, clean pipe and fittings using the following procedures:
 - 1. Shot blast the interior of piping.
 - 2. Remove coarse particles of dirt and dust by drawing a clean, lintless cloth through tubing by means of a wire or electrician's tape.
 - 3. Draw a clean, lintless cloth saturated with trichloroethylene through the tube or pipe. Continue this procedure until cloth is not discolored by dirt.
 - 4. Draw a clean, lintless cloth, saturated with compressor oil, squeezed dry, through the tube or pipe to remove remaining lint. Inspect tube or pipe visually for remaining dirt and lint.
 - 5. Finally, draw a clean, dry, lintless cloth through the tube or pipe.
 - 6. Safety-relief-valve discharge piping is not required to be cleaned but is required to be open to allow unrestricted flow.
- R. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.
- S. Identify refrigerant piping and valves according to Section 230553 "Identification for HVAC Piping and Equipment."
- T. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

- U. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
- V. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

3.4 PIPE JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide), during brazing or welding, to prevent scale formation.
- D. Soldered Joints: Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
 - 1. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper pipe.
 - 2. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.
- F. Threaded Joints: Thread steel pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry-seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Steel pipe can be threaded, but threaded joints must be seal brazed or seal welded.
- H. Welded Joints: Construct joints according to AWS D10.12/D10.12M.
- I. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.5 HANGERS AND SUPPORTS

- A. Hanger, support, and anchor products are specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Install the following pipe attachments:

- 1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet long.
- 2. Roller hangers and spring hangers for individual horizontal runs 20 feet or longer.
- 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
- 4. Spring hangers to support vertical runs.
- 5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
- C. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:
 - 1. NPS 1/2: Maximum span, 60 inches; minimum rod size, 1/4 inch.
 - 2. NPS 5/8: Maximum span, 60 inches; minimum rod size, 1/4 inch.
 - 3. NPS 1: Maximum span, 72 inches; minimum rod size, 1/4 inch.
 - 4. NPS 1-1/4: Maximum span, 96 inches; minimum rod size, 3/8 inch.
 - 5. NPS 1-1/2: Maximum span, 96 inches; minimum rod size, 3/8 inch.
 - 6. NPS 2: Maximum span, 96 inches; minimum rod size, 3/8 inch.
 - 7. NPS 2-1/2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
 - 8. NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch
 - 9. NPS 4: Maximum span, 12 feet; minimum rod size, 1/2 inch.
- D. Support multifloor vertical runs at least at each floor.

3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
- B. Tests and Inspections:
 - 1. Comply with ASME B31.5, Chapter VI.
 - 2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
 - 3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in Part 1 "Performance Requirements" Article.
 - a. Fill system with nitrogen to the required test pressure.
 - b. System shall maintain test pressure at the manifold gage throughout duration of test.
 - c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
 - d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

3.7 SYSTEM CHARGING

- A. Charge system using the following procedures:
 - 1. Install core in filter dryers after leak test but before evacuation.

- 2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.
- 3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
- 4. Charge system with a new filter-dryer core in charging line.

3.8 ADJUSTING

- A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.
- B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.
- C. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.
- D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:
 - 1. Open shutoff valves in condenser water circuit.
 - 2. Verify that compressor oil level is correct.
 - 3. Open compressor suction and discharge valves.
 - 4. Open refrigerant valves except bypass valves that are used for other purposes.
 - 5. Check open compressor-motor alignment and verify lubrication for motors and bearings.
- E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION 232300

SECTION 233113 - METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Single-wall rectangular ducts and fittings.
 - 2. Single-wall round ducts and fittings.
 - 3. Double-wall round ducts and fittings.
 - 4. Sheet metal materials.
 - 5. Sealants and gaskets.
 - 6. Hangers and supports.
 - 7. Seismic-restraint devices.
- B. Related Sections:
 - 1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
 - 2. Section 233300 "Air Duct Accessories" for dampers, sound-control devices, ductmounting access doors and panels, turning vanes, and flexible ducts.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Structural Performance: Duct hangers and supports and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards Metal and Flexible", ASCE/SEI 7 and SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."
 - 1. Seismic Hazard Level A: Seismic force to weight ratio, 0.48.
 - 2. Seismic Hazard Level B: Seismic force to weight ratio, 0.30.
 - 3. Seismic Hazard Level C: Seismic force to weight ratio, 0.15.
- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of the following products:
 - 1. Liners and adhesives.
 - 2. Sealants and gaskets.
 - 3. Seismic-restraint devices.
- B. Shop Drawings:
 - 1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
 - 2. Factory- and shop-fabricated ducts and fittings.
 - 3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
 - 4. Elevation of top of ducts.
 - 5. Dimensions of main duct runs from building grid lines.
 - 6. Fittings.
 - 7. Reinforcement and spacing.
 - 8. Seam and joint construction.
 - 9. Penetrations through fire-rated and other partitions.
 - 10. Equipment installation based on equipment being used on Project.
 - 11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
 - 12. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.
- C. Delegated-Design Submittal:
 - 1. Sheet metal thicknesses.
 - 2. Joint and seam construction and sealing.
 - 3. Reinforcement details and spacing.
 - 4. Materials, fabrication, assembly, and spacing of hangers and supports.
 - 5. Design Calculations: Calculations for selecting hangers and supports and seismic restraints.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
 - 2. Suspended ceiling components.
 - 3. Structural members to which duct will be attached.
 - 4. Size and location of initial access modules for acoustical tile.
 - 5. Penetrations of smoke barriers and fire-rated construction.
 - 6. Items penetrating finished ceiling including the following:
 - a. Lighting fixtures.

- b. Air outlets and inlets.
- c. Speakers.
- d. Sprinklers.
- e. Access panels.
- f. Perimeter moldings.
- B. Welding certificates.
- C. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports. And AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code Steel," for hangers and supports.
 - 2. AWS D1.2/D1.2M, "Structural Welding Code Aluminum," for aluminum supports.
 - 3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.
- C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 "Systems and Equipment" and Section 7 "Construction and System Start-up."
- D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 "HVAC System Construction and Insulation."
- E. Mockups:
 - 1. Before installing duct systems, build mockups representing static-pressure classes in excess of 3-inch wg. Build mockups to comply with the following requirements, using materials indicated for the completed Work:
 - a. Five transverse joints.
 - b. One access door(s).
 - c. Two typical branch connections, each with at least one elbow.
 - d. Two typical flexible duct or flexible-connector connections for each duct and apparatus.
 - e. One 90-degree turn(s) with turning vanes.
 - f. One fire damper(s).
 - g. Perform leakage tests specified in "Field Quality Control" Article. Revise mockup construction and perform additional tests as required to achieve specified minimum acceptable results.
 - 2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards Metal and Flexible."
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards Metal and Flexible."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 SINGLE-WALL ROUND DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Lindab Inc.
 - b. McGill AirFlow LLC.
 - c. SEMCO Incorporated.
 - d. Sheet Metal Connectors, Inc.
 - e. Spiral Manufacturing Co., Inc.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards Metal and Flexible."
 - 1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.

- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards Metal and Flexible."
 - 1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
- D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards Metal and Flexible."

2.3 DOUBLE-WALL ROUND DUCTS AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Lindab Inc.
 - 2. McGill AirFlow LLC.
 - 3. SEMCO Incorporated.
 - 4. Sheet Metal Connectors, Inc.
- B. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on static-pressure class unless otherwise indicated.
 - 1. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards Metal and Flexible."
 - a. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.
 - 2. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards Metal and Flexible."
 - a. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
 - b. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.
 - 3. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals,"

and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

- C. Inner Duct: Minimum 0.028-inch solid sheet steel.
- D. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
 - 1. Maximum Thermal Conductivity: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
 - 2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
 - 3. Coat insulation with antimicrobial coating.
 - 4. Cover insulation with polyester film complying with UL 181, Class 1.
- E. Interstitial Insulation: Flexible elastomeric duct liner complying with ASTM C 534, Type II for sheet materials, and with NFPA 90A or NFPA 90B.
 - 1. Maximum Thermal Conductivity: 0.25 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.

2.4 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G60.
 - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.
- D. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.
- E. Aluminum Sheets: Comply with ASTM B 209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.
- F. Factory- or Shop-Applied Antimicrobial Coating:
 - 1. Apply to the surface of sheet metal that will form the interior surface of the duct. An untreated clear coating shall be applied to the exterior surface.
 - 2. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.

- 3. Coating containing the antimicrobial compound shall have a hardness of 2H, minimum, when tested according to ASTM D 3363.
- 4. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- 5. Shop-Applied Coating Color: Black.
- 6. Antimicrobial coating on sheet metal is not required for duct containing liner treated with antimicrobial coating.
- G. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
 - 1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- H. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.5 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Two-Part Tape Sealing System:
 - 1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
 - 2. Tape Width: 3 inches.
 - 3. Sealant: Modified styrene acrylic.
 - 4. Water resistant.
 - 5. Mold and mildew resistant.
 - 6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
 - 7. Service: Indoor and outdoor.
 - 8. Service Temperature: Minus 40 to plus 200 deg F.
 - 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
 - 10. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 11. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Water-Based Joint and Seam Sealant:
 - 1. Application Method: Brush on.
 - 2. Solids Content: Minimum 65 percent.
 - 3. Shore A Hardness: Minimum 20.
 - 4. Water resistant.
 - 5. Mold and mildew resistant.

- 6. VOC: Maximum 75 g/L (less water).
- 7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
- 8. Service: Indoor or outdoor.
- 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- D. Solvent-Based Joint and Seam Sealant:
 - 1. Application Method: Brush on.
 - 2. Base: Synthetic rubber resin.
 - 3. Solvent: Toluene and heptane.
 - 4. Solids Content: Minimum 60 percent.
 - 5. Shore A Hardness: Minimum 60.
 - 6. Water resistant.
 - 7. Mold and mildew resistant.
 - 8. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 9. VOC: Maximum 395 g/L.
 - 10. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
 - 11. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
 - 12. Service: Indoor or outdoor.
 - 13. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- E. Flanged Joint Sealant: Comply with ASTM C 920.
 - 1. General: Single-component, acid-curing, silicone, elastomeric.
 - 2. Type: S.
 - 3. Grade: NS.
 - 4. Class: 25.
 - 5. Use: O.
 - 6. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 7. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- F. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
- G. Round Duct Joint O-Ring Seals:
 - 1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for10-inch wg static-pressure class, positive or negative.
 - 2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
 - 3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.6 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
- D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
- F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- H. Trapeze and Riser Supports:
 - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
 - 2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
 - 3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

2.7 SEISMIC-RESTRAINT DEVICES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Cooper B-Line, Inc.; a division of Cooper Industries.
 - 2. Ductmate Industries, Inc.
 - 3. Hilti Corp.
 - 4. Kinetics Noise Control.
 - 5. Loos & Co.; Cableware Division.
 - 6. Mason Industries.
 - 7. TOLCO; a brand of NIBCO INC.
 - 8. Unistrut Corporation; Tyco International, Ltd.
- B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.
 - 1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

- C. Channel Support System: Shop- or field-fabricated support assembly made of slotted steel channels rated in tension, compression, and torsion forces and with accessories for attachment to braced component at one end and to building structure at the other end. Include matching components and corrosion-resistant coating.
- D. Restraint Cables: ASTM A 492, stainless-steel cables with end connections made of cadmiumplated steel assemblies with brackets, swivel, and bolts designed for restraining cable service; and with an automatic-locking and clamping device or double-cable clips.
- E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.
- F. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards Metal and Flexible" unless otherwise indicated.
- C. Install round and flat-oval ducts in maximum practical lengths.
- D. Install ducts with fewest possible joints.
- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal

flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

- K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers.
- *L.* Protect duct interiors from moisture, construction debris and dust, and other foreign materials.

3.2 INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards Metal and Flexible."
- B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards Metal and Flexible":
 - 1. Comply with SMACNA's "HVAC Duct Construction Standards Metal and Flexible."
 - 2. Outdoor, Supply-Air Ducts: Seal Class A.
 - 3. Outdoor, Exhaust Ducts: Seal Class C.
 - 4. Outdoor, Return-Air Ducts: Seal Class C.
 - 5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.
 - 6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.
 - 7. Unconditioned Space, Exhaust Ducts: Seal Class C.
 - 8. Unconditioned Space, Return-Air Ducts: Seal Class B.
 - 9. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class C.
 - 10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class B.

- 11. Conditioned Space, Exhaust Ducts: Seal Class B.
- 12. Conditioned Space, Return-Air Ducts: Seal Class C.

3.4 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Where practical, install concrete inserts before placing concrete.
 - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
 - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
 - 5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.5 SEISMIC-RESTRAINT-DEVICE INSTALLATION

- A. Install ducts with hangers and braces designed to support the duct and to restrain against seismic forces required by applicable building codes. Comply with SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."
 - 1. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
 - 2. Brace a change of direction longer than 12 feet.
- B. Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.
- C. Install cables so they do not bend across edges of adjacent equipment or building structure.
- D. Install cable restraints on ducts that are suspended with vibration isolators.

- E. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction.
- F. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, to upper truss chords of bar joists, or to concrete members.
- G. Drilling for and Setting Anchors:
 - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify the Architect if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
 - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 - 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
 - 4. Set anchors to manufacturer's recommended torque, using a torque wrench.
 - 5. Install zinc-coated steel anchors for interior applications and stainless-steel anchors for applications exposed to weather.

3.6 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.7 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

3.8 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Leakage Tests:
 - 1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
 - 2. Test the following systems:

- a. Supply Ducts with a Pressure Class of 2-Inch wg or Higher: Test representative duct sections, selected by Architect from sections installed, totaling no less than 50 percent of total installed duct area for each designated pressure class.
- b. Return Ducts with a Pressure Class of 2-Inch wg or Higher: Test representative duct sections, selected by Architect from sections installed, totaling no less than 50 percent of total installed duct area for each designated pressure class.
- c. Exhaust Ducts with a Pressure Class of 2-Inch wg or Higher: Test representative duct sections, selected by Architect from sections installed, totaling no less than 50 percent of total installed duct area for each designated pressure class.
- d. Outdoor Air Ducts with a Pressure Class of 2-Inch wg or Higher: Test representative duct sections, selected by Architect from sections installed, totaling no less than 50 percent of total installed duct area for each designated pressure class.
- 3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
- 4. Test for leaks before applying external insulation.
- 5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
- 6. Give seven days' advance notice for testing.
- C. Duct System Cleanliness Tests:
 - 1. Visually inspect duct system to ensure that no visible contaminants are present.
 - 2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
 - a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.
- D. Duct system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.9 DUCT CLEANING

- A. Clean new duct system(s) before testing, adjusting, and balancing.
- B. Use service openings for entry and inspection.
 - 1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Section 233300 "Air Duct Accessories" for access panels and doors.
 - 2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
 - 3. Remove and reinstall ceiling to gain access during the cleaning process.
- C. Particulate Collection and Odor Control:

- 1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
- 2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.
- D. Clean the following components by removing surface contaminants and deposits:
 - 1. Air outlets and inlets (registers, grilles, and diffusers).
 - 2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
 - 3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
 - 4. Coils and related components.
 - 5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
 - 6. Supply-air ducts, dampers, actuators, and turning vanes.
 - 7. Dedicated exhaust and ventilation components and makeup air systems.
- E. Mechanical Cleaning Methodology:
 - 1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
 - 2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
 - 3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
 - 4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
 - 5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
 - 6. Provide drainage and cleanup for wash-down procedures.
 - 7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

3.10 START UP

A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.11 DUCT SCHEDULE

A. Supply Ducts:

METAL DUCTS

- 1. Ducts Connected to Fan Coil Units and Heat Pumps:
 - a. Pressure Class: Positive 2-inch wg.
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: 12.
 - d. SMACNA Leakage Class for Round and Flat Oval: 12.
- 2. Ducts Connected to Constant-Volume Air-Handling Units:
 - a. Pressure Class: Positive 3-inch wg.
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: 6.
 - d. SMACNA Leakage Class for Round and Flat Oval: 6.
- 3. Ducts Connected to Equipment Not Listed Above:
 - a. Pressure Class: Positive 4-inch wg.
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: 3.
 - d. SMACNA Leakage Class for Round and Flat Oval: 3.
- B. Return Ducts:
 - 1. Ducts Connected to Fan Coil Units and Heat Pumps,:
 - a. Pressure Class: Positive or negative 2-inch wg.
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: 12.
 - d. SMACNA Leakage Class for Round and Flat Oval: 12.
 - 2. Ducts Connected to Air-Handling Units:
 - a. Pressure Class: Positive or negative 3-inch wg.
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: 6.
 - d. SMACNA Leakage Class for Round and Flat Oval: 6.
 - 3. Ducts Connected to Equipment Not Listed Above:
 - a. Pressure Class: Positive or negative 4-inch wg.
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: 3.
 - d. SMACNA Leakage Class for Round and Flat Oval: 3.
- C. Exhaust Ducts:
 - 1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
 - a. Pressure Class: Negative 3-inch wg.
 - b. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.

- c. SMACNA Leakage Class for Rectangular: 12.
- d. SMACNA Leakage Class for Round and Flat Oval: 6.
- 2. Ducts Connected to Air-Handling Units:
 - a. Pressure Class: Positive or negative 3-inch wg.
 - b. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.
 - c. SMACNA Leakage Class for Rectangular: 6.
 - d. SMACNA Leakage Class for Round and Flat Oval: 3.
- 3. Ducts Connected to Equipment Not Listed Above:
 - a. Pressure Class: Positive or negative 4-inch wg.
 - b. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.
 - c. SMACNA Leakage Class for Rectangular: 6.
 - d. SMACNA Leakage Class for Round and Flat Oval: 3.
- D. Intermediate Reinforcement:
 - 1. Galvanized-Steel Ducts: Galvanized steel.
- E. Double-Wall Duct Interstitial Insulation:
 - 1. Supply Air Ducts: 2 inches thick.
 - 2. Return Air Ducts: 1-1/2 inches thick.
- F. Elbow Configuration:
 - 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Figure 4-2, "Rectangular Elbows."
 - a. Velocity 1000 fpm or Lower:
 - 1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
 - 2) Mitered Type RE 4 without vanes.
 - b. Velocity 1000 to 1500 fpm:
 - 1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
 - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
 - c. Velocity 1500 fpm or Higher:
 - 1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.

- 2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
- 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
- 2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Figure 4-2, "Rectangular Elbows."
 - a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
- 3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Figure 3-4, "Round Duct Elbows."
 - Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
 - 1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
 - 2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
 - 3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
 - 4) Radius-to Diameter Ratio: 1.5.
 - b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
 - c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam.
- G. Branch Configuration:
 - 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Figure 4-6, "Branch Connection."
 - a. Rectangular Main to Rectangular Branch: 45-degree entry.
 - b. Rectangular Main to Round Branch: Spin in.
 - 2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards -Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
 - a. Velocity 1000 fpm or Lower: 90-degree tap.
 - b. Velocity 1000 to 1500 fpm: Conical tap.
 - c. Velocity 1500 fpm or Higher: 45-degree lateral.

University of South Carolina Softball Stadium Construction BID SET END OF SECTION 233113 Architect's Project No. 11.122.00 State Project No. H27-6088-MJ 03/16/12

SECTION 233300 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Backdraft and pressure relief dampers.
 - 2. Barometric relief dampers.
 - 3. Manual volume dampers.
 - 4. Control dampers.
 - 5. Fire dampers.
 - 6. Smoke dampers.
 - 7. Intake and relief louvers.
 - 8. Flange connectors.
 - 9. Duct silencers.
 - 10. Turning vanes.
 - 11. Duct-mounted access doors.
 - 12. Flexible connectors.
 - 13. Flexible ducts.
 - 14. Duct security bars.
 - 15. Duct accessory hardware.
- B. Related Sections:
 - 1. Division 28 Section "Fire Detection and Alarm" for duct-mounted fire and smoke detectors.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. For duct silencers, include pressure drop and dynamic insertion loss data. Include breakout noise calculations for high transmission loss casings.
- B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.
 - 1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:

- a. Special fittings.
- b. Manual volume damper installations.
- c. Control damper installations.
- d. Fire-damper, smoke-damper, combination fire- and smoke-damper, ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
- e. Duct security bars.
- f. Wiring Diagrams: For power, signal, and control wiring.
- C. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.
- D. Source quality-control reports.
- E. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with AMCA 500-D testing for damper rating.

1.5 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Comply with SMACNA's "HVAC Duct Construction Standards Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G90.
 - 2. Exposed-Surface Finish: Mill phosphatized.
- C. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish for concealed ducts and No. 2 finish for exposed ducts.

- D. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- E. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.
- F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- G. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.2 BACKDRAFT AND PRESSURE RELIEF DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Air Balance Inc.; a division of Mestek, Inc.
 - 2. American Warming and Ventilating; a division of Mestek, Inc.
 - 3. Cesco Products; a division of Mestek, Inc.
 - 4. Duro Dyne Inc.
 - 5. Greenheck Fan Corporation.
 - 6. Lloyd Industries, Inc.
 - 7. Nailor Industries Inc.
 - 8. NCA Manufacturing, Inc.
 - 9. Pottorff; a division of PCI Industries, Inc.
 - 10. Ruskin Company.
 - 11. SEMCO Incorporated.
 - 12. Vent Products Company, Inc.
- B. Description: Gravity balanced.
- C. Maximum Air Velocity: 2000 fpm.
- D. Maximum System Pressure: 2-inch wg.
- E. Frame: 0.052-inch-thick, galvanized sheet steel, with welded corners and mounting flange.
- F. Blades: Multiple single-piece blades, center-pivoted, maximum 6-inch width, 0.050-inch-thick aluminum sheet with sealed edges.
- G. Blade Action: Parallel.
- H. Blade Seals: Neoprene, mechanically locked.
- I. Blade Axles:
 - 1. Material: Stainless steel.
 - 2. Diameter: 0.20 inch.
- J. Tie Bars and Brackets: Galvanized steel.

- K. Return Spring: Adjustable tension.
- L. Bearings: Steel ball or synthetic pivot bushings.
- M. Accessories:
 - 1. Adjustment device to permit setting for varying differential static pressure.
 - 2. Counterweights and spring-assist kits for vertical airflow installations.
 - 3. Electric actuators.
 - 4. Chain pulls.
 - 5. Front of rear screens.
 - 6. 90-degree stops.
- N. Sleeve: Minimum 20-gage thickness.

2.3 BAROMETRIC RELIEF DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Air Balance Inc.; a division of Mestek, Inc.
 - 2. American Warming and Ventilating; a division of Mestek, Inc.
 - 3. Cesco Products; a division of Mestek, Inc.
 - 4. Duro Dyne Inc.
 - 5. Greenheck Fan Corporation.
 - 6. Lloyd Industries, Inc.
 - 7. Nailor Industries Inc.
 - 8. NCA Manufacturing, Inc.
 - 9. Pottorff; a division of PCI Industries, Inc.
 - 10. Ruskin Company.
 - 11. SEMCO Incorporated.
 - 12. Vent Products Company, Inc.
- B. Suitable for horizontal or vertical mounting.
- C. Maximum Air Velocity: 2000 fpm.
- D. Maximum System Pressure: 2-inch wg.
- E. Frame: 0.063-inch-thick extruded aluminum, with welded corners and mounting flange.
- F. Blades:
 - 1. Multiple, 0.050-inch-thick aluminum sheet.
 - 2. Maximum Width: 6 inches.
 - 3. Action: Parallel.
 - 4. Balance: Gravity.
 - 5. Eccentrically pivoted.
- G. Blade Seals: Neoprene.

- H. Blade Axles: Nonferrous metal.
- I. Tie Bars and Brackets:
 - 1. Material: Aluminum.
 - 2. Rattle free with 90-degree stop.
- J. Return Spring: Adjustable tension.
- K. Bearings: Stainless steel.
- L. Accessories:
 - 1. Flange on intake.
 - 2. Adjustment device to permit setting for varying differential static pressures.

2.4 MANUAL VOLUME DAMPERS

- A. Standard, Steel, Manual Volume Dampers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Air Balance Inc.; a division of Mestek, Inc.
 - b. American Warming and Ventilating; a division of Mestek, Inc.
 - c. Flexmaster U.S.A., Inc.
 - d. McGill AirFlow LLC.
 - e. METALAIRE, Inc.
 - f. Nailor Industries Inc.
 - g. Pottorff; a division of PCI Industries, Inc.
 - h. Ruskin Company.
 - i. Trox USA Inc.
 - j. Vent Products Company, Inc.
 - 2. Standard leakage rating[, with linkage outside airstream].
 - 3. Suitable for horizontal or vertical applications.
 - 4. Frames:
 - a. Hat-shaped, stainless-steel channels, 0.064-inch minimum thickness.
 - b. Mitered and welded corners.
 - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
 - 5. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Stainless, 0.064 inch thick.
 - 6. Blade Axles: Stainless steel.
 - 7. Bearings:

- a. Stainless-steel sleeve.
- b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
- 8. Tie Bars and Brackets: Galvanized steel.
- B. Standard, Aluminum, Manual Volume Dampers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Air Balance Inc.; a division of Mestek, Inc.
 - b. American Warming and Ventilating; a division of Mestek, Inc.
 - c. Flexmaster U.S.A., Inc.
 - d. McGill AirFlow LLC.
 - e. METALAIRE, Inc.
 - f. Nailor Industries Inc.
 - g. Pottorff; a division of PCI Industries, Inc.
 - h. Ruskin Company.
 - i. Trox USA Inc.
 - j. Vent Products Company, Inc.
 - 2. Standard leakage rating.
 - 3. Suitable for horizontal or vertical applications.
 - 4. Frames: Hat-shaped, 0.10-inch-thick, aluminum sheet channels; frames with flanges for attaching to walls and flangeless frames for installing in ducts.
 - 5. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Roll-Formed Aluminum Blades: 0.10-inch-thick aluminum sheet.
 - e. Extruded-Aluminum Blades: 0.050-inch-thick extruded aluminum.
 - 6. Blade Axles: Stainless steel.
 - 7. Bearings:
 - a. Stainless-steel sleeve.
 - b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
 - 8. Tie Bars and Brackets: Aluminum.
- C. Low-Leakage, Steel, Manual Volume Dampers:
 - 1. Manufacturers: Subject to compliance with requirements, [provide products by one of the following:
 - a. Air Balance Inc.; a division of Mestek, Inc.
 - b. American Warming and Ventilating; a division of Mestek, Inc.
- c. Flexmaster U.S.A., Inc.
- d. McGill AirFlow LLC.
- e. METALAIRE, Inc.
- f. Nailor Industries Inc.
- g. Pottorff; a division of PCI Industries, Inc.
- h. Ruskin Company.
- i. Trox USA Inc.
- j. Vent Products Company, Inc.
- 2. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
- 3. Suitable for horizontal or vertical applications.
- 4. Frames:
 - a. Angle shaped.
 - b. Stainless-steel channels, 0.064 inch thick.
 - c. Mitered and welded corners.
 - d. Flanges for attaching to walls and flangeless frames for installing in ducts.
- 5. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Stainless, roll-formed steel, 0.064 inch thick.
- 6. Blade Axles: Stainless steel.
- 7. Bearings:
 - a. Stainless-steel sleeve.
 - b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
- 8. Blade Seals: Neoprene.
- 9. Jamb Seals: Cambered stainless steel.
- 10. Tie Bars and Brackets: Aluminum.
- 11. Accessories:
 - a. Include locking device to hold single-blade dampers in a fixed position without vibration.
- D. Low-Leakage, Aluminum, Manual Volume Dampers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Air Balance Inc.; a division of Mestek, Inc.
 - b. American Warming and Ventilating; a division of Mestek, Inc.
 - c. Flexmaster U.S.A., Inc.
 - d. McGill AirFlow LLC.
 - e. METALAIRE, Inc.

- f. Nailor Industries Inc.
- g. Pottorff; a division of PCI Industries, Inc.
- h. Ruskin Company.
- i. Trox USA Inc.
- j. Vent Products Company, Inc.
- 2. Low-leakage rating and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
- 3. Suitable for horizontal or vertical applications.
- 4. Frames: Hat-shaped, 0.10-inch-thick, aluminum sheet channels; frames with flanges for attaching to walls and flangeless frames for installing in ducts.
- 5. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Roll-Formed Aluminum Blades: 0.10-inch-thick aluminum sheet.
 - d. Extruded-Aluminum Blades: 0.050-inch-thick extruded aluminum.
- 6. Blade Axles: Stainless steel.
- 7. Bearings:
 - a. Stainless-steel sleeve.
 - b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
- 8. Blade Seals: Neoprene.
- 9. Jamb Seals: Cambered stainless steel.
- 10. Tie Bars and Brackets: Galvanized steel.
- 11. Accessories:
 - a. Include locking device to hold single-blade dampers in a fixed position without vibration.
- E. Jackshaft:
 - 1. Size: 1-inch diameter.
 - 2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
 - 3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.
- F. Damper Hardware:
 - 1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch-thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
 - 2. Include center hole to suit damper operating-rod size.
 - 3. Include elevated platform for insulated duct mounting.

2.5 CONTROL DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. American Warming and Ventilating; a division of Mestek, Inc.
 - 2. Arrow United Industries; a division of Mestek, Inc.
 - 3. Cesco Products; a division of Mestek, Inc.
 - 4. Duro Dyne Inc.
 - 5. Flexmaster U.S.A., Inc.
 - 6. Greenheck Fan Corporation.
 - 7. Lloyd Industries, Inc.
 - 8. M&I Air Systems Engineering; Division of M&I Heat Transfer Products Ltd.
 - 9. McGill AirFlow LLC.
 - 10. METALAIRE, Inc.
 - 11. Metal Form Manufacturing, Inc.
 - 12. Nailor Industries Inc.
 - 13. NCA Manufacturing, Inc.
 - 14. Ruskin Company.
 - 15. Vent Products Company, Inc.
 - 16. Young Regulator Company.
- B. Low-leakage rating and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
- C. Frames:
 - 1. Hat shaped.
 - 2. Stainless-steel channels, 0.064 inch thick.
 - 3. Mitered and welded corners.
- D. Blades:
 - 1. Multiple blade with maximum blade width of 8 inches.
 - 2. Opposed-blade design.
 - 3. Stainless steel.
 - 4. 0.064 inch thick.
 - 5. Blade Edging: Closed-cell neoprene edging.
 - 6. Blade Edging: Inflatable seal blade edging, or replaceable rubber seals.
- E. Blade Axles: 1/2-inch-diameter; stainless steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.
 - 1. Operating Temperature Range: From minus 40 to plus 200 deg F.
- F. Bearings:
 - 1. Stainless-steel sleeve.
 - 2. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of

- damper blades and bearings at both ends of operating shaft.
- 3. Thrust bearings at each end of every blade.

2.6 FIRE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Air Balance Inc.; a division of Mestek, Inc.
 - 2. Arrow United Industries; a division of Mestek, Inc.
 - 3. Cesco Products; a division of Mestek, Inc.
 - 4. Greenheck Fan Corporation.
 - 5. McGill AirFlow LLC.
 - 6. METALAIRE, Inc.
 - 7. Nailor Industries Inc.
 - 8. NCA Manufacturing, Inc.
 - 9. PHL, Inc.
 - 10. Pottorff; a division of PCI Industries, Inc.
 - 11. Prefco; Perfect Air Control, Inc.
 - 12. Ruskin Company.
 - 13. Vent Products Company, Inc.
 - 14. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Type: Static and dynamic; rated and labeled according to UL 555 by an NRTL.
- C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 4000-fpm velocity.
- D. Fire Rating: 1-1/2 hours. 3 hour damper shall be installed where required by the wall or floor rating.
- E. Frame: Curtain type with blades outside airstream; fabricated with roll-formed, 0.034-inch-thick galvanized steel; with mitered and interlocking corners.
- F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.
 - 1. Minimum Thickness: 0.052 or 0.138 inch thick, as indicated, and of length to suit application.
 - 2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.
- G. Mounting Orientation: Vertical or horizontal as indicated.
- H. Blades: Roll-formed, interlocking, 0.034-inch-thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch-thick, galvanized-steel blade connectors.
- I. Horizontal Dampers: Include blade lock and stainless-steel closure spring.
- J. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.

2.7 SMOKE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Air Balance Inc.; a division of Mestek, Inc.
 - 2. Cesco Products; a division of Mestek, Inc.
 - 3. Greenheck Fan Corporation.
 - 4. Nailor Industries Inc.
 - 5. PHL, Inc.
 - 6. Ruskin Company.
- B. General Requirements: Label according to UL 555S by an NRTL.
- C. Smoke Detector: Integral, factory wired for single-point connection.
- D. Frame: Curtain type with blades outside airstream; fabricated with roll-formed, 0.034-inch-thick galvanized steel; with mitered and interlocking corners.
- E. Blades: Roll-formed, horizontal, interlocking, 0.034-inch-thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch-thick, galvanized-steel blade connectors.
- F. Leakage: Class I.
- G. Rated pressure and velocity to exceed design airflow conditions.
- H. Mounting Sleeve: Factory-installed, 0.052-inch-thick, galvanized sheet steel; length to suit wall or floor application with factory-furnished silicone calking.
- I. Damper Motors: Two-position action.
- J. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
 - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
 - 2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections.
 - 3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
 - 4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf and breakaway torque rating of 150 in. x lbf .
 - 5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.
 - 6. Nonspring-Return Motors: For dampers larger than 25 sq. ft., size motor for running torque rating of 150 in. x lbf and breakaway torque rating of 300 in. x lbf.
 - 7. Electrical Connection: 115 V, single phase, 60 Hz.

- K. Accessories:
 - 1. Auxiliary switches for signaling, fan control or position indication.
 - 2. Momentary test switch, Test and reset switches, remote mounted.

2.8 DUCT SILENCERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Industrial Noise Control, Inc.
 - 2. McGill AirFlow LLC.
 - 3. Ruskin Company.
 - 4. Vibro-Acoustics.

B. General Requirements:

- 1. Factory fabricated.
- 2. Fire-Performance Characteristics: Adhesives, sealants, packing materials, and accessory materials shall have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested according to ASTM E 84.
- C. Shape:
 - 1. Rectangular straight with splitters or baffles.
 - 2. Round straight with center bodies or pods.
 - 3. Rectangular elbow with splitters or baffles.
 - 4. Round elbow with center bodies or pods.
 - 5. Rectangular transitional with splitters or baffles.
- D. Rectangular Silencer Outer Casing: ASTM A 653/A 653M, G90, galvanized sheet steel, 0.040 inch thick.
- E. Round Silencer Outer Casing: ASTM A 653/A 653M, G90, galvanized sheet steel.
 - 1. Sheet Metal Thickness for Units up to 24 Inches in Diameter: 0.034 inch thick.
 - 2. Sheet Metal Thickness for Units 26 through 40 Inches in Diameter: 0.040 inch thick.
 - 3. Sheet Metal Thickness for Units 42 through 52 Inches in Diameter: 0.052 inch thick.
 - 4. Sheet Metal Thickness for Units 54 through 60 Inches in Diameter: 0.064 inch thick.
- F. Inner Casing and Baffles: ASTM A 653/A 653M, G90 galvanized sheet metal, 0.034 inch thick, and with 1/8-inch-diameter perforations.
- G. Special Construction:
 - 1. Suitable for outdoor use.
 - 2. High transmission loss to achieve STC 45.
- H. Connection Sizes: Match connecting ductwork unless otherwise indicated.
- I. Principal Sound-Absorbing Mechanism:

- 1. Controlled impedance membranes and broadly tuned resonators without absorptive media.
- 2. Film-lined type with fill material.
 - a. Fill Material: Inert and vermin-proof fibrous material, packed under not less than 5 percent compression.
 - b. Erosion Barrier: Polymer bag enclosing fill, and heat sealed before assembly.
- 3. Lining: Tedlar.
- J. Fabricate silencers to form rigid units that will not pulsate, vibrate, rattle, or otherwise react to system pressure variations. Do not use mechanical fasteners for unit assemblies.
 - 1. Flange connections.
 - 2. Suspended Units: Factory-installed suspension hooks or lugs attached to frame in quantities and spaced to prevent deflection or distortion.
 - 3. Reinforcement: Cross or trapeze angles for rigid suspension.
- K. Accessories:
 - 1. Integral 1-1/2-hour fire damper with access door. Access door to be high transmission loss to match silencer.
 - 2. Factory-installed end caps to prevent contamination during shipping.
 - 3. Removable splitters.
 - 4. Airflow measuring devices.
- L. Source Quality Control: Test according to ASTM E 477.
 - 1. Record acoustic ratings, including dynamic insertion loss and generated-noise power levels with an airflow of at least 2000-fpm face velocity.
 - 2. Leak Test: Test units for airtightness at 200 percent of associated fan static pressure or 6inch wg static pressure, whichever is greater.
- M. Capacities and Characteristics:
 - 1. Configuration: Straight.
 - 2. Shape: Rectangular.
 - 3. Attenuation Mechanism: Acoustical glass fiber with protective film liner.
 - 4. Maximum Pressure Drop: 0.25-inch wg.
 - 5. Casing:
 - a. Attenuation: High transmission loss.
 - b. Outer Material: Galvanized steel.
 - c. Inner Material: Galvanized steel.
 - 6. End Connection: Flange.
 - 7. Accessories:
 - a. Access door.
 - b. Birdscreen.

2.9 TURNING VANES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ductmate Industries, Inc.
 - 2. Duro Dyne Inc.
 - 3. METALAIRE, Inc.
 - 4. SEMCO Incorporated.
 - 5. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
 - 1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.
- C. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
- D. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards Metal and Flexible"; Figures 2-3, "Vanes and Vane Runners," and 2-4, "Vane Support in Elbows."
- E. Vane Construction: Double wall.

2.10 DUCT-MOUNTED ACCESS DOORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. American Warming and Ventilating; a division of Mestek, Inc.
 - 2. Cesco Products; a division of Mestek, Inc.
 - 3. Ductmate Industries, Inc.
 - 4. Flexmaster U.S.A., Inc.
 - 5. Greenheck Fan Corporation.
 - 6. McGill AirFlow LLC.
 - 7. Nailor Industries Inc.
 - 8. Pottorff; a division of PCI Industries, Inc.
 - 9. Ventfabrics, Inc.
 - 10. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-10, "Duct Access Doors and Panels," and 2-11, "Access Panels - Round Duct."
 - 1. Door:
 - a. Double wall, rectangular.

- b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
- c. Vision panel.
- d. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
- e. Fabricate doors airtight and suitable for duct pressure class.
- 2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
- 3. Number of Hinges and Locks:
 - a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
 - b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
 - c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches with outside and inside handles.
 - d. Access Doors Larger Than 24 by 48 Inches: Four hinges and two compression latches with outside and inside handles.

2.11 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ductmate Industries, Inc.
 - 2. Duro Dyne Inc.
 - 3. Ventfabrics, Inc.
 - 4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Materials: Flame-retardant or noncombustible fabrics.
- C. Coatings and Adhesives: Comply with UL 181, Class 1.
- D. Metal-Edged Connectors: Factory fabricated with a fabric strip 5-3/4 inches wide attached to 2 strips of 2-3/4-inch-wide, 0.028-inch-thick, galvanized sheet steel or 0.032-inch-thick aluminum sheets. Provide metal compatible with connected ducts.
- E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
 - 1. Minimum Weight: 26 oz./sq. yd.
 - 2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
 - 3. Service Temperature: Minus 40 to plus 200 deg F.
- F. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
 - 1. Minimum Weight: 24 oz./sq. yd.
 - 2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
 - 3. Service Temperature: Minus 50 to plus 250 deg F.
- G. High-Temperature System, Flexible Connectors: Glass fabric coated with silicone rubber.
 - 1. Minimum Weight: 16 oz./sq. yd.

- 2. Tensile Strength: 285 lbf/inch in the warp and 185 lbf/inch in the filling.
- 3. Service Temperature: Minus 67 to plus 500 deg F.
- H. High-Corrosive-Environment System, Flexible Connectors: Glass fabric with chemical-resistant coating.
 - 1. Minimum Weight: 14 oz./sq. yd..
 - 2. Tensile Strength: 450 lbf/inch in the warp and 340 lbf/inch in the filling.
 - 3. Service Temperature: Minus 67 to plus 500 deg F.
- I. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.
 - 1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
 - 2. Outdoor Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 - 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 - 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
 - 7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

2.12 FLEXIBLE DUCTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Flexmaster U.S.A., Inc.
 - 2. McGill AirFlow LLC.
 - 3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Insulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, springsteel wire; fibrous-glass insulation; polyethylene vapor-barrier film.
 - 1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
 - 2. Maximum Air Velocity: 4000 fpm.
 - 3. Temperature Range: Minus 10 to plus 160 deg F.
- C. Flexible Duct Connectors:
 - 1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a wormgear action in sizes 3 through 18 inches, to suit duct size.
 - 2. Non-Clamp Connectors: Adhesive plus sheet metal screws.

2.13 DUCT ACCESSORY HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
 - 1. Coordinate subparagraphs below with Division 23 Section "Metal Ducts."Install steel volume dampers in steel ducts.
 - 2. Install aluminum volume dampers in aluminum ducts.
- E. Set dampers to fully open position before testing, adjusting, and balancing.
- F. Install test holes at fan inlets and outlets and elsewhere as indicated.
- G. Install fire and smoke dampers according to UL listing.
- H. Install duct security bars. Construct duct security bars from 0.164-inch steel sleeve, continuously welded at all joints and 1/2-inch-diameter steel bars, 6 inches o.c. in each direction in center of sleeve. Weld each bar to steel sleeve and each crossing bar. Weld 2-1/2-by-2-1/2-by-1/4-inch steel angle to 4 sides and both ends of sleeve. Connect duct security bars to ducts with flexible connections. Provide 12-by-12-inch hinged access panel with cam lock in duct in each side of sleeve.
- I. Connect ducts to duct silencers rigidly.
- J. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:

- 1. On both sides of duct coils.
- 2. Downstream from manual volume dampers, control dampers and equipment.
- 3. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
- 4. At each change in direction and at maximum 50-foot spacing.
- 5. Upstream of turning vanes.
- 6. Elsewhere as indicated.
- K. Install access doors with swing against duct static pressure.
- L. Access Door Sizes:
 - 1. One-Hand or Inspection Access: 8 by 5 inches.
 - 2. Two-Hand Access: 12 by 6 inches.
 - 3. Head and Hand Access: 18 by 10 inches.
 - 4. Head and Shoulders Access: 21 by 14 inches.
 - 5. Body Access: 25 by 14 inches.
 - 6. Body plus Ladder Access: 25 by 17 inches.
- M. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- N. Install flexible connectors to connect ducts to equipment.
- O. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
- P. Connect terminal units to supply ducts with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.
- Q. Connect diffusers or light troffer boots to low-pressure ducts with maximum 60-inch lengths of flexible duct clamped or strapped in place.
- R. Connect flexible ducts to metal ducts with draw bands.
- S. Install duct test holes where required for testing and balancing purposes.
- T. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.

3.2 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Operate dampers to verify full range of movement.
 - 2. Inspect locations of access doors and verify that purpose of access door can be performed.
 - 3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of

movement and verify that proper heat-response device is installed.

- 4. Inspect turning vanes for proper and secure installation.
- 5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION 233300

SECTION 233423 - HVAC POWER VENTILATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. In-line centrifugal fans.
 - 2. Propeller fans.

1.3 PERFORMANCE REQUIREMENTS

- A. Project Altitude: Base fan-performance ratings on sea level.
- B. Operating Limits: Classify according to AMCA 99.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Also include the following:
 - 1. Certified fan performance curves with system operating conditions indicated.
 - 2. Certified fan sound-power ratings.
 - 3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
 - 4. Material thickness and finishes, including color charts.
 - 5. Dampers, including housings, linkages, and operators.
 - 6. Fan speed controllers.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Wiring Diagrams: For power, signal, and control wiring.
- C. Delegated-Design Submittal: For unit hangars and supports indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

- 1. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
- 2. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
 - 1. Roof framing and support members relative to duct penetrations.
 - 2. Ceiling suspension assembly members.
 - 3. Size and location of initial access modules for acoustical tile.
 - 4. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
- B. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For power ventilators to include in emergency, operation, and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Belts: One set(s) for each belt-driven unit.

1.8 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. AMCA Compliance: Fans shall have AMCA-Certified performance ratings and shall bear the AMCA-Certified Ratings Seal.
- C. UL Standards: Power ventilators shall comply with UL 705. Power ventilators for use for restaurant kitchen exhaust shall also comply with UL 762.

1.9 COORDINATION

A. Coordinate size and location of structural-steel support members.

- B. Coordinate sizes and locations of concrete bases with actual equipment provided.
- C. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

PART 2 - PRODUCTS

2.1 IN-LINE CENTRIFUGAL FANS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Acme Engineering & Manufacturing Corporation.
 - 2. American Coolair Corporation.
 - 3. Ammerman; Millennium Equipment.
 - 4. Breidert Air Products.
 - 5. Carnes Company.
 - 6. FloAire.
 - 7. Greenheck Fan Corporation.
 - 8. Hartzell Fan Incorporated.
 - 9. JencoFan.
 - 10. Loren Cook Company.
 - 11. Madison Manufacturing.
 - 12. PennBarry.
 - 13. Quietaire Inc.
- B. Housing: galvanized steel with inlet and outlet flanges, and support bracket adaptable to floor, side wall, or ceiling mounting.
- C. Direct-Drive Units: Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing[; with wheel, inlet cone, and motor on swing-out service door].
- D. Fan Wheels: Aluminum, airfoil blades welded to aluminum hub.
- E. Accessories:
 - 1. Companion Flanges: For inlet and outlet duct connections.
 - 2. Fan Guards: 1/2- by 1-inch mesh of galvanized steel in removable frame. Provide guard for inlet or outlet for units not connected to ductwork.
 - 3. Motor and Drive Cover (Belt Guard): Epoxy-coated steel.

2.2 PROPELLER FANS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Acme Engineering & Manufacturing Corporation.
 - 2. Aerovent; a division of Twin City Fan Companies, Ltd.

University of South Carolina Softball Stadium Construction BID SET

- 3. Airmaster Fan Company.
- 4. American Coolair Corporation.
- 5. Ammerman; Millennium Equipment.
- 6. Breidert Air Products.
- 7. Broan-NuTone LLC; NuTone Inc.
- 8. Carnes Company.
- 9. Chicago Blower Corporation.
- 10. Cincinnati Fan.
- 11. Hartzell Fan Incorporated.
- 12. Howden Buffalo Inc.
- 13. JencoFan.
- 14. King Company; part of Mestek, Inc.
- 15. Loren Cook Company.
- 16. Madison Manufacturing.
- 17. Moffitt Corporation Inc.
- 18. New York Blower Company (The).
- 19. PennBarry.
- 20. Quietaire Inc.
- 21. Stanley Fans.
- 22. W.W. Grainger, Inc.; Dayton Products.
- B. Housing: Galvanized-steel sheet with flanged edges and integral orifice ring with baked-enamel finish coat applied after assembly.
- C. Steel Fan Wheels: Formed-steel blades riveted to heavy-gage steel spider bolted to cast-iron hub.
- D. Fan Wheel: Replaceable, aluminum, airfoil blades fastened to hub; factory set pitch angle of blades.
- E. Fan Drive: Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing.
- F. Fan Drive:
 - 1. Resiliently mounted to housing.
 - 2. Statically and dynamically balanced.
 - 3. Selected for continuous operation at maximum rated fan speed and motor horsepower, with final alignment and belt adjustment made after installation.
 - 4. Extend grease fitting to accessible location outside of unit.
 - 5. Service Factor Based on Fan Motor Size: 1.4.
 - 6. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
 - 7. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
 - a. Ball-Bearing Rating Life: ABMA 9, L₁₀ of 100,000 hours.
 - 8. Pulleys: Cast iron with split, tapered bushing; dynamically balanced at factory.
 - 9. Motor Pulleys: Adjustable pitch for use with motors through 5 hp; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
 - 10. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.

- 11. Belt Guards: Fabricate of steel for motors mounted on outside of fan cabinet.
- G. Accessories:
 - 1. Gravity Shutters: Aluminum blades in aluminum frame; interlocked blades with nylon bearings.
 - 2. Motor-Side Back Guard: Galvanized steel, complying with OSHA specifications, removable for maintenance.
 - 3. Wall Sleeve: Galvanized steel to match fan and accessory size.
 - 4. Weathershield Hood: Galvanized steel to match fan and accessory size.
 - 5. Weathershield Front Guard: Galvanized steel with expanded metal screen.
 - 6. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
 - 7. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.

2.3 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
 - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
- B. Enclosure Type: Totally enclosed, fan cooled.

2.4 SOURCE QUALITY CONTROL

- A. Certify sound-power level ratings according to AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.
- B. Certify fan performance ratings, including flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating." Label fans with the AMCA-Certified Ratings Seal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install power ventilators level and plumb.

- B. Support units using restrained spring isolators having a static deflection of 1 inch. Vibrationand seismic-control devices are specified in Section 230548 "Vibration and Seismic Controls for HVAC Piping and Equipment."
 - 1. Secure vibration and seismic controls to concrete bases using anchor bolts cast in concrete base.
- C. Ceiling Units: Suspend units from structure; use steel wire or metal straps.
- D. Support suspended units from structure using threaded steel rods and spring hangers with vertical-limit stops having a static deflection of 1 inch. Vibration-control devices are specified in Section 230548 "Vibration and Seismic Controls for HVAC Piping and Equipment."
- E. Install units with clearances for service and maintenance.
- F. Label units according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."

3.2 CONNECTIONS

- A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 233300 "Air Duct Accessories."
- B. Install ducts adjacent to power ventilators to allow service and maintenance.
- C. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
 - 1. Verify that shipping, blocking, and bracing are removed.
 - 2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 - 3. Verify that cleaning and adjusting are complete.

- 4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
- 5. Adjust belt tension.
- 6. Adjust damper linkages for proper damper operation.
- 7. Verify lubrication for bearings and other moving parts.
- 8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
- 9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
- 10. Shut unit down and reconnect automatic temperature-control operators.
- 11. Remove and replace malfunctioning units and retest as specified above.
- C. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Prepare test and inspection reports.

3.4 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Adjust belt tension.
- C. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.
- D. Replace fan and motor pulleys as required to achieve design airflow.
- E. Lubricate bearings.

END OF SECTION 233423

SECTION 233713 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Rectangular and square ceiling diffusers.
 - 2. Perforated diffusers.
 - 3. Louver face diffusers.
 - 4. Linear bar diffusers.
 - 5. Linear slot diffusers.
 - 6. Ceiling-integral continuous diffusers.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated, include the following:
 - 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
 - 2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.
- B. Samples for Initial Selection: For diffusers, registers, and grilles with factory-applied color finishes.
- C. Samples for Verification: For diffusers, registers, and grilles, in manufacturer's standard sizes to verify color selected.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
 - 1. Ceiling suspension assembly members.
 - 2. Method of attaching hangers to building structure.
 - 3. Size and location of initial access modules for acoustical tile.
 - 4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

- 5. Duct access panels.
- B. Source quality-control reports.

PART 2 - PRODUCTS

2.1 CEILING DIFFUSERS

- A. Round Ceiling Diffuser:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Anemostat Products; a Mestek company.
 - b. Carnes.
 - c. Hart & Cooley Inc.
 - d. METALAIRE, Inc.
 - e. Nailor Industries Inc.
 - f. Price Industries.
 - g. Titus.
 - h. Tuttle & Bailey.
 - 2. Devices shall be specifically designed for variable-air-volume flows.
 - 3. Material: Aluminum.
 - 4. Finish: Baked enamel, white.
 - 5. Face Style: Four cone.
 - 6. Mounting: Duct connection.
 - 7. Pattern: Fully adjustable.
 - 8. Dampers: Radial opposed blade.
 - 9. Accessories:
 - a. Equalizing grid.
 - b. Plaster ring.
 - c. Safety chain.
 - d. Wire guard.
 - e. Sectorizing baffles.
 - f. Operating rod extension.
- B. Rectangular and Square Ceiling Diffusers:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. A-J Manufacturing Co., Inc.
 - b. Anemostat Products; a Mestek company.
 - c. Carnes.
 - d. Hart & Cooley Inc.

- e. Krueger.
- f. METALAIRE, Inc.
- g. Nailor Industries Inc.
- h. Price Industries.
- i. Titus.
- j. Tuttle & Bailey.
- 2. Devices shall be specifically designed for variable-air-volume flows.
- 3. Material: Aluminum.
- 4. Finish: Baked enamel, white.
- 5. Face Size: 24 by 24 inches.
- 6. Face Style: Three cone.
- 7. Mounting: Surface, T-bar, Snap in, Spline or Mounting panel.
- 8. Pattern: Adjustable.
- 9. Dampers: Radial opposed blade.
- 10. Accessories:
 - a. Equalizing grid.
 - b. Plaster ring.
 - c. Safety chain.
 - d. Wire guard.
 - e. Sectorizing baffles.
 - f. Operating rod extension.
- C. Perforated Diffuser:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Air Research Diffuser Products, Inc.
 - b. A-J Manufacturing Co., Inc.
 - c. Anemostat Products; a Mestek company.
 - d. Carnes.
 - e. Hart & Cooley Inc.
 - f. Krueger.
 - g. METALAIRE, Inc.
 - h. Nailor Industries Inc.
 - i. Price Industries.
 - j. Titus.
 - k. Tuttle & Bailey.
 - 1. Warren Technology.
 - 2. Devices shall be specifically designed for variable-air-volume flows.
 - 3. Material: Steel backpan and pattern controllers, with aluminum face.
 - 4. Finish: Baked enamel, white.
 - 5. Face Size: 24 by 12 inches
 - 6. Duct Inlet: Round.
 - 7. Face Style: Flush.
 - 8. Mounting: Surface, T-bar, Snap in, Spline or Mounting panel.
 - 9. Pattern Controller: Four louvered deflector patches.

- 10. Dampers: Radial opposed blade.
- 11. Accessories:
 - a. Equalizing grid.
 - b. Plaster ring.
 - c. Safety chain.
 - d. Wire guard.
 - e. Sectorizing baffles.
 - f. Operating rod extension.

2.2 CEILING LINEAR SLOT OUTLETS

- A. Linear Slot Diffuser:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Air Research Diffuser Products, Inc.
 - b. Anemostat Products; a Mestek company.
 - c. Carnes.
 - d. Hart & Cooley Inc.
 - e. Krueger.
 - f. METALAIRE, Inc.
 - g. Nailor Industries Inc.
 - h. Price Industries.
 - i. Titus.
 - j. Tuttle & Bailey.
 - 2. Devices shall be specifically designed for variable-air-volume flows.
 - 3. Material Shell: Aluminum, insulated.
 - 4. Material Pattern Controller and Tees: Aluminum.
 - 5. Finish Face and Shell: Baked enamel, black.
 - 6. Finish Pattern Controller: Baked enamel, black.
 - 7. Finish Tees: Baked enamel, color selected by Architect.
 - 8. Slot Width: Varies
 - 9. Number of Slots: Varies.
 - 10. Length: Varies
- B. Ceiling-Integral Continuous Diffuser:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following
 - a. Air Research Diffuser Products, Inc.
 - b. Anemostat Products; a Mestek company.
 - c. Carnes.
 - d. Hart & Cooley Inc.
 - e. Krueger.

- f. METALAIRE, Inc.
- g. Nailor Industries Inc.
- h. Price Industries.
- i. Titus.
- j. Tuttle & Bailey.
- 2. Slot Width: Varies
- 3. Section Length: Varies
- 4. Straight and curved sections as required to accommodate layout.
- 5. Mitered tees and corners..
- 6. Material: Aluminum, extruded, heavy wall.
- 7. Finishes:
 - a. Exterior: By architect.
 - b. Interior: Standard black.
- 8. Throw: High.
- 9. Mounting: Ceiling or Sidewall.
- 10. Plenum: Insulated.
- 11. Other Features:
 - a. Painted interior.
 - b. Blank-offs.

2.3 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels,

locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713

SECTION 238126 – HEATING AND AIR CONDITIONING EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The drawings and general provisions of the Contract, including General and Supplementary Conditions, General Requirements and all other Specification Sections apply to the work specified in this section. In the event of conflict between specific requirements of the various documents, the more restrictive, the more extensive (i.e.: more expensive) requirement shall govern.

1.2 SCOPE

- A. This section includes all heating and air conditioning equipment as indicated on the drawings and described herein.
- B. The requirements of Division 23500, Section "Mechanical and Electrical General Provisions" shall apply to the work specified under this section.
- C. Controls and Building Management System Integration: All controls for the variable refrigerant system, ventilation air unit and heat recovery wheel shall be provided by the equipment manufacturer. Control wiring will be provided as specified under section 230910. Equipment controls shall utilize BACnet communication protocol and will be compatible with the USC campus automation system which is Johnson Controls Metasys. Equipment manufacturer shall provide all programming, checkout commissioning and startup of the VRF system and ventilation air systems. A BACnet Network Automation Engine model NAE4500 for communication of the VRF system with the USC campus Metasys network will be provided by the controls contractor as specified under section 230910. VRF and ventilation air equipment manufacturer is responsible for providing BACnet controls compatible with the BACnet NAE4500. Equipment manufacturer shall provide onsite technical personnel to assist and support controls contractor in integrating the VRF system with the USC BMS.

1.3 COORDINATION

- A. The installing contractor for any equipment shall coordinate the following items with applicable trades:
 - 1. Structural supports, curbs, and/or housekeeping pads required for all equipment.
 - 2. Piping size and connection/header locations. Locations shall be indicated on the installation and coordination shop drawings and final coordination shall be done on site.
 - 3. Ductwork connection sizes and locations. Locations shall be indicated on the installation and coordination shop drawings and final coordination shall be done on site.
 - 4. Electrical power requirements and wire/conduit and over-current protection sizes. Sizes shall be indicated on the installation and coordination shop drawings and final coordination shall be done on site.

2.1 VARIABLE REFRIGERANT FLOW (VRF) SYSTEM

- A. The variable capacity, heat pump heat recovery air conditioning system shall be a Mitsubishi Electric CITY MULTI VRFZ (Variable Refrigerant Flow Zoning) R2-Series system consisting of simultaneous cooling and heating.
- B. The R2-Series system shall consist of a PURY outdoor unit, BC (Branch Circuit) Controller, multiple indoor units (-E models), and M-NET DDC (Direct Digital Controls). Each indoor unit or group of indoor units shall be capable of operating in any mode independently of other indoor units or groups. System shall be capable of changing mode (cooling to heating, heating to cooling) with no interruption to system operation. The entire system, including outdoor units shall remain operating during all times when connected fan coil units switch from modes (cooling to heating, heating to cooling). Each indoor unit shall be independently controlled.
- C. The units shall be listed by Electrical Laboratories (ETL) and bear the ETL label. Wiring shall be in accordance with the National Electrical Code (N.E.C.). Units shall be manufactured in a facility registered to ISO 9001 and ISO14001. A full charge of R-410A for the condensing unit only shall be provided in the condensing unit.
- D. R2- Series Outdoor Unit
 - 1. The R2-Series PURY outdoor unit shall be used specifically with CITY MULTI VRFZ components. The PURY outdoor units shall be equipped with multiple circuit boards that interface to the M-NET controls system and shall perform all functions necessary for operation. Each outdoor unit module shall be completely factory assembled, piped and wired and run tested at the factory.
 - 2. The model nomenclature and unit requirements are shown below. All units requiring a factory supplied twinning kits shall be piped together in the field, without the need for equalizing line(s).
 - 3. Outdoor unit shall have a sound rating no higher than 60 dB(A) individually or 63 dB(A) twinned. Units shall have a sound rating no higher than 50 dB(A) individually or 53 dB(A) twinned while in night mode operation.
 - 4. Both refrigerant lines from the outdoor unit to the BC (Branch Circuit) Controller shall be insulated.
 - 5. There shall be no more than 1 Branch Controller/Branch Selector connected to any one outdoor unit.
 - 6. Outdoor unit shall be able to connect to up to 50 indoor units depending upon model.
 - 7. The outdoor unit shall have an accumulator with refrigerant level sensors and controls.
 - 8. The outdoor unit shall have a high pressure safety switch, over-current protection, crankcase heater and DC bus protection.
 - 9. The outdoor unit shall have the ability to operate with a maximum height difference of 164 feet and have total refrigerant tubing length of 1804-2625 feet. The greatest length is not to exceed 541 feet between outdoor unit and the indoor units without the need for line size changes or traps.
 - 10. The outdoor unit shall be capable of operating in heating mode down to -4°F ambient temperature or cooling mode down to 23°F ambient temperature, without additional low ambient controls.

- 11. The outdoor unit shall not cease operation in any mode based solely on outdoor ambient temperature.
- 12. The outdoor unit shall have a high efficiency oil separator plus additional logic controls to ensure adequate oil volume in the compressor is maintained.
- 13. Unit Cabinet:
 - a. The casing(s) shall be fabricated of galvanized steel, bonderized and finished. Units cabinets shall be able to withstand 960 hours per ASTM B117 criteria for seacoast protected models (–BS models).
- 14. Fan:
 - a. Each outdoor unit module shall be furnished with one direct drive, variable speed propeller type fan. The fan shall be factory set for operation under 0 in. WG external static pressure, but capable of normal operation under a maximum of 0.24 in. WG external static pressure via dipswitch.
 - b. All fan motors shall have inherent protection, have permanently lubricated bearings, and be completely variable speed.
 - c. All fan motors shall be mounted for quiet operation.
 - d. All fans shall be provided with a raised guard to prevent contact with moving parts.
 - e. The outdoor unit shall have vertical discharge airflow.
- 15. Refrigerant
 - a. R410A refrigerant shall be required for each system.
- 16. Coil:
 - a. The outdoor coil shall be of nonferrous construction with lanced or corrugated plate fins on copper tubing.
 - b. The coil fins shall have a factory applied corrosion resistant blue-fin finish.
 - c. The coil shall be protected with an integral metal guard.
 - d. Refrigerant flow from the outdoor unit shall be controlled by means of an inverter driven compressor.
 - e. The outdoor coil shall include 4 circuits with two position valves for each circuit, except for the last stage.
- 17. Compressor:
 - a. All compressors shall be inverter driven scroll hermetic compressors. Each outdoor unit module shall be equipped with one inverter driven scroll hermetic compressor. Non inverter-driven compressors shall not be allowed.
 - b. A crankcase heater(s) shall be factory mounted on the compressor(s).
 - c. The outdoor unit compressor shall have an inverter to modulate capacity. The capacity shall be completely variable with a turndown of 19%-8% of rated capacity, depending upon unit size.
 - d. The compressor will be equipped with an internal thermal overload.
 - e. The compressor shall be mounted to avoid the transmission of vibration.

- 18. Electrical:
 - a. The outdoor unit electrical power shall be 460 volts, 3-phase, 60 hertz.
 - b. The outdoor unit shall be capable of satisfactory operation within voltage limits of 414-506V (460V/60Hz).
 - c. The outdoor unit shall be controlled by integral microprocessors.
 - d. The control circuit between the indoor units, BC Controller and the outdoor unit shall be 24VDC completed using a 2-conductor, twisted pair shielded cable to provide total integration of the system.
- E. Branch Circuit (BC) Controllers
 - 1. There shall be no more than one Branch Controller/Branch Selector connected to any one outdoor unit. Each system shall have no more than one Branch Selector. The BC (Branch Circuit) Controllers shall be specifically used with R410A R2-Series systems. These units shall be equipped with a circuit board that interfaces to the M-NET controls system and shall perform all functions necessary for operation. The unit shall have a galvanized steel finish. The BC Controller shall be completely factory assembled, piped and wired. Each unit shall be run tested at the factory. This unit shall be mounted indoors, with access and service clearance provided for each controller. The sum of connected capacity of all indoor air handlers shall range from 50% to 150% of rated capacity.
 - 2. BC Unit Cabinet:
 - a. The casing shall be fabricated of galvanized steel.
 - b. Each cabinet shall house a liquid-gas separator and multiple refrigeration control valves.
 - c. The unit shall house two tube-in-tube heat exchangers.
 - 3. Refrigerant
 - a. R410A refrigerant shall be required.
 - 4. Refrigerant valves:
 - a. The unit shall be furnished with multiple branch circuits which can individually accommodate up to 54,000 BTUH and up to three indoor units. Branches may be twinned to allow more than 54,000 BTUH.
 - b. Each branch shall have multiple two-position valves to control refrigerant flow.
 - c. Service shut-off valves shall be field-provided/installed for each branch to allow service to any indoor unit without field interruption to overall system operation.
 - d. Linear electronic expansion valves shall be used to control the variable refrigerant flow.
 - 5. Shut-Off Ball Valves:
 - a. Service shut-off valves shall be provided by manufacturer and field-installed for each Fan Coil units Hi and Low Pressure Refrigerant Line to allow service to any indoor fan coil unit without field interruption to overall system operation.
 - 6. Integral Drain Pan:

- a. An integral condensate pan and drain shall be provided.
- 7. Electrical:
 - a. The unit electrical power shall be 208/230 volts, 1 phase, 60 hertz.
 - b. The unit shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz) or 207-253V (230V/60Hz).
 - c. The BC Controller shall be controlled by integral microprocessors.
 - d. The control circuit between the indoor units and the outdoor unit shall be 24VDC completed using a 2-conductor, twisted pair shielded cable to provide total integration of the system.
- F. PEFY
 - 1. The PEFY-NMHU (High Static Option) unit shall be a ceiling concealed ducted indoor fan coil that mounts above the ceiling with a fixed rear return and a horizontal discharge supply, and shall have a modulating linear expansion device. The PEFY-NMHU shall be used with the R2-Series outdoor unit and BC Controller, Y-Series outdoor unit, or S-Series outdoor unit. The PEFY-NMLU shall support individual control using M-NET DDC controllers. PEFY-NMHU (High Static Option) models shall feature external static pressure settings up 0.80 in. WG. Units shall have the ability to control supplemental heat via connector CN24 and a 12 VDC output.
 - 2. Indoor Unit.
 - a. The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, and an auto restart function. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.
 - 3. Unit Cabinet:
 - a. The cabinet shall be ceiling-concealed, ducted.
 - b. The cabinet panel shall have provisions for a field installed filtered outside air intake.
 - 4. Fan:
 - a. The indoor unit fan shall be an assembly with one or two Sirocco fan(s) direct driven by a single motor.
 - b. The indoor fan shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings.
 - c. The indoor unit shall have a ducted air outlet system and ducted return air system.
 - 5. Filter:
 - a. Return air shall be filtered by a field-supplied filter.
 - b. Optional rear return filter box with long-life filter shall available for all PEFY-NMHU-E indoor units.

- 6. Coil:
 - a. The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing.
 - b. The tubing shall have inner grooves for high efficiency heat exchange.
 - c. All tube joints shall be brazed with phos-copper or silver alloy.
 - d. The coils shall be pressure tested at the factory.
 - e. A condensate pan and drain shall be provided under the coil.
 - f. The condensate shall be gravity drained from the fan coil.
 - g. Both refrigerant lines to the PEFY indoor units shall be insulated.
- 7. Electrical:
 - a. The unit electrical power shall be 208/230 volts, 1-phase, 60 hertz, except for the PEFY-P72NMHU-E and PEFY-P86NMHU-E. The PEFY-P72NMHU-E and PEFY-P96NMHU=E shall be 208/230 volts, 3-phase, 60 hertz.
 - b. The system shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz) or 207-253 volts (230V/60Hz).
- 8. Controls:
 - a. This unit shall use controls provided by Mitsubishi Electric to perform functions necessary to operate the system.
- G. PKFY
 - 1. The PKFY unit shall be a wall mounted indoor fan coil with a fixed return and a horizontal discharge supply, and shall have a modulating linear expansion device. The PKFY shall be used with the R2-Series outdoor unit and BC Controller, Y-Series outdoor unit, or S-Series outdoor unit. The PKFY shall support individual control using M-NET DDC controllers. Units shall have the ability to control supplemental heat via connector CN24 and a 12 VDC output.
 - 2. Indoor Unit.
 - a. The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, and an auto restart function. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.
 - 3. Unit Cabinet:
 - a. The cabinet shall be white.
 - 4. Fan:
 - a. The indoor unit fan shall be an assembly with one or two Sirocco fan(s) direct driven by a single motor.

- b. The indoor fan shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings.
- c. The indoor unit shall have a ducted air outlet system and ducted return air system.
- 5. Filter:
 - a. Return air shall be filtered by a field-supplied filter.
- 6. Coil:
 - a. The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing.
 - b. The tubing shall have inner grooves for high efficiency heat exchange.
 - c. All tube joints shall be brazed with phos-copper or silver alloy.
 - d. The coils shall be pressure tested at the factory.
 - e. A condensate pan and drain shall be provided under the coil.
 - f. The condensate shall be gravity drained from the fan coil.
 - g. Both refrigerant lines to the PKFY indoor units shall be insulated.
- 7. Electrical:
 - a. The system shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz) or 207-253 volts (230V/60Hz).
- 8. Controls:
 - a. This unit shall use controls provided by Mitsubishi Electric to perform functions necessary to operate the system.
- H. Controls
 - 1. The CITY MULTI Controls Network (CMCN) shall be capable of supporting remote controllers, schedule timers, system controllers, centralized controllers, an integrated web based interface, graphical user workstation, and system integration to Building Management Systems via BACnet®.
 - 2. Electrical Characteristics
 - a. The CMCN shall operate at 24VDC. Controller power and communications shall be via a common non-polar communications bus.
 - b. Wiring:
 - 1) Control wiring shall be installed in a system daisy chain configuration from indoor unit to ME remote controller to indoor unit, to the BC controller (main and subs, if applicable) and to the outdoor unit. Control wiring to remote controllers shall be run from the indoor unit terminal block to the controller associated with that unit.
 - 2) Control wiring for schedule timers, system controllers, and centralized controllers shall be installed in a daisy chain configuration from outdoor unit to outdoor unit, to system controllers, to the power supply.

- 3) Control wiring for the Deluxe MA remote controllers shall be from the remote controller to the first associated indoor unit (TB-15) then to the remaining associated indoor units (TB-15) in a daisy chain configuration...
- 4) The GB-50A system controllers shall be capable of being networked with other GB-50A system controllers for web based control.
- c. Wiring type:
 - 1) Wiring shall be 2-conductor (16 AWG), twisted shielded pair, stranded wire, as defined by the Design Tool AutoCAD output.
 - 2) Network wiring shall be CAT-5e with RJ-45 connection.

I. CITY MULTI Controls Network

- 1. The CITY MULTI Controls Network (CMCN) consists of remote controllers, schedule timers, system controllers, centralized controllers, and integrated web based interface communicating over a high-speed communication bus. The CITY MULTI Controls Network shall support operation monitoring, scheduling, error email distribution, personal browsers, tenant billing, online maintenance support, and integration with Building Management Systems (BMS) using BACnet® interfaces. The below figure illustrates a sample CMCN System Configuration.
- 2. CMCN: Remote Controllers
 - a. Deluxe MA Remote Controller (PAR-21MAA)
 - 1) The Deluxe MA Remote Controller (PAR-21MAA) shall be capable of controlling up to 16 indoor units (defined as 1 group). The Deluxe MA Remote Controller shall be approximately 5" x 5" in size and white in color with a light-green LCD display. The PAR-21MAA shall support a selection from multiple languages (Spanish, German, Japanese, Chinese, English, Russian, Italian, or French) for display information. The Deluxe MA supports temperature display selection of Fahrenheit or Celsius. The Deluxe MA Remote Controller shall control the following grouped operations: On/Off, Operation Mode (cool, heat, auto (R2-Series only), dry, and fan), temperature set point, fan speed setting, and airflow direction setting. The Deluxe MA Remote Controller shall support timer settings of on/off/temperature up to 8 times in a day in 1-minute increments. The Deluxe MA Remote Controller shall support an Auto Off timer. The Deluxe MA Remote Controller shall be able to limit the set temperature range from the Deluxe MA. The room temperature shall be sensed at either the Deluxe MA Remote Controller or the Indoor Unit dependent on the indoor unit dipswitch setting. The Deluxe MA Remote Controller shall display a fourdigit error code in the event of system abnormality/error.
 - 2) The Deluxe MA Remote Controller shall only be used in the same group with other Deluxe MA Remote Controllers (PAR-21MAA), Wireless MA (PAR-FL32MA / PAR-FA32MA), or Simple MA Remote Controllers (PAC-YT51CRB), with up to two remote controllers per group.
 - 3) The Deluxe MA Remote Controller shall require no addressing. The Deluxe MA Remote Controller shall connect using two-wire, stranded, non-polar control wire to TB15 connection terminal on the indoor unit. The PAR-21MAA shall require cross-over wiring for grouping across indoor units.
- b. GB-50A Centralized Controller
 - 1) The GB-50A Centralized Controller shall be capable of controlling via a PC a maximum of 50 indoor units across multiple CITY MULTI outdoor units. A field supplied PC shall be required for the GB-50A Centralized Controller. The GB-50A Centralized Controller shall be approximately 5"x11" in size and shall be powered from a Power Supply Unit (PAC-SC50KUA). The GB-50A Centralized Controller shall support operation superceding that of the remote controllers, system configuration, daily/weekly/annual scheduling, monitoring of operation status, error email notification, online maintenance tool and malfunction monitoring. The GB-50A Centralized Controller shall have basic operation controls which can be applied to an individual indoor unit, a group of indoor units (up to 50 indoor units), or all indoor units (collective batch operation). This basic control set of operation controls for the GB-50A Centralized Controller shall include on/off, operation mode selection (cool, heat, auto (R2-Series only), dry, and fan), temperature setting, fan speed setting, airflow direction setting, error email notification, and online maintenance. Since the GB-50A provides centralized control it shall be able to enable or disable operation of local remote controllers via the PC. In terms of scheduling, the GB-50A Centralized Controller shall allow the user to define daily, weekly, and annual schedules with operations consisting of ON/OFF, mode selection, temperature setting, and permit/prohibit of remote controllers.
- 3. CMCN: System Integration
 - a. The CMCN shall be capable of supporting integration with Building Management Systems (BMS) via BACnet® interfaces.
 - b. PAC-YTG31CDA: BACnet Interface
 - 1) The Mitsubishi Electric HVAC BACnet® interface, PAC-YG31CDA (SW-BACnet), shall be compliant with BACnet®/IP (ANSI/ASHRAE 135-1995, 135a) and UDP/IP of Ethernet (ANSI/ASHRAE 135-1995, 135b). The BACnet® interface shall require a dedicated network computer and activated BACnet® software function via Mitsubishi Electric HVAC issued license. The BACnet® software license shall be on a per AG-150A/G-50A/GB-50A basis for a maximum of 50 indoor units controlled by one AG-150A/G-50A/GB-50A Centralized Controller. The BACnet® interface shall support a maximum of ten AG-150A/G-50A/GB-50A Centralized Controllers for a maximum of 500 indoor units. Operation and monitoring points include, but are not limited to, on/off, operation mode, fan speed, prohibit remote controller, filter sign reset, alarm state, error code, and error address.

2.2 DEDICATED OUTDOOR AIR (VENTILATION) HANDLING UNIT

A. Unit(s) furnished and installed shall be packaged units with integral hot gas reheat as scheduled on contract documents and within these specifications. Unit(s) shall consist of insulated weather tight casing with compressor(s), hot gas reheat coil, energy wheel, modulating face and by-pass

dampers for hot gas reheat control, air cooled condenser coil, condenser fans, evaporator coil, return air filters, supply motors and drives, and factory mounted DDC microprocessor controls. Field mounted controls and electromechanical controls are not acceptable. The entire unit and all components shall be mounted on a separate common 6" unit platform base, that shall be integral to the entire unit/energy wheel assembly.

- B. All accessories mentioned above, including DDC controls shall be provided as factory mounted and shall be an integral part of the packaged unit. Field assembly is not acceptable. Packaged units shall be manufactured with a single point power connection. Disconnects shall be provided per Division 16 Section "Electrical."
- C. Cooling performance shall be rated in accordance with ARI testing procedures and must be ARI 210/240 or ARI 340/360 certified. All units must meet ASHRAE 90.1, minimum efficiency requirements. All units shall be factory assembled, internally wired, fully charged with R-410A refrigerant and 100% run-tested before leaving the factory. Wiring internal to the unit shall be colored and numbered for simplified identification. Units shall be UL listed and labeled in accordance with UL 1995/CAS/CSA No. 236-M90.
- D. The DDC controller must control and modulate Face and By-pass dampers to maintain discharge air temperature and humidity per the schedule.
- E. The hot gas reheat coil shall be series piped and re-heat shall be controlled by face and by-pass dampers without the use of refrigerant modulating control valves or solenoid valves. Parallel refrigerant piping is not acceptable.
- F. Unit shall be manufactured by Trane, Annexair, or SEMCO. Ventilation unit manufacturers shall comply with all specifications, performance data, unit components, efficiency, dimensional requirements, and warranty, as they apply to all manufacturers.
- G. Unit Casing
 - 1. Unit casing shall be constructed of zinc coated, heavy gauge, galvanized steel. Exterior surfaces shall be cleaned, phosphatized, and finished with a weather-resistant baked enamel finish with removable access panels. All exposed vertical panels and top covers in the indoor wet section shall be insulated with a cleanable foil faced, fire-retardant permanent, odorless glass fiber insulation. Cabinet surface shall be tested 1000 hours in salt spray test in compliance with ASTM B117.
 - 2. The base of the unit shall be insulated with 1/2 inch, 1 pound density foil-faced, closedcell material. All insulation edges shall be either captured or sealed. The unit's base pan shall have no penetrations within the perimeter of the curb other than the raised 1 1/8 inch high downflow supply-return openings.
 - 3. Cabinet construction shall incorporate removable panels to access the filter/evaporator, indoor fan/heat exchanger, and the compressor.
 - 4. Factory installed hail guards shall be provided for condenser coil protection.
 - 5. Cabinet top cover shall be one piece construction or where seams exist, it shall be doublehemmed and gasket sealed. Provide hinged access doors.
 - 6. Insulation: Provide 1/2 inch thick fiberglass insulation with matt-face on all exterior panels in contact with the return and conditioned air stream. All edges must be captured so that there is no insulation exposed in the air stream.
- H. Air Filters

- 1. Air Filters: Two inch pleated media filters shall mount integral within the unit and shall be accessible through access doors.
- I. Evaporator Fan
 - 1. Provide belt driven, FC centrifugal fans with fixed-pitch sheave drive assemblies. Fan assembly shall have an adjustment idler-arm assembly for quick-adjustment to fan belts and motor sheaves. All motors shall be thermally protected. All indoor fan motors shall meet the U.S. Energy Policy Act of 1992 (EPACT).
 - 2. Fans shall be provided with self-aligning, grease lubricated, ball or sleeve bearings with permanent lubrication fittings.
 - 3. Mount fan motor(s) and fan on a common base assembly and isolated from unit with double deflection rubber-in-shear isolators. Provide thrust restraint isolation on the fan housing/fan board to assure smooth fan startup transition and operation.
 - 4. Dynamically balance all fans and the unit's running fan assembly to assure smooth operation of the fan and its associated assembly. Balancing of the fan only shall not be acceptable.
- J. Evaporator and Hot Gas Reheat Section
 - 1. Internally finned, 5/16" copper tubes, mechanically bonded to a configured aluminum plate fin shall be standard. Coils shall be leak tested at the factory to ensure pressure integrity. The evaporator coil shall be leak tested to 200 psig and pressure tested to 450 psig. The evaporator coil shall be located in the draw-thru position.
 - 2. A removable, reversible, double-sloped stainless steel condensate drain pan shall be provided.
 - 3. Provide separate, independent hot gas reheat coil located 18 inches downstream of the supply fan. Hot gas reheat coil shall be completely separate and detached from the cooling and located downstream of the supply fan.
 - 4. Fully modulating reheat capacity control shall be provided by face and by-pass dampers to provide discharge air temperature and humidity control.
 - 5. Hot gas reheat coil must be piped in series to condenser coil. Parallel piping is unacceptable. Controlling reheat with refrigerant modulating control valves and/or solenoid valves is unacceptable.
- K. Compressors and Refrigeration System
 - 1. Compressor(s): Units shall have direct-drive, hermetic, scroll type compressors, with centrifugal type oil pumps. Provide suction gas cooled motor with over temperature and over current protection. Internal overloads shall be provided with the scroll compressors, as well as inlet dirt separator, rolling element bearings, crankcase heater, in completely enclosed compression chamber with no leakage paths. Reciprocating compressors are not acceptable.
 - 2. Each refrigerant circuit shall be provided with a thermal expansion valve for optimum refrigerant capacity control. Service pressure ports, and refrigerant line filter driers shall be factory-installed. An area shall be provided for replacement suction line driers. Fixed orifice metering devices are not acceptable.
 - 3. Compressor(s) shall be manufactured by the HVAC unit manufacturer.
 - 4. Units shall have cooling capabilities down to 0 degree F.
- L. Condenser Section

- 1. Internally finned, 5/16" copper tubes, mechanically bonded to a configured aluminum plate fin shall be standard. Coils shall be leak tested at the factory to ensure pressure integrity. The condenser coil shall be leak tested to 200 psig and pressure tested to 450 psig.
- 2. The outdoor fans shall be direct-drive, statically and dynamically balanced, draw-through in the vertical discharge position. The fan motor shall be permanently lubricated and shall have built-in thermal overload protection in a weather tight casing.
- 3. Condenser fans shall be controlled by variable speed drives.
- 4. Provide factory-installed louvered steel coil guards around perimeter of condensing section to protect the condenser coils, refrigerant piping and control components. Louvered panels shall be fabricated from minimum 20 ga. galvanized steel and be rigid enough to provide permanent protection for shipping and pre/post- installation. Wire mesh is not an acceptable material for coil guards.
- M. Total Energy Wheel
 - 1. Heat wheel package shall include outside air and exhaust fans, filters, and total energy wheel as described below, and shall match the heat pump unit construction and color. Total Energy Wheel shall be factory mounted and wired to the heat pump unit and shall have a single point power connection.
 - 2. Energy wheel shall be factory mounted, wired and powered. The energy wheel shall be integral to the rooftop unit, and shall sit on a common 6" base with the rooftop unit.
 - 3. Fans shall be double width double inlet design with forward curve type wheels. Fans shall be driven by direct drive motors. Impellers shall be statically and dynamically balanced.
 - 4. The energy recovery wheel shall be certified to ANSI/ARI Standard 1060 and bear the ARI 1060 label. Performance characteristics of the energy wheel shall be provided as defined by ARI 1060 definitions. The energy wheel shall be a total energy wheel, with the sensible and latent effectiveness reported and within 5% of each other. The calculated total net effectiveness of the recovery wheel shall not be less than 70% when the specified ventilation flow rate equals the exhaust flow rate.
 - 5. The energy recovery component shall incorporate a rotary wheel in an insulated cassette frame complete with seals, drive motor and drive belts. The energy wheel media shall be constructed of synthetic fiber or polymer media. The media shall not be subject to corrosion in marine or coastal environments. The adsorbent shall be integrally bound into the media or impregnated into the media with out the use of binders or adhesives. The adsorbent shall not be applied as a glued on surface coating and not susceptible to erosion, abrasion, or delamination. The adsorbent shall be selected for its high affinity for water vapor and shall not dissolve or deliquesce in the presence of water or high humidity. Energy recovery cassettes shall be UL-recognized components certified for mechanical, electrical and fire safety in accordance with UL Standard 1812.
 - 6. Wheel drive motor shall be provided mounted in the cassette frame. Motor locations shall be as indicated on the schedule and drawings. Wheel drive motor shall be thermally protected and UL Component Recognized. Drive belts shall not require belt tensioners. Wheels shall have flanged or pillow block bearings which support the rotating shaft of the wheel. Outboard bearings shall be provided with grease fittings for periodic lubrication. L-10 bearing life shall be greater than 400,000 hours at design conditions.
 - 7. Access doors shall be provided for the removal of wheel segments. Doors shall be located to allow access to the entire upstream and downstream face of each wheel. Adequate space and access shall be provided for energy wheel motor, bearing and belt removal.

- 8. Control of energy wheels shall be incorporated and an integral part of the AHU control systems and shall be as described under the AHU control specifications. Secondary independent wheel controllers are not acceptable.
- N. Factory Mounted Unit DDC Controls
 - 1. Unit control shall be provided by the manufacturer's unit mounted DDC control module with clear language display that shall make all unit decisions in order to satisfy the discharge air temperature and humidity. The packaged unit manufacturer shall bear all cost and responsibility to provide, factory install, wire, mount, and pre-program the unit manufacturer's DDC programmable controller. Subcontracting the BAS controls contractor is not acceptable. Electromechanical controls are not acceptable.
 - 2. Unit shall be capable of independent, standalone control and operation without intervention or modification by the HVAC control subcontractor. Field mounted controls are not acceptable. Factory mounted control module shall provide a link that is compatible with the Building Automation Temperature Control System specified in Division 15 Section "HVAC Instrumentation and Controls." As a minimum, the control module shall include the following:
 - 3. Interface the following points with the Building Management System and these points must also be readable at the unit control module's LCD Clear Language Display
 - a. Analog Input: Discharge Temperature Set Point
 - b. Analog Input: Discharge Relative Humidity Set Point
 - c. Analog Output: Outside Air Temperature
 - d. Analog Output: Face/Bypass Damper
 - e. Analog Output: Evaporator Discharge Air Temperature
 - f. Binary Output: Evaporator Fan
 - g. Binary Output: Compressor 1
 - h. Binary Output: Compressor 2
 - i. Digital Input: Start/Stop (occupied/unoccupied)
 - j. Digital Output: Alarm Status (unit failure)
 - 4. In addition to the above points, the following points must also be readable at the unit control module's LCD Clear Language display:
 - a. Unit Supply Air Temperature
 - b. Mode (occupied/unoccupied)
 - c. Outside Air Temperature
 - d. Evaporator Discharge Air Temperature
 - e. Evaporator Discharge Air Temperature Set Point
 - f. Reheat Status (face and bypass damper position)
 - g. Compressor Status
 - h. Condenser Fan Status
 - i. Suction Line Temperature
 - j. Liquid Line Temperature
 - 5. Pre-Programmed Sequence of Operation:
 - a. Provide microprocessor unit mounted control which when used with an electronic discharge air sensor provides proportional integral supply air control. This UCM shall perform all unit functions by making all cooling and ventilating decisions

through resident software logic. The microprocessor shall include 5 temperature functions. A discharge air sensor mounted after the evaporator coil shall maintain the specified dehumidification temperature. The second temperature sensor shall modulate the hot gas reheat coil's face and by pass damper to maintain the specified supply air temperature. The third temperature sensor shall monitor suction temperature and lockout compressors to keep evaporator coil from freezing. The fourth temperature sensor shall monitor liquid line temperature to modulate condenser fans to maintain head pressure. The fifth sensor is a unit mounted discharge adjustable humidity sensor (input). All functions of the microprocessor shall be fully programmable and have the capability to be monitored and adjusted thru a laptop computer.

- b. Occupied: The supply air fan shall operate continuously. The compressors shall be staged to maintain design coil leaving air temperature (53 0F adjustable). The face and bypass dampers shall modulate reheat (face-n-bypass dampers) to maintain a discharge temperature/humidity set point based on a call for ventilation. BAS controls subcontractor shall provide and install the duct-mounted temperature sensor and duct-mounted humidity sensor.
- c. Unoccupied: Unit shall be off. Outside and exhaust air dampers closed.
- O. Start-Up and Warranty
 - 1. Packaged units shall be provided with a warranty of one year for parts and labor, plus an additional three (4) years parts and labor for the whole unit.
 - 2. Provide start up by local manufacturer's authorized service agency.

PART 3 - EXECUTION

3.1 VARIABLE REFRIGERANT FLOW (VRF) SYSTEM

- A. Installation
 - 1. All required installation, fabrication and connection drawings shall be submitted and approved prior to the start of work detailed on these drawings.
 - 2. Equipment shall be installed in accordance with manufacturer's recommendations. Installation drawings shall be in accordance with referenced standards in this section.
 - 3. Repair damaged galvanized areas with paint. Repair painted units by touch up of all scratches with finish paint material.
- B. Operation and Maintenance
 - 1. Contractor shall submit Operation and Maintenance Manuals complete with descriptive literature, model, and serial number of all equipment, performance data, manufacturer's instructions for operating and maintenance, lubrication recommendation and schedule.
- C. Coordination

1. Contractor shall provide complete coordination for the installation of the indoor and outdoor components, including size and location of outdoor unit support, automatic temperature controls and electrical requirements

3.2 DEDICATED OUTDOOR AIR (VENTILATION) HANDLING UNIT

- A. Installation
 - 1. All required installation, fabrication and connection drawings shall be submitted and approved prior to the start of work detailed on these drawings.
 - 2. Equipment shall be installed in accordance with manufacturer's recommendations. Installation drawings shall be in accordance with referenced standards in this section.
 - 3. Repair damaged galvanized areas with paint. Repair painted units by touch up of all scratches with finish paint material.
- B. Operation and Maintenance
 - 1. Contractor shall submit Operation and Maintenance Manuals complete with descriptive literature, model, and serial number of all equipment, performance data, manufacturer's instructions for operating and maintenance, lubrication recommendation and schedule.
- C. Coordination
 - 1. Contractor shall provide complete coordination for the installation of the indoor and outdoor components, including size and location of outdoor unit support, automatic temperature controls and electrical requirements

END OF SECTION 15700

SECTION 238239 - UNIT HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Propeller unit heaters with electric-resistance heating coils.
 - 2. Wall and ceiling heaters with propeller fans and electric-resistance heating coils.

1.3 DEFINITIONS

- A. BAS: Building automation system.
- B. CWP: Cold working pressure.
- C. PTFE: Polytetrafluoroethylene plastic.
- D. TFE: Tetrafluoroethylene plastic.

1.4 ACTION SUBMITTALS

- A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each product indicated.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Plans, elevations, sections, and details.
 - 2. Location and size of each field connection.
 - 3. Details of anchorages and attachments to structure and to supported equipment.
 - 4. Equipment schedules to include rated capacities, operating characteristics, furnished specialties, and accessories.
 - 5. Location and arrangement of piping valves and specialties.
 - 6. Location and arrangement of integral controls.
 - 7. Wiring Diagrams: Power, signal, and control wiring.
- C. Samples for Initial Selection: Finish colors for units with factory-applied color finishes.

D. Samples for Verification: Finish colors for each type of cabinet unit heater and wall and ceiling heaters indicated with factory-applied color finishes.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Floor plans, reflected ceiling plans, and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
 - 1. Suspended ceiling components.
 - 2. Structural members to which unit heaters will be attached.
 - 3. Method of attaching hangers to building structure.
 - 4. Size and location of initial access modules for acoustical tile.
 - 5. Items penetrating finished ceiling, including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 - 6. Perimeter moldings for exposed or partially exposed cabinets.
- B. Manufacturer Seismic Qualification Certification: Submit certification that cabinet unit heaters, accessories, and components will withstand seismic forces defined in Section 230548 "Vibration and Seismic Controls for HVAC Piping and Equipment." Include the following:
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
 - b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Field quality-control test reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For cabinet unit heaters to include in emergency, operation, and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Cabinet Unit Heater Filters: Furnish one spare filter(s) for each filter installed.

1.8 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 "Systems and Equipment" and Section 7 "Construction and Startup."
- C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 "Heating, Ventilating, and Air-Conditioning."

PART 2 - PRODUCTS

2.1 PROPELLER UNIT HEATERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Airtherm; a Mestek Company.
 - 2. Reznor
 - 3. Engineered Air Ltd.
 - 4. McQuay International.
 - 5. Rosemex Products.
 - 6. Ruffneck Heaters; a division of Lexa Corporation.
 - 7. Trane.
- B. Description: An assembly including casing, coil, fan, and motor in vertical and horizontal discharge configuration with adjustable discharge louvers.
- C. Comply with UL 2021.
- D. Comply with UL 823.
- E. Cabinet: Removable panels for maintenance access to controls.
- F. Cabinet Finish: Manufacturer's standard baked enamel applied to factory-assembled and -tested propeller unit heater before shipping.
- G. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

- H. Discharge Louver: Adjustable fin diffuser for horizontal units and conical diffuser for vertical units.
- I. Electric-Resistance Heating Elements: Nickel-chromium heating wire, free from expansion noise and 60-Hz hum, embedded in magnesium oxide refractory and sealed in steel or corrosion-resistant metallic sheath with fins no closer than 0.16 inch. Element ends shall be enclosed in terminal box. Fin surface temperature shall not exceed 550 deg F at any point during normal operation.
 - 1. Circuit Protection: One-time fuses in terminal box for overcurrent protection and limit controls for high-temperature protection of heaters.
 - 2. Wiring Terminations: Stainless-steel or corrosion-resistant material.
- J. Fan: Propeller type with aluminum wheel directly mounted on motor shaft in the fan venturi.
- K. Fan Motors: Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."
 - 1. Motor Type: Permanently lubricated, explosion proof, multispeed.
- L. Control Devices:
 - 1. Unit-mounted, thermostat.
- M. Capacities and Characteristics

2.2 WALL AND CEILING HEATERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Berko Electric Heating; a division of Marley Engineered Products.
 - 2. Chromalox, Inc.; a division of Emerson Electric Company.
 - 3. Indeeco.
 - 4. Markel Products; a division of TPI Corporation.
 - 5. Marley Electric Heating; a division of Marley Engineered Products.
 - 6. Ouellet Canada Inc.
 - 7. QMark Electric Heating; a division of Marley Engineered Products.
 - 8. Trane.
- B. Description: An assembly including chassis, electric heating coil, fan, motor, and controls. Comply with UL 2021.
- C. Cabinet:
 - 1. Front Panel: Stamped-steel louver, with removable panels fastened with tamperproof fasteners.
 - 2. Finish: Baked enamel over baked-on primer with manufacturer's standard color selected by Architect, applied to factory-assembled and -tested wall and ceiling heaters before shipping.

- 3. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- D. Surface-Mounting Cabinet Enclosure: Steel with finish to match cabinet.
- E. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and hum, embedded in magnesium oxide refractory and sealed in corrosion-resistant metallic sheath. Terminate elements in stainless-steel, machine-staked terminals secured with stainlesssteel hardware, and limit controls for high temperature protection. Provide integral circuit breaker for overcurrent protection.
- F. Fan: Aluminum propeller directly connected to motor.
 - 1. Motor: Permanently lubricated, multispeed. Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."
- G. Controls: Unit-mounted thermostat.
- H. Electrical Connection: Factory wire motors and controls for a single field connection with disconnect switch.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in for electrical connections to verify actual locations before unit heater installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install wall boxes in finished wall assembly; seal and weatherproof. Joint-sealant materials and applications are specified in Section 079200 "Joint Sealants."
- B. Install cabinet unit heaters to comply with NFPA 90A.
- C. Install propeller unit heaters level and plumb.
- D. Suspend cabinet unit heaters from structure with elastomeric hangers and seismic restraints. Vibration isolators and seismic restraints are specified in Section 230548 "Vibration and Seismic Controls for HVAC Piping and Equipment."
- E. Suspend propeller unit heaters from structure with all-thread hanger rods and spring hangers with vertical-limit stop. Hanger rods and attachments to structure are specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment." Vibration hangers

are specified in Section 230548 "Vibration and Seismic Controls for HVAC Piping and Equipment."

- F. Install wall-mounting thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.
- G. Install new filters in each fan-coil unit within two weeks of Substantial Completion.

3.3 CONNECTIONS

- A. Comply with safety requirements in UL 1995.
- B. Unless otherwise indicated, install union and gate or ball valve on supply-water connection and union and calibrated balancing valve on return-water connection of unit heater. Hydronic specialties are specified in Section 232113 "Hydronic Piping."
- C. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 2. Operate electric heating elements through each stage to verify proper operation and electrical connections.
 - 3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.
- B. Remove and replace malfunctioning units and retest as specified above.

3.5 ADJUSTING

- A. Adjust initial temperature set points.
- B. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain cabinet unit heaters. Refer to Section 017900 "Demonstration and Training."

END OF SECTION 238239

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Building wires and cables rated 600 V and less.
 - 2. Connectors, splices, and terminations rated 600 V and less.

1.3 DEFINITIONS

A. VFC: Variable frequency controller.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Alcan Products Corporation; Alcan Cable Division.
 - 2. Alpha Wire.
 - 3. Belden Inc.
 - 4. Encore Wire Corporation.
 - 5. General Cable Technologies Corporation.
 - 6. Southwire Incorporated.
- B. Copper Conductors: Comply with NEMA WC 70/ICEA S-95-658.

- C. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for Type THHN-2-THWN-2.
- D. Multiconductor Cable: Comply with NEMA WC 70/ICEA S-95-658 for metal-clad cable, Type MC with ground wire.

2.2 CONNECTORS AND SPLICES

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Gardner Bender.
 - 3. Hubbell Power Systems, Inc.
 - 4. Ideal Industries, Inc.
 - 5. Ilsco; a branch of Bardes Corporation.
 - 6. NSi Industries LLC.
 - 7. O-Z/Gedney; a brand of the EGS Electrical Group.
 - 8. 3M; Electrical Markets Division.
 - 9. Tyco Electronics.
- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.3 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger, except VFC cable, which shall be extra flexible stranded.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type THHN-2-THWN-2, single conductors in raceway.
- B. Exposed Feeders: Type THHN-2-THWN-2, single conductors in raceway.

- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN-2-THWN-2, single conductors in raceway.
- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-2-THWN-2, single conductors in raceway.
- E. Exposed Branch Circuits, Including in Crawlspaces: Type THHN-2-THWN-2, single conductors in raceway.
- F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-2-THWN-2, single conductors in raceway.
- G. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-2-THWN-2, single conductors in raceway.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
- B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torquetightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

3.5 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."

B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260500 "Common Work Results for Electrical."

3.7 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly.

3.8 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
 - 2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
- B. Test and Inspection Reports: Prepare a written report to record the following:
 - 1. Procedures used.
 - 2. Results that comply with requirements.
 - 3. Results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- C. Cables will be considered defective if they do not pass tests and inspections.

END OF SECTION 260519

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Grounding systems and equipment.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
 - 1. Solid Conductors: ASTM B 3.
 - 2. Stranded Conductors: ASTM B 8.
 - 3. Tinned Conductors: ASTM B 33.
 - 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
 - 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
 - 6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
 - 7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

2.2 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, pressure type with at least two bolts.
 - 1. Pipe Connectors: Clamp type, sized for pipe.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- D. Bus-bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

2.3 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet in diameter.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 2/0 AWG minimum.
 - 1. Bury at least 24 inches below grade.
 - 2. Duct-Bank Grounding Conductor: Bury 12 inches above duct bank when indicated as part of duct-bank installation.
- C. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
 - 3. Connections to Structural Steel: Welded connectors.

3.2 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

3.3 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.
 - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
- C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
 - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
 - 3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

3.4 FIELD QUALITY CONTROL

- A. Report measured ground resistances that exceed the following values:
 - 1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
 - 2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
- B. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Hangers and supports for electrical equipment and systems.
 - 2. Construction requirements for concrete bases.
- B. Related Sections include the following:
 - 1. Section 260548 "Vibration and Seismic Controls for Electrical Systems" for products and installation requirements necessary for compliance with seismic criteria.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. IMC: Intermediate metal conduit.
- C. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

1.5 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel slotted support systems.
 - 2. Nonmetallic slotted support systems.

1.6 QUALITY ASSURANCE

A. Comply with NFPA 70.

1.7 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified together with concrete Specifications.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.; a division of Cooper Industries.
 - c. ERICO International Corporation.
 - d. GS Metals Corp.
 - e. Thomas & Betts Corporation.
 - f. Unistrut; Tyco International, Ltd.
 - g. Wesanco, Inc.
 - 2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 - 3. Channel Dimensions: Selected for applicable load criteria.
- B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

- 1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Hilti Inc.
 - 2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 3) MKT Fastening, LLC.
 - 4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.
- 2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Cooper B-Line, Inc.; a division of Cooper Industries.
 - 2) Empire Tool and Manufacturing Co., Inc.
 - 3) Hilti Inc.
 - 4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 5) MKT Fastening, LLC.
- 3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
- 4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
- 5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
- 6. Toggle Bolts: All-steel springhead type.
- 7. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Section 055000 "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by IBC. Minimum rod size shall be 1/4 inch in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slottedsupport system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 - 1. Secure raceways and cables to these supports with two-bolt conduit clamps.
- D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - 1. To Wood: Fasten with lag screws or through bolts.
 - 2. To New Concrete: Bolt to concrete inserts.
 - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 4. To Existing Concrete: Expansion anchor fasteners.
 - 5. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts.
 - 6. To Light Steel: Sheet metal screws.
 - 7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- B. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000-psi, 28-day compressive-strength concrete.
- C. Anchor equipment to concrete base.
 - 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

END OF SECTION 260529

SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Metal conduits, tubing, and fittings.
 - 2. Metal wireways and auxiliary gutters.
 - 3. Boxes, enclosures, and cabinets.
- B. Related Requirements:
 - 1. Section 260543 "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.

1.3 DEFINITIONS

- A. ARC: Aluminum rigid conduit.
- B. GRC: Galvanized rigid steel conduit.
- C. IMC: Intermediate metal conduit.

1.4 ACTION SUBMITTALS

A. Product Data: For raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

1.5 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Certificates: For enclosures, cabinets, and conduit racks and their mounting provisions, including those for internal components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

- 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- 4. Detailed description of conduit support devices and interconnections on which the certification is based and their installation requirements.
- B. Source quality-control reports.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Allied Tube & Conduit; a Tyco International Ltd. Co.
 - 3. Anamet Electrical, Inc.
 - 4. Electri-Flex Company.
 - 5. O-Z/Gedney; a brand of EGS Electrical Group.
 - 6. Picoma Industries, a subsidiary of Mueller Water Products, Inc.
 - 7. Republic Conduit.
 - 8. Robroy Industries.
 - 9. Southwire Company.
 - 10. Thomas & Betts Corporation.
 - 11. Western Tube and Conduit Corporation.
 - 12. Wheatland Tube Company; a division of John Maneely Company.
- B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. GRC: Comply with ANSI C80.1 and UL 6.
- D. ARC: Comply with ANSI C80.5 and UL 6A.
- E. IMC: Comply with ANSI C80.6 and UL 1242.
- F. EMT: Comply with ANSI C80.3 and UL 797.
- G. FMC: Comply with UL 1; zinc-coated steel.
- H. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
- I. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.1. Fittings for EMT:
 - a. Material: Steel.
 - b. Type: compression.

- 2. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
- 3. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.
- J. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Adalet.
 - 2. Cooper Technologies Company; Cooper Crouse-Hinds.
 - 3. EGS/Appleton Electric.
 - 4. Erickson Electrical Equipment Company.
 - 5. FSR Inc.
 - 6. Hoffman; a Pentair company.
 - 7. Hubbell Incorporated; Killark Division.
 - 8. Kraloy.
 - 9. Milbank Manufacturing Co.
 - 10. Mono-Systems, Inc.
 - 11. O-Z/Gedney; a brand of EGS Electrical Group.
 - 12. RACO; a Hubbell Company.
 - 13. Robroy Industries.
 - 14. Spring City Electrical Manufacturing Company.
 - 15. Stahlin Non-Metallic Enclosures; a division of Robroy Industries.
 - 16. Thomas & Betts Corporation.
 - 17. Wiremold / Legrand.
- B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- E. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.
- F. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- G. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.
- H. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

- I. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.
- J. Gangable boxes are prohibited.
- K. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 with continuous-hinge cover with flush latch unless otherwise indicated.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 - 2. Nonmetallic Enclosures: Plastic.
 - 3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
 - 1. Exposed Conduit: EMT.
 - 2. Concealed Conduit, Aboveground: EMT.
 - 3. Concealed Conduit, Aboveground within concrete beams and columns: RNC, Type EPC-40-PVC with rigid steel conduit elbows.
 - 4. Concealed Conduit, In concrete slab: RNC, Type EPC-40-PVC with rigid steel conduit elbows.
 - 5. Underground Conduit: See specification 260543.
 - 6. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
 - 7. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
- B. Indoors: Apply raceway products as specified below unless otherwise indicated:
 - 1. Exposed, Not Subject to Physical Damage: EMT.
 - 2. Exposed, Not Subject to Severe Physical Damage: EMT.
 - 3. Concealed in Ceilings and Interior Walls and Partitions: EMT.
 - 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
 - 5. Damp or Wet Locations: EMT.
- C. Minimum Raceway Size: 3/4-inch trade size.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
 - 1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
 - 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after

installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.

- 3. EMT: Use compression, steel fittings. Comply with NEMA FB 2.10.
- 4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
- E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.
- F. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- G. Install surface raceways only where indicated on Drawings.
- H. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

3.2 INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- C. Complete raceway installation before starting conductor installation.
- D. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
- E. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- F. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- H. Support conduit within 12 inches of enclosures to which attached.
- I. Stub-ups to Above Recessed Ceilings:
 - 1. Use EMT, IMC, or RMC for raceways.
 - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- J. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

- K. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- L. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- M. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- N. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- O. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- P. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- Q. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.
- R. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
 - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 - 2. Where an underground service raceway enters a building or structure.
 - 3. Where otherwise required by NFPA 70.
- S. Comply with manufacturer's written instructions for solvent welding RNC and fittings.
- T. Expansion-Joint Fittings:
 - 1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
 - 2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
 - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
- c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
- d. Attics: 135 deg F temperature change.
- 3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
- 4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
- 5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- U. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
 - 1. Use LFMC in damp or wet locations subject to severe physical damage.
 - 2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
- V. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to top of box unless otherwise indicated.
- W. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.
- X. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- Y. Locate boxes so that cover or plate will not span different building finishes.
- Z. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- AA. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- BB. Set metal floor boxes level and flush with finished floor surface.
- CC. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

- 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
- 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533

SECTION 260543 - UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Conduit, ducts, and duct accessories for direct-buried and concrete-encased duct banks, and in single duct runs.
 - 2. Handholes and boxes.

1.3 DEFINITION

A. RNC: Rigid nonmetallic conduit.

1.4 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Duct-bank materials, including separators and miscellaneous components.
 - 2. Ducts and conduits and their accessories, including elbows, end bells, bends, fittings, and solvent cement.
 - 3. Accessories for handholes, boxes.
 - 4. Warning tape.
 - 5. Warning planks.
- B. Shop Drawings for Factory-Fabricated Handholes and Boxes Other Than Precast Concrete: Include dimensioned plans, sections, and elevations, and fabrication and installation details, including the following:
 - 1. Duct entry provisions, including locations and duct sizes.
 - 2. Cover design.
 - 3. Grounding details.
 - 4. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.

1.5 INFORMATIONAL SUBMITTALS

A. Source quality-control test reports.

B. Field quality-control test reports.

1.6 QUALITY ASSURANCE

- A. Comply with ANSI C2.
- B. Comply with NFPA 70.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver ducts to Project site with ends capped. Store nonmetallic ducts with supports to prevent bending, warping, and deforming.

1.8 PROJECT CONDITIONS

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
 - 1. Notify Owner no fewer than seven days in advance of proposed interruption of electrical service.
 - 2. Do not proceed with interruption of electrical service without Owner's written permission.

1.9 COORDINATION

- A. Coordinate layout and installation of ducts, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field.
- B. Coordinate elevations of ducts and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of ducts and duct banks as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations from those indicated as required to suit field conditions and to ensure that duct runs drain to manholes and handholes, and as approved by Architect.

PART 2 - PRODUCTS

2.1 CONDUIT

- A. Rigid Steel Conduit: Galvanized. Comply with ANSI C80.1.
- B. RNC: NEMA TC 2, Type EPC-40-PVC, UL 651, with matching fittings by same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B.

2.2 NONMETALLIC DUCTS AND DUCT ACCESSORIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. ARNCO Corp.
 - 2. Beck Manufacturing.
 - 3. Cantex, Inc.
 - 4. CertainTeed Corp.; Pipe & Plastics Group.
 - 5. Condux International, Inc.
 - 6. ElecSys, Inc.
 - 7. Electri-Flex Company.
 - 8. IPEX Inc.
 - 9. Lamson & Sessions; Carlon Electrical Products.
 - 10. Manhattan/CDT; a division of Cable Design Technologies.
 - 11. Spiraduct/AFC Cable Systems, Inc.
- B. Duct Accessories:
 - 1. Duct Separators: Factory-fabricated rigid PVC interlocking spacers, sized for type and sizes of ducts with which used, and selected to provide minimum duct spacings indicated while supporting ducts during concreting or backfilling.
 - 2. Warning Tape: Underground-line warning tape specified in Section 260553 "Identification for Electrical Systems."
 - 3. Concrete Warning Planks: Nominal 12 by 24 by 3 inches in size, manufactured from 6000-psi concrete.
 - a. Color: Red dye added to concrete during batching.
 - b. Mark each plank with "ELECTRIC" in 2-inch- high, 3/8-inch- deep letters.

2.3 HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

- A. Description: Comply with SCTE 77.
 - 1. Color: Match color of installed surface.
 - 2. Configuration: Units shall be designed for flush burial and have open bottom, unless otherwise indicated.
 - 3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
 - 4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 - 5. Cover Legend: Molded lettering, "ELECTRIC."
 - 6. Direct-Buried Wiring Entrance Provisions: Knockouts equipped with insulated bushings or end-bell fittings, selected to suit box material, sized for wiring indicated, and arranged for secure, fixed installation in enclosure wall.
 - 7. Duct Entrance Provisions: Duct-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
 - 8. Handholes 12 inches wide by 24 inches long and larger shall have factory-installed inserts for cable racks and pulling-in irons.

- B. Polymer Concrete Handholes and Boxes with Polymer Concrete Cover: Molded of sand and aggregate, bound together with a polymer resin, and reinforced with steel or fiberglass or a combination of the two.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armorcast Products Company.
 - b. Carson Industries LLC.
 - c. CDR Systems Corporation.
 - d. NewBasis.

PART 3 - EXECUTION

3.1 UNDERGROUND DUCT APPLICATION

- A. Ducts for Electrical Cables Over 600 V: RNC, NEMA Type EPC-40-PVC, in concrete-encased duct bank, unless otherwise indicated.
- B. Ducts for Electrical Feeders 600 V and Less: RNC, NEMA Type EPC-40-PVC, in concreteencased duct bank, unless otherwise indicated.
- C. Ducts for Electrical Branch Circuits: RNC, NEMA Type EPC-40-PVC, in direct-buried duct bank, unless otherwise indicated.
- D. Ducts for Electrical Feeders and Ducts for Fiber (Telecomm) shall be kept a minimum of 24" apart.

3.2 UNDERGROUND ENCLOSURE APPLICATION

- A. Handholes and Boxes for 600 V and Less:
 - 1. Units in Roadways and Other Deliberate Traffic Paths: Precast concrete. AASHTO HB 17, H-10 structural load rating.
 - 2. Units in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Polymer concrete, SCTE 77, Tier 15 structural load rating.
 - 3. Units in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Polymer concrete units, SCTE 77, Tier 8 structural load rating.

3.3 EARTHWORK

- A. Restore surface features at areas disturbed by excavation and reestablish original grades, unless otherwise indicated. Replace removed sod immediately after backfilling is completed.
- B. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching.

C. Cut and patch existing pavement in the path of underground ducts and utility structures.

3.4 DUCT INSTALLATION

- A. Slope: Pitch ducts a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope ducts from a high point in runs between two manholes to drain in both directions.
- B. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 48 inches, both horizontally and vertically, at other locations, unless otherwise indicated.
- C. Joints: Use solvent-cemented joints in ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in same plane.
- D. Duct Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use end bells, spaced approximately 10 inches o.c. for 5-inch ducts, and vary proportionately for other duct sizes.
 - 1. Begin change from regular spacing to end-bell spacing 10 feet from the end bell without reducing duct line slope and without forming a trap in the line.
 - 2. Direct-Buried Duct Banks: Install an expansion and deflection fitting in each conduit in the area of disturbed earth adjacent to manhole or handhole.
 - 3. Grout end bells into structure walls from both sides to provide watertight entrances.
- E. Building Wall Penetrations: Make a transition from underground duct to rigid steel conduit at least 5 feet outside the building wall without reducing duct line slope away from the building, and without forming a trap in the line. Use fittings manufactured for duct-to-conduit transition. Install conduit penetrations of building walls as specified in Section 260500 "Common Work Results for Electrical."
- F. Sealing: Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psig hydrostatic pressure.
- G. Pulling Cord: Install 100-lbf- test nylon cord in ducts, including spares.
- H. Concrete-Encased Ducts: Support ducts on duct separators.
 - 1. Concrete: Provide red colored concrete.
 - 2. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts, with not less than 5 spacers per 20 feet of duct. Secure separators to earth and to ducts to prevent floating during concreting. Stagger separators approximately 6 inches between tiers. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
 - 3. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.

- a. Start at one end and finish at the other, allowing for expansion and contraction of ducts as their temperature changes during and after the pour. Use expansion fittings installed according to manufacturer's written recommendations, or use other specific measures to prevent expansion-contraction damage.
- b. If more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch reinforcing rod dowels extending 18 inches into concrete on both sides of joint near corners of envelope.
- 4. Pouring Concrete: Spade concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Use a plank to direct concrete down sides of bank assembly to trench bottom. Allow concrete to flow to center of bank and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-bank application.
- 5. Reinforcement: Reinforce concrete-encased duct banks where they cross disturbed earth and where indicated. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.
- 6. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
- 7. Minimum Space between Ducts: 3 inches between ducts and exterior envelope wall, 2 inches between ducts for like services, and 4 inches between power and signal ducts.
- 8. Depth: Install top of duct bank at least 24 inches below finished grade in areas not subject to deliberate traffic, and at least 30 inches below finished grade in deliberate traffic paths for vehicles, unless otherwise indicated.
- 9. Stub-Ups: Use manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
 - b. Stub-Ups to Equipment: For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of base. Install insulated grounding bushings on terminations at equipment.
- 10. Warning Tape: Bury warning tape approximately 12 inches above all concrete-encased ducts and duct banks. Align tape parallel to and within 3 inches of the centerline of duct bank. Provide an additional warning tape for each 12-inch increment of duct-bank width over a nominal 18 inches. Space additional tapes 12 inches apart, horizontally.
- I. Direct-Buried Duct Banks:
 - 1. Support ducts on duct separators coordinated with duct size, duct spacing, and outdoor temperature.
 - 2. Space separators close enough to prevent sagging and deforming of ducts, with not less than 5 spacers per 20 feet of duct. Secure separators to earth and to ducts to prevent displacement during backfill and yet permit linear duct movement due to expansion and contraction as temperature changes. Stagger spacers approximately 6 inches between tiers.
 - 3. Excavate trench bottom to provide firm and uniform support for duct bank. Prepare trench bottoms as specified in Section 312000 "Earth Moving" for pipes less than 6 inches in nominal diameter.
 - 4. Install backfill as specified in Section 312000 "Earth Moving."

- 5. After installing first tier of ducts, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand-place backfill to 4 inches over ducts and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling with normal compaction as specified in Section 312000 "Earth Moving."
- 6. Depth: Install top of duct bank at least 36 inches below finished grade, unless otherwise indicated.
- 7. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
 - b. For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.
- 8. Warning Planks: Bury warning planks approximately 12 inches above direct-buried ducts and duct banks, placing them 24 inches o.c. Align planks along the width and along the centerline of duct bank. Provide an additional plank for each 12-inch increment of duct-bank width over a nominal 18 inches. Space additional planks 12 inches apart, horizontally.

3.5 INSTALLATION OF HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of ducts, and seal joint between box and extension as recommended by the manufacturer.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas and trafficways, set so cover surface will be flush with finished grade. Set covers of other handholes 1 inch above finished grade.
- D. Field-cut openings for ducts and conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.
- E. For enclosures installed in asphalt paving and subject to occasional, nondeliberate, heavyvehicle loading, form and pour a concrete ring encircling, and in contact with, enclosure and with top surface screeded to top of box cover frame. Bottom of ring shall rest on compacted earth.
 - 1. Concrete: 3000 psi, 28-day strength.
 - 2. Dimensions: 10 inches wide by 12 inches deep.

3.6 GROUNDING

A. Ground underground ducts and utility structures according to Section 260526 "Grounding and Bonding for Electrical Systems."

3.7 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections and prepare test reports:
 - 1. Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.
 - 2. Pull aluminum or wood test mandrel through duct to prove joint integrity and test for outof-round duct. Provide mandrel equal to 80 percent fill of duct. If obstructions are indicated, remove obstructions and retest.
 - 3. Test handhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Correct deficiencies and retest as specified above to demonstrate compliance.

END OF SECTION 260543

SECTION 260548 - VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Isolation pads.
 - 2. Spring isolators.
 - 3. Restrained spring isolators.
 - 4. Channel support systems.
 - 5. Restraint cables.
 - 6. Hanger rod stiffeners.
 - 7. Anchorage bushings and washers.
- B. Related Sections include the following:
 - 1. Section 260529 "Hangers and Supports for Electrical Systems" for commonly used electrical supports and installation requirements.

1.3 DEFINITIONS

- A. The IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.

1.4 PERFORMANCE REQUIREMENTS

- A. Seismic-Restraint Loading:
 - 1. See Structural Code Sheet.

1.5 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.

- 2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
 - a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an evaluation service member of ICC-ES.
 - b. Annotate to indicate application of each product submitted and compliance with requirements.
- 3. Restrained-Isolation Devices: Include ratings for horizontal, vertical, and combined loads.
- B. Delegated-Design Submittal: For vibration isolation and seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic forces required to select vibration isolators and seismic restraints.
 - a. Coordinate design calculations with wind-load calculations required for equipment mounted outdoors. Comply with requirements in other electrical Sections for equipment mounted outdoors.
 - 2. Indicate materials and dimensions and identify hardware, including attachment and anchorage devices.
 - 3. Field-fabricated supports.
 - 4. Seismic-Restraint Details:
 - a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
 - b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
 - c. Preapproval and Evaluation Documentation: By an evaluation service member of ICC-ES, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

1.6 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Show coordination of seismic bracing for electrical components with other systems and equipment in the vicinity, including other supports and seismic restraints.
- B. Qualification Data: For professional engineer.
- C. Welding certificates.
- D. Field quality-control test reports.

1.7 QUALITY ASSURANCE

- A. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code Steel."
- C. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.
- D. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ace Mountings Co., Inc.
 - 2. Amber/Booth Company, Inc.
 - 3. California Dynamics Corporation.
 - 4. Isolation Technology, Inc.
 - 5. Kinetics Noise Control.
 - 6. Mason Industries.
 - 7. Vibration Eliminator Co., Inc.
 - 8. Vibration Isolation.
 - 9. Vibration Mountings & Controls, Inc.
- B. Pads: Arrange in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.
 - 1. Resilient Material: Oil- and water-resistant neoprene.
- C. Spring Isolators: Freestanding, laterally stable, open-spring isolators.
 - 1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - 2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - 3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 - 4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

- 5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch- thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 500 psig.
- 6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

2.2 SEISMIC-RESTRAINT DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Amber/Booth Company, Inc.
 - 2. California Dynamics Corporation.
 - 3. Cooper B-Line, Inc.; a division of Cooper Industries.
 - 4. Hilti Inc.
 - 5. Loos & Co.; Seismic Earthquake Division.
 - 6. Mason Industries.
 - 7. TOLCO Incorporated; a brand of NIBCO INC.
 - 8. Unistrut; Tyco International, Ltd.
- B. General Requirements for Restraint Components: Rated strengths, features, and application requirements shall be as defined in reports by an evaluation service member of ICC-ES.
 - 1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.
- C. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.
- D. Restraint Cables: ASTM A 603 galvanized-steel cables with end connections made of steel assemblies with thimbles, brackets, swivels, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.
- E. Hanger Rod Stiffener: Reinforcing steel angle clamped to hanger rod. Do not weld stiffeners to rods.
- F. Bushings for Floor-Mounted Equipment Anchor: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchors and studs.
- G. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices.
- H. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.
- I. Mechanical Anchor: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchors with strength

required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.

J. Adhesive Anchor: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.3 FACTORY FINISHES

- A. Finish: Manufacturer's standard prime-coat finish ready for field painting.
- B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
 - 1. Powder coating on springs and housings.
 - 2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
 - 3. Baked enamel or powder coat for metal components on isolators for interior use.
 - 4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Multiple Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application by an evaluation service member of ICC-ES.
- B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Equipment and Hanger Restraints:
 - 1. Install restrained isolators on electrical equipment.
 - 2. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
 - 3. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES providing required submittals for component.
- B. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- C. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- D. Drilled-in Anchors:
 - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
 - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 - 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
 - 4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
 - 5. Set anchors to manufacturer's recommended torque, using a torque wrench.
 - 6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where they terminate with connection to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:

- 1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
- 2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
- 3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
- 4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
- 5. Test to 90 percent of rated proof load of device.
- 6. Measure isolator restraint clearance.
- 7. Measure isolator deflection.
- 8. Verify snubber minimum clearances.
- 9. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.
- C. Remove and replace malfunctioning units and retest as specified above.
- D. Prepare test and inspection reports.

3.6 ADJUSTING

- A. Adjust isolators after isolated equipment is at operating weight.
- B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
- C. Adjust active height of spring isolators.
- D. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION 260548

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Identification for raceways.
 - 2. Identification of power and control cables.
 - 3. Identification for conductors.
 - 4. Underground-line warning tape.
 - 5. Warning labels and signs.
 - 6. Instruction signs.
 - 7. Equipment identification labels.
 - 8. Miscellaneous identification products.

1.3 ACTION SUBMITTALS

- A. Product Data: For each electrical identification product indicated.
- 1.4 QUALITY ASSURANCE
 - A. Comply with ANSI A13.1 and IEEE C2.
 - B. Comply with NFPA 70.
 - C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
 - D. Comply with ANSI Z535.4 for safety signs and labels.
 - E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.5 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 POWER AND CONTROL RACEWAY IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.
- B. Colors for Raceways Carrying Circuits at 600 V or Less:
 - 1. Black letters on an orange field.
 - 2. Legend: Indicate voltage and system or service type.
- C. Colors for Raceways Carrying Circuits at More Than 600 V:
 - 1. Black letters on an orange field.
 - 2. Legend: "DANGER CONCEALED HIGH VOLTAGE WIRING."
- D. Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.
- E. Snap-Around Labels for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- F. Snap-Around, Color-Coding Bands for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- G. Tape and Stencil for Raceways Carrying Circuits More Than 600 V: 4-inch- wide black stripes on 10-inch centers diagonally over orange background that extends full length of raceway or duct and is 12 inches wide. Stop stripes at legends.
- H. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.
- I. Write-On Tags: Polyester tag, 0.010 inch thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
 - 1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.

2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.2 ARMORED AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each cable size.
- B. Colors for Cables Carrying Circuits at 600 V and Less:
 - 1. Black letters on an orange field.
 - 2. Legend: Indicate voltage and system or service type.
- C. Colors for Cables Carrying Circuits at More Than 600 V:
 - 1. Black letters on an orange field.
 - 2. Legend: "DANGER HIGH VOLTAGE WIRING."
- D. Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.
- E. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches wide; compounded for outdoor use.
- F. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tube with machine-printed identification label. Sized to suit diameter of and shrinks to fit firmly around cable it identifies. Full shrink recovery at a maximum of 200 deg F. Comply with UL 224.

2.3 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each cable size.
- B. Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.
- C. Self-Adhesive, Self-Laminating Polyester Labels: Write-on, 3-mil- thick flexible label with acrylic pressure-sensitive adhesive that provides a clear, weather- and chemical-resistant, self-laminating, protective shield over the legend. Labels sized to fit the cable diameter such that the clear shield overlaps the entire printed legend.
- D. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tube with machine-printed identification label. Sized to suit diameter of and shrinks to fit firmly around cable it identifies. Full shrink recovery at a maximum of 200 deg F. Comply with UL 224.
- E. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.

- F. Write-On Tags: Polyester tag, 0.015 inch thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
 - 1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
 - 2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.
- G. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of cable it identifies and to stay in place by gripping action.
- H. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of cable it identifies and to stay in place by gripping action.

2.4 CONDUCTOR IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.
- B. Self-Adhesive, Self-Laminating Polyester Labels: Write-on, 3-mil- thick flexible label with acrylic pressure-sensitive adhesive that provides a clear, weather- and chemical-resistant, self-laminating, protective shield over the legend. Labels sized to fit the conductor diameter such that the clear shield overlaps the entire printed legend.
- C. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of conductor it identifies and to stay in place by gripping action.
- D. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve with diameter sized to suit diameter of conductor it identifies and to stay in place by gripping action.
- E. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tube with machine-printed identification label. Sized to suit diameter of and shrinks to fit firmly around conductor it identifies. Full shrink recovery at a maximum of 200 deg F. Comply with UL 224.
- F. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- G. Write-On Tags: Polyester tag, 0.015 inch thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
 - 1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
 - 2. Labels for Tags: Self-adhesive label, machine-printed with permanent, waterproof, black ink recommended by printer manufacturer, sized for attachment to tag.

- A. Tape:
 - 1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical utility lines.
 - 2. Printing on tape shall be permanent and shall not be damaged by burial operations.
 - 3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.
- B. Color and Printing:
 - 1. Comply with ANSI Z535.1 through ANSI Z535.5.
 - 2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE,.

2.6 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.
- C. Baked-Enamel Warning Signs:
 - 1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
 - 2. 1/4-inch grommets in corners for mounting.
 - 3. Nominal size, 7 by 10 inches.
- D. Warning label and sign shall include, but are not limited to, the following legends:
 - 1. Multiple Power Source Warning: "DANGER ELECTRICAL SHOCK HAZARD EQUIPMENT HAS MULTIPLE POWER SOURCES."
 - 2. Workspace Clearance Warning: "WARNING OSHA REGULATION AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

2.7 INSTRUCTION SIGNS

- A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. inches and 1/8 inch thick for larger sizes.
 - 1. Engraved legend with black letters on white face.
 - 2. Punched or drilled for mechanical fasteners.
 - 3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.
- B. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch.

C. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and UV-resistant seal for label.

2.8 EQUIPMENT IDENTIFICATION LABELS

- A. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch.
- B. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and UV-resistant seal for label.
- C. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch.
- D. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch.

2.9 CABLE TIES

- A. General-Purpose Cable Ties: Fungus inert, self extinguishing, one piece, self locking, Type 6/6 nylon.
 - 1. Minimum Width: 3/16 inch.
 - 2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
 - 3. Temperature Range: Minus 40 to plus 185 deg F.
 - 4. Color: Black except where used for color-coding.
- B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self extinguishing, one piece, self locking, Type 6/6 nylon.
 - 1. Minimum Width: 3/16 inch.
 - 2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
 - 3. Temperature Range: Minus 40 to plus 185 deg F.
 - 4. Color: Black.

2.10 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

3.1 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- F. Attach plastic raceway and cable labels that are not self-adhesive type with clear vinyl tape with adhesive appropriate to the location and substrate.
- G. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
- H. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.
- I. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:
 - 1. Outdoors: UV-stabilized nylon.
 - 2. In Spaces Handling Environmental Air: Plenum rated.
- J. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trenchexceeds 16 inches overall.

3.2 IDENTIFICATION SCHEDULE

- A. Concealed Raceways, Duct Banks, More Than 600 V, within Buildings: Tape and stencil 4inch- wide black stripes on 10-inch centers over orange background that extends full length of raceway or duct and is 12 inches wide. Stencil legend "DANGER CONCEALED HIGH VOLTAGE WIRING" with 3-inch- high black letters on 20-inch centers. Stop stripes at legends. Apply to the following finished surfaces:
 - 1. Floor surface directly above conduits running beneath and within 12 inches of a floor that is in contact with earth or is framed above unexcavated space.

- 2. Wall surfaces directly external to raceways concealed within wall.
- 3. Accessible surfaces of concrete envelope around raceways in vertical shafts, exposed in the building, or concealed above suspended ceilings.
- B. Accessible Raceways, Armored and Metal-Clad Cables, More Than 600 V: Self-adhesive vinyl labels. Install labels at 10-foot maximum intervals.
- C. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A, and 120 V to ground: Identify with self-adhesive vinyl label. Install labels at 30-foot maximum intervals.
- D. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.
 - 1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service and feeder conductors.
 - a. Color shall be factory applied[or field applied for sizes larger than No. 8 AWG.
 - b. Colors for 208/120-V Circuits:
 - 1) Phase A: Black.
 - 2) Phase B: Red.
 - 3) Phase C: Blue.
 - c. Colors for 480/277-V Circuits:
 - 1) Phase A: Brown.
 - 2) Phase B: Orange.
 - 3) Phase C: Yellow.
 - d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
- E. Power-Circuit Conductor Identification, More than 600 V: For conductors in vaults, pull and junction boxes, manholes, and handholes, use write-on tags.
- F. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.
- G. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive vinyl labels with the conductor or cable designation, origin, and destination.
- H. Control-Circuit Conductor Termination Identification: For identification at terminations provide self-adhesive vinyl labels with the conductor designation.
- I. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source.

- J. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
 - 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
 - 2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
 - 3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.
- K. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.
 - 1. Limit use of underground-line warning tape to direct-buried cables.
 - 2. Install underground-line warning tape for both direct-buried cables and cables in raceway.
- L. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.
- M. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Selfadhesive warning labels.
 - 1. Comply with 29 CFR 1910.145.
 - 2. Identify system voltage with black letters on an orange background.
 - 3. Apply to exterior of door, cover, or other access.
 - 4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:
 - a. Power transfer switches.
 - b. Controls with external control power connections.
- N. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
 - 1. Labeling Instructions:
 - a. Indoor Equipment: Adhesive film label. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high label; where two lines of text are required, use labels 2 inches high.
 - b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
 - c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.

- d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.
- 2. Equipment to Be Labeled:
 - a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be self-adhesive, engraved, laminated acrylic or melamine label.
 - b. Enclosures and electrical cabinets.
 - c. Access doors and panels for concealed electrical items.
 - d. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
 - e. Enclosed switches.
 - f. Enclosed circuit breakers.
 - g. Enclosed controllers.
 - h. Variable-speed controllers.
 - i. Automatic Transfer Switches.

END OF SECTION 260553

SECTION 260573 - OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes computer-based, fault-current and overcurrent protective device coordination studies. Protective devices shall be set based on results of the protective device coordination study.
- B. The contractor shall furnish an Arc Flash Hazard Analysis Study per the requirements set forth in NFPA 70E Standard for Electrical Safety in the Workplace. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E-2004, Annex D.

1.3 ACTION SUBMITTALS

- A. Product Data: For computer software program to be used for studies.
- B. Other Action Submittals: The following submittals shall be made after the approval process for system protective devices has been completed. Submittals may be in digital form.
 - 1. Coordination-study input data, including completed computer program input data sheets.
 - 2. Study and Equipment Evaluation Reports.
 - 3. Coordination-Study Report draft copy and sealed and signed by professional engineer for final submission.
 - 4. Arc Flash Evaluation.
 - 5. Arc flash labels shall be provided in hard copy only.
 - 6. Submit certified "as-set" overcurrent protective device tabulations for the record.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For coordination-study specialist.
- B. Product Certificates: For coordination-study and fault-current-study computer software programs, certifying compliance with IEEE 399.

1.5 QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are not acceptable.

- B. Coordination-Study Specialist Qualifications: An entity experienced in the application of computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.
 - 1. Professional engineer, licensed in the state where Project is located, shall be responsible for the study. All elements of the study shall be performed under the direct supervision and control of engineer.
- C. Comply with IEEE 242 for short-circuit currents and coordination time intervals.
- D. Comply with IEEE 399 for general study procedures.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

- A. Computer Software Developers: Subject to compliance with requirements, provide products by one of the following:
 - 1. <u>CGI CYME</u>.
 - 2. EDSA Micro Corporation.
 - 3. <u>ESA Inc</u>.
 - 4. <u>Operation Technology, Inc</u>.
 - 5. SKM Systems Analysis, Inc.

2.2 COMPUTER SOFTWARE PROGRAM REQUIREMENTS

- A. Comply with IEEE 399.
- B. Analytical features of fault-current-study computer software program shall include "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.
- C. Computer software program shall be capable of plotting and diagramming time-currentcharacteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.
 - 1. Optional Features:
 - a. Arcing faults.
 - b. Simultaneous faults.
 - c. Explicit negative sequence.
 - d. Mutual coupling in zero sequence.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance.

Devices to be coordinated are indicated on single line diagram and include all new gear and existing medium voltage switch and transformer ahead of the building distribution.

1. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.

3.2 POWER SYSTEM DATA

- A. Gather and tabulate the following input data to support coordination study:
 - 1. Product Data for overcurrent protective devices specified in other electrical Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
 - 2. Product Data on existing medium voltage switches and existing cable lengths.
 - 3. Impedance of utility service entrance.
 - 4. Electrical Distribution System Diagram: In hard-copy and electronic-copy formats, showing the following:
 - a. Circuit-breaker and fuse-current ratings and types.
 - b. Relays and associated power and current transformer ratings and ratios.
 - c. Transformer kilovolt amperes, primary and secondary voltages, connection type, impedance, and X/R ratios.
 - d. Generator kilovolt amperes, size, voltage, and source impedance.
 - e. Cables: Indicate conduit material, sizes of conductors, conductor material, insulation, and length.
 - f. Busway ampacity and impedance.
 - g. Motor horsepower and code letter designation according to NEMA MG 1.
 - 5. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram, showing the following:
 - a. Special load considerations, including starting inrush currents and frequent starting and stopping.
 - b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
 - c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
 - d. Generator thermal-damage curve.
 - e. Ratings, types, and settings of utility company's overcurrent protective devices.
 - f. Special overcurrent protective device settings or types stipulated by utility company.
 - g. Time-current-characteristic curves of devices indicated to be coordinated.
 - h. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
 - i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.

j. Panelboards, switchboards, motor-control center ampacity, and interrupting rating in amperes rms symmetrical.

3.3 FAULT-CURRENT STUDY

- A. Calculate the maximum available short-circuit current in amperes rms symmetrical at circuitbreaker positions of the electrical power distribution system. The calculation shall be for a current immediately after initiation and for a three-phase bolted short circuit at each of the following:
 - 1. At each Medium Voltage switch back to the SCE&G source at Heyward and Sumter Streets (see one-line diagram).
 - 2. Switchboard bus.
 - 3. Distribution panelboard.
 - 4. Branch circuit panelboard.
- B. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Include studies of system-switching configurations and alternate operations that could result in maximum fault conditions.
- C. Calculate momentary and interrupting duties on the basis of maximum available fault current.
- D. Calculations to verify interrupting ratings of overcurrent protective devices shall comply with IEEE 241 and IEEE 242.
 - 1. Transformers:
 - a. ANSI C57.12.10.
 - b. ANSI C57.12.22.
 - c. ANSI C57.12.40.
 - d. IEEE C57.12.00.
 - e. IEEE C57.96.
 - 2. Low-Voltage Circuit Breakers: IEEE 1015 and IEEE C37.20.1.
 - 3. Low-Voltage Fuses: IEEE C37.46.
- E. Study Report:
 - 1. Show calculated X/R ratios and equipment interrupting rating (1/2-cycle) fault currents on electrical distribution system diagram.
- F. Equipment Evaluation Report:
 - 1. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
 - 2. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.
 - 3. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

3.4 COORDINATION STUDY

- A. Perform coordination study using approved computer software program. Prepare a written report using results of fault-current study. Comply with IEEE 399.
 - 1. Calculate the maximum and minimum 1/2-cycle short-circuit currents.
 - 2. Calculate the maximum and minimum ground-fault currents.
- B. Comply with IEEE 241 and IEEE 242 recommendations for fault currents and time intervals.
- C. Transformer Primary Overcurrent Protective Devices:
 - 1. Device shall not operate in response to the following:
 - a. Inrush current when first energized.
 - b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
 - c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.
 - 2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.
- D. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and conductor melting curves in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.
- E. Coordination-Study Report: Prepare a written report indicating the following results of coordination study:
 - 1. Tabular Format of Settings Selected for Overcurrent Protective Devices:
 - a. Device tag.
 - b. Relay-current transformer ratios; and tap, time-dial, and instantaneous-pickup values.
 - c. Circuit-breaker sensor rating; and long-time, short-time, and instantaneous settings.
 - d. Fuse-current rating and type.
 - e. Ground-fault relay-pickup and time-delay settings.
 - 2. Coordination Curves: Prepared to determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:
 - a. Device tag.
 - b. Voltage and current ratio for curves.
 - c. Three-phase and single-phase damage points for each transformer.
 - d. No damage, melting, and clearing curves for fuses.
 - e. Cable damage curves.

- f. Transformer inrush points.
- g. Maximum fault-current cutoff point.
- 3. The report shall be sealed by the professional engineer who performed the study.
- F. Completed data sheets for setting of overcurrent protective devices.

3.5 ARC FLASH EVALUATION

- A. Perform calculation to determine the incident energy and arc flash boundary for each location in the power system.
- B. Incident energy and arc flash boundaries shall following the NFPA 70E and IEEE 1584 standards.
- C. Arc Flash Report:
 - 1. Incident energy and flash protection boundary calculations
 - a. Arcing fault magnitude
 - b. Protective device clearing time
 - c. Duration of arc
 - d. Arc flash boundary
 - e. Working distance
 - f. Incident energy
 - g. Hazard Risk Category
 - 2. Recommendations for arc flash energy reduction

3.6 ARC FLASH WARNING LABELS

- A. The contractor of the Arc Flash Hazard Analysis shall provide a 3.5 in. x 5 in. thermal transfer type label of high adhesion polyester for each work location analyzed.
- B. All labels will be based on recommended overcurrent device settings and will be provided after the results of the analysis have been presented to the owner and after any system changes, upgrades or modifications have been incorporated in the system.
- C. The label shall include the following information, at a minimum:
 - 1. Location designation
 - 2. Nominal voltage
 - 3. Flash protection boundary
 - 4. Hazard risk category
 - 5. Incident energy
 - 6. Working distance
 - 7. Engineering report number, revision number and issue date.
- D. Labels shall be machine printed, with no field markings.
- E. Arc flash labels shall be provided in the following manner and all labels shall be based on recommended overcurrent device settings.
 - 1. For each 480 and 208 volt panelboard, one arc flash label shall be provided.

University of South Carolina Softball Stadium Construction BID SET

2. For each switchboard, one arc flash label shall be provided.

END OF SECTION 260573
SECTION 262200 - LOW-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following types of dry-type transformers rated 600 V and less, with capacities up to 1000 kVA:
 - 1. Distribution transformers.

1.3 ACTION SUBMITTALS

- A. Product Data: Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer indicated.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Wiring Diagrams: Power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- Manufacturer Seismic Qualification Certification: Submit certification that transformers, accessories, and components will withstand seismic forces defined in Section 260548
 "Vibration and Seismic Controls for Electrical Systems." Include the following:
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- B. Qualification Data: For testing agency.

- C. Source quality-control test reports.
- D. Field quality-control test reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain each transformer type through one source from a single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with IEEE C57.12.91, "Test Code for Dry-Type Distribution and Power Transformers."

1.7 COORDINATION

- A. Coordinate size and location of concrete bases with actual transformer provided. Cast anchorbolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.
- B. Coordinate installation of wall-mounting and structure-hanging supports with actual transformer provided.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Products.
 - 2. General Electric Company.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D; Schneider Electric.

2.2 GENERAL TRANSFORMER REQUIREMENTS

- A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.
- B. Cores: Grain-oriented, non-aging silicon steel.

- C. Coils: Continuous windings without splices except for taps.
 - 1. Internal Coil Connections: Brazed or pressure type.
 - 2. Coil Material: Aluminum.

2.3 DISTRIBUTION TRANSFORMERS

- A. Comply with NEMA ST 20, and list and label as complying with UL 1561.
- B. Provide transformers that are constructed to withstand seismic forces specified in Section 260548 "Vibration and Seismic Controls for Electrical Systems."
- C. Cores: One leg per phase.
- D. Enclosure: Ventilated, NEMA 250, Type 2.
 - 1. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.
- E. Transformer Enclosure Finish: Comply with NEMA 250.
 - 1. Finish Color: Gray.
- F. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity.
- G. Insulation Class: 220 deg C, UL-component-recognized insulation system with a maximum of 115 deg C rise above 40 deg C ambient temperature.
- H. Energy Efficiency for Transformers Rated 15 kVA and Larger:
 - 1. Complying with NEMA TP 1, Class 1 efficiency levels.
 - 2. Tested according to NEMA TP 2.
- I. Low-Sound-Level Requirements: Minimum of 3 dBA less than NEMA ST 20 standard sound levels when factory tested according to IEEE C57.12.91.
- J. Low-Sound-Level Requirements: Maximum sound levels, when factory tested according to IEEE C57.12.91, as follows:
 - 1. 151 to 300 kVA: 50 dB
 - 2. 301 to 500 kVA: 60 dB

2.4 IDENTIFICATION DEVICES

A. Nameplates: Engraved, laminated-plastic or metal nameplate for each distribution transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Section 260553 "Identification for Electrical Systems."

2.5 SOURCE QUALITY CONTROL

- A. Test and inspect transformers according to IEEE C57.12.91.
- B. Factory Sound-Level Tests: Conduct sound-level tests on equipment for this Project.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.
- B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.
- C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.
- D. Verify that ground connections are in place and requirements in Section 260526 "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Construct concrete bases and anchor floor-mounting transformers according to manufacturer's written instructions, seismic codes applicable to Project, and requirements in Section 260529 "Hangers and Supports for Electrical Systems."

3.3 CONNECTIONS

- A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

- B. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
- C. Remove and replace units that do not pass tests or inspections and retest as specified above.
- D. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

3.5 ADJUSTING

- A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 10 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.
- B. Output Settings Report: Prepare a written report recording output voltages and tap settings.

3.6 CLEANING

A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION 262200

SECTION 262413 - SWITCHBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Service and distribution switchboards rated 600 V and less.
 - 2. Transient voltage suppression devices.
 - 3. Disconnecting and overcurrent protective devices.
 - 4. Identification.

1.3 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Switchboards shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of switchboard, overcurrent protective device, transient voltage suppression device, ground-fault protector, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
- B. Shop Drawings: For each switchboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings.
 - 2. Detail enclosure types for types other than NEMA 250, Type 1.
 - 3. Detail bus configuration, current, and voltage ratings.
 - 4. Detail short-circuit current rating of switchboards and overcurrent protective devices.
 - 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

6. Include time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

1.5 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Certificates: Submit certification that switchboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Section 260548 "Vibration and Seismic Controls for Electrical Systems." Include the following:
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- B. Field Quality-Control Reports:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For switchboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823
 "Operation and Maintenance Data," include the following:
 - 1. Routine maintenance requirements for switchboards and all installed components.
 - 2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 - 3. Time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers qualified as defined in NEMA PB 2.1 and trained in electrical safety as required by NFPA 70E.
- B. Source Limitations: Obtain switchboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchboards including clearances between switchboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. Comply with NEMA PB 2.
- F. Comply with NFPA 70.
- G. Comply with UL 891.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver switchboards in sections or lengths that can be moved past obstructions in delivery path.
- B. Handle and prepare switchboards for installation according to NECA 400.

1.9 PROJECT CONDITIONS

- A. Environmental Limitations:
 - 1. Do not deliver or install switchboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above switchboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
 - 2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Not exceeding 104 deg F (40 deg C).
 - b. Altitude: Not exceeding 6600 feet (2000 m).
- B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 - 1. Notify Owner no fewer than seven days in advance of proposed interruption of electric service.
 - 2. Indicate method of providing temporary electric service.
 - 3. Do not proceed with interruption of electric service without Owner's written permission.
 - 4. Comply with NFPA 70E.

1.10 COORDINATION

A. Coordinate layout and installation of switchboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchorbolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

1.11 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. <u>General Electric Company; GE Consumer & Industrial Electrical Distribution</u>.
 - 3. <u>Siemens Energy & Automation, Inc</u>.
 - 4. <u>Square D; a brand of Schneider Electric</u>.
- B. Front-Connected, Front-Accessible Switchboards:
 - 1. Main Devices: Fixed, individually mounted.
 - 2. Branch Devices: Panel mounted.
 - 3. Sections front and rear aligned.
- C. Nominal System Voltage: 480Y/277 V.
- D. Seismic Requirements: Fabricate and test switchboards according to IEEE 344 to withstand seismic forces defined in Section 260548 "Vibration and Seismic Controls for Electrical Systems."
- E. Indoor Enclosures: Steel, NEMA 250, Type 1.
- F. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.
- G. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard.
- H. Removable, Hinged Rear Doors and Compartment Covers: Secured by standard bolts, for access to rear interior of switchboard.
- I. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments.

- J. Buses and Connections: Three phase, four wire unless otherwise indicated.
 - 1. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity, silverplated, with tin-plated aluminum or copper feeder circuit-breaker line connections.
 - 2. Load Terminals: Insulated, rigidly braced, runback bus extensions, of same material as through buses, equipped with mechanical connectors for outgoing circuit conductors. Provide load terminals for future circuit-breaker positions at full-ampere rating of circuit-breaker position.
 - 3. Ground Bus: 1/4-by-2-inch- (6-by-50-mm-) hard-drawn copper of 98 percent conductivity, equipped with mechanical connectors for feeder and branch-circuit ground conductors. For busway feeders, extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.
 - 4. Main Phase Buses and Equipment Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.
 - 5. Neutral Buses: 100 percent of the ampacity of phase buses unless otherwise indicated, equipped with mechanical connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus.
- K. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.

2.2 TRANSIENT VOLTAGE SUPPRESSION DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. <u>Eaton Electrical Inc.; Cutler-Hammer Business Unit</u>.
 - 2. <u>General Electric Company; GE Consumer & Industrial Electrical Distribution</u>.
 - 3. <u>Siemens Energy & Automation, Inc</u>.
 - 4. <u>Square D; a brand of Schneider Electric</u>.
- B. Surge Protection Device Description: IEEE C62.41-compliant, integrally mounted, wired-in, solid-state, parallel-connected, modular (with field-replaceable modules) type, with sine-wave tracking suppression and filtering modules, UL 1449, second edition, short-circuit current rating matching or exceeding the switchboard short-circuit rating, and with the following features and accessories:
 - 1. Fabrication using bolted compression lugs for internal wiring.
 - 2. Integral disconnect switch.
 - 3. Redundant suppression circuits.
 - 4. Redundant replaceable modules.
 - 5. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
 - 6. LED indicator lights for power and protection status.
 - 7. Audible alarm, with silencing switch, to indicate when protection has failed.
 - 8. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of system operation. Contacts shall reverse position on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
 - 9. Six-digit, transient-event counter set to totalize transient surges.

- C. Peak Single-Impulse Surge Current Rating: 120 kA per mode/240 kA per phase.
- D. Withstand Capabilities: 12,000 IEEE C62.41, Category C3 (10 kA), 8-by-20-mic.sec. surges with less than 5 percent change in clamping voltage.
- E. Protection modes and UL 1449 SVR for grounded wye circuits with 480Y/277-V, three-phase, four-wire circuits shall be as follows:
 - 1. Line to Neutral: 800 V for 480Y/277.
 - 2. Line to Ground: 800 V for 480Y/277.
 - 3. Neutral to Ground: 800 V for 480Y/277.
- F. Protection modes and UL 1449 SVR for 240/120-V, three-phase, four-wire circuits with high leg shall be as follows:
 - 1. Line to Neutral: 400 V, 800 V from high leg.
 - 2. Line to Ground: 400 V.
 - 3. Neutral to Ground: 400 V.
- G. Protection modes and UL 1449 SVR for 240-, 480-, or 600-V, three-phase, three-wire, delta circuits shall be as follows:
 - 1. Line to Line: 2000 V for 480 V.
 - 2. Line to Ground: 1500 V for 480 V.

2.3 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 - 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with frontmounted, field-adjustable trip setting.
 - 3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long- and short-time time adjustments.
 - d. Ground-fault pickup level, time delay, and I^2t response.
 - 4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
 - 5. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiterstyle fuse listed for use with circuit breaker; trip activation on fuse opening or on opening of fuse compartment door.
 - 6. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).

- 7. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
- 8. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor material.
 - c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
 - d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - e. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
 - f. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
 - g. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.

2.4 INSTRUMENTATION

- A. Instrument Transformers: IEEE C57.13, NEMA EI 21.1, and the following:
 - 1. Potential Transformers: IEEE C57.13; 120 V, 60 Hz, single secondary; disconnecting type with integral fuse mountings. Burden and accuracy shall be consistent with connected metering and relay devices.
 - 2. Current Transformers: IEEE C57.13; 5 A, 60 Hz, secondary; wound type; single secondary winding and secondary shorting device. Burden and accuracy shall be consistent with connected metering and relay devices.
 - 3. Control-Power Transformers: Dry type, mounted in separate compartments for units larger than 3 kVA.
 - 4. Current Transformers for Neutral and Ground-Fault Current Sensing: Connect secondary wiring to ground overcurrent relays, via shorting terminals, to provide selective tripping of main and tie circuit breaker. Coordinate with feeder circuit-breaker, ground-fault protection.
- B. Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three- or fourwire systems and with the following features:
 - 1. Switch-selectable digital display of the following values with maximum accuracy tolerances as indicated:
 - a. Phase Currents, Each Phase: Plus or minus 1 percent.
 - b. Phase-to-Phase Voltages, Three Phase: Plus or minus 1 percent.
 - c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 1 percent.
 - d. Megawatts: Plus or minus 2 percent.
 - e. Megavars: Plus or minus 2 percent.
 - f. Power Factor: Plus or minus 2 percent.
 - g. Frequency: Plus or minus 0.5 percent.

- h. Accumulated Energy, Megawatt Hours: Plus or minus 2 percent; accumulated values unaffected by power outages up to 72 hours.
- i. Megawatt Demand: Plus or minus 2 percent; demand interval programmable from five to 60 minutes.
- j. Contact devices to operate remote impulse-totalizing demand meter.
- 2. Mounting: Display and control unit flush or semiflush mounted in instrument compartment door.

2.5 IDENTIFICATION

A. Service Equipment Label: NRTL labeled for use as service equipment for switchboards with one or more service disconnecting and overcurrent protective devices.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Receive, inspect, handle, and store switchboards according to NECA 400.
- B. Examine switchboards before installation. Reject switchboards that are moisture damaged or physically damaged.
- C. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install switchboards and accessories according to NECA 400.
- B. Equipment Mounting: Install switchboards on concrete base, 4-inch (100-mm) nominal thickness. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."
 - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
 - 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 4. Install anchor bolts to elevations required for proper attachment to switchboards.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchboard units and components.

- D. Comply with mounting and anchoring requirements specified in Section 260548 "Vibration and Seismic Controls for Electrical Systems."
- E. Operating Instructions: Frame and mount the printed basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.
- F. Install filler plates in unused spaces of panel-mounted sections.
- G. Install overcurrent protective devices, transient voltage suppression devices, and instrumentation.
 - 1. Set field-adjustable switches and circuit-breaker trip ranges.
- H. Comply with NECA 1.

3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Switchboard Nameplates: Label each switchboard compartment with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- C. Device Nameplates: Label each disconnecting and overcurrent protective device and each meter and control device mounted in compartment doors with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.

- D. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- E. Switchboard will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports, including a certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573 "Overcurrent Protective Device Coordination Study."

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain switchboards, overcurrent protective devices, instrumentation, and accessories.

END OF SECTION 262413

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Distribution panelboards.
 - 2. Lighting and appliance branch-circuit panelboards.

1.3 DEFINITIONS

- A. SVR: Suppressed voltage rating.
- B. SPD: Surge protective device

1.4 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
 - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
 - 3. Detail bus configuration, current, and voltage ratings.
 - 4. Short-circuit current rating of panelboards and overcurrent protective devices.

- 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
- 6. Include wiring diagrams for power, signal, and control wiring.

1.6 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Certificates: Submit certification that panelboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Section 260548
 "Vibration and Seismic Controls for Electrical Systems." Include the following:
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- B. Field Quality-Control Reports:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- C. Panelboard Schedules: For installation in panelboards.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - 1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 - 2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.8 QUALITY ASSURANCE

- A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

- D. Comply with NEMA PB 1.
- E. Comply with NFPA 70.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Handle and prepare panelboards for installation according to NEMA PB 1.

1.10 COORDINATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.11 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Section 260548 "Vibration and Seismic Controls for Electrical Systems."
- B. Enclosures: Flush- and surface-mounted cabinets.
 - 1. Rated for environmental conditions at installed location.
 - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
 - b. Outdoor Locations: NEMA 250, Type 3R.
 - 2. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
 - 3. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
 - 4. Finishes:
 - a. Panels and Trim: Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
 - b. Back Boxes: Galvanized steel.

- 5. Directory Card: Inside panelboard door, mounted in transparent card holder.
- C. Incoming Mains Location: Top or bottom as required.
- D. Phase, Neutral, and Ground Buses:
 - 1. Material: Hard-drawn copper, 98 percent conductivity.
 - 2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
- E. Conductor Connectors: Suitable for use with conductor material and sizes.
 - 1. Material: Hard-drawn copper, 98 percent conductivity.
 - 2. Main and Neutral Lugs: Compression type.
 - 3. Ground Lugs and Bus-Configured Terminators: Compression type.
 - 4. Feed-Through Lugs: Compression type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
- F. Service Equipment Label: NRTL labeled for use as service equipment for panelboards or load centers with one or more main service disconnecting and overcurrent protective devices.
- G. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- H. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.2 DISTRIBUTION PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. <u>Eaton Electrical Inc.; Cutler-Hammer Business Unit.</u>
 - 2. <u>General Electric Company; GE Consumer & Industrial Electrical Distribution</u>.
 - 3. <u>Siemens Energy & Automation, Inc.</u>
 - 4. <u>Square D; a brand of Schneider Electric</u>.
- B. Panelboards: NEMA PB 1, power and feeder distribution type.
- C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
- D. Mains: Circuit breaker and Lugs only.
- E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
- F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. General Electric Company; GE Consumer & Industrial Electrical Distribution.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D; a brand of Schneider Electric.
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Mains: As indicated on panel schedules.
- D. Branch Overcurrent Protective Devices: Plug-in circuit breakers, replaceable without disturbing adjacent units.
- E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. General Electric Company; GE Consumer & Industrial Electrical Distribution.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D; a brand of Schneider Electric.
- B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 - 2. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Lugs: compression style, suitable for number, size, trip ratings, and conductor materials.
 - c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.

3.1 EXAMINATION

- A. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.
- B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.
- C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install panelboards and accessories according to NEMA PB 1.1.
- B. Comply with mounting and anchoring requirements specified in Section 260548 "Vibration and Seismic Controls for Electrical Systems."
- C. Mount top of trim 90 inches above finished floor unless otherwise indicated.
- D. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- E. Install filler plates in unused spaces.
- F. Stub four 1-inchempty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.
- G. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.
- H. Comply with NECA 1.

3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section 260553 "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- C. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- D. Panelboards will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.

END OF SECTION 262416

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Receptacles, receptacles with integral GFCI, and associated device plates.
 - 2. Weather-resistant receptacles.
 - 3. Twist-locking receptacles.
 - 4. Snap switches.
 - 5. Floor service outlets.

1.3 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- D. RFI: Radio-frequency interference.
- E. TVSS: Transient voltage surge suppressor.
- F. UTP: Unshielded twisted pair.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packinglabel warnings and instruction manuals that include labeling conditions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
 - 1. Cooper Wiring Devices; Division of Cooper Industries, Inc. (Cooper).
 - 2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
 - 3. Leviton Mfg. Company Inc. (Leviton).
 - 4. Pass & Seymour/Legrand (Pass & Seymour).
- B. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 GENERAL WIRING-DEVICE REQUIREMENTS

- A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.
- C. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:
 - 1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
 - 2. Devices shall comply with the requirements in this Section.

2.3 STRAIGHT-BLADE RECEPTACLES

- A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 5351 (single), CR5362 (duplex).
 - b. Hubbell; HBL5351 (single), HBL5352 (duplex).
 - c. Leviton; 5891 (single), 5352 (duplex).
 - d. Pass & Seymour; 5361 (single), 5362 (duplex).

2.4 GFCI RECEPTACLES

- A. General Description:
 - 1. Straight blade, feed-through type.
 - 2. Comply with NEMA WD 1, NEMA WD 6, UL 498, UL 943 Class A, and FS W-C-596.
 - 3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.
- B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; VGF20.
 - b. Hubbell; GFR5352L.
 - c. Pass & Seymour; 2095.
 - d. Leviton; 7590.

2.5 TWIST-LOCKING RECEPTACLES

- A. Single Convenience Receptacles, 250 V, 30 A: Comply with NEMA WD 1, NEMA WD 6 Configuration L6-30R, and UL 498.
 - 1. <u>Products</u>: Subject to compliance with requirements, provide one of the following:
 - a. <u>Cooper; CWL520R</u>.
 - b. <u>Hubbell; HBL2310</u>.
 - c. <u>Leviton; 2310</u>.
 - d. Pass & Seymour; L520-R.

2.6 FLOOR SERVICE FITTINGS

- A. Type: Modular, flush-type, dual-service units suitable for wiring method used.
- B. Compartments: Barrier separates power from voice and data communication cabling.
- C. Service Plate: Rectangular, die-cast aluminum with satin finish suitable for installation in synthetic turf for the batting cage.
- D. Power Receptacle: NEMA WD 6 Configuration 5-20R, gray finish, unless otherwise indicated.
- E. Voice and Data Communication Outlet: Blank cover with bushed cable opening.

2.7 TOGGLE SWITCHES

- A. Comply with NEMA WD 1, UL 20, and FS W-S-896.
- B. Switches, 120/277 V, 20 A:

WIRING DEVICES

- 1. Products: Subject to compliance with requirements, provide one of the following:
 - 1) <u>Single Pole:</u>
 - a) <u>Cooper; AH1221</u>.
 - b) <u>Hubbell; HBL1221</u>.
 - c) <u>Leviton; 1221-2</u>.
 - d) Pass & Seymour; CSB20AC1.
 - 2) <u>Three Way:</u>
 - a) <u>Cooper; AH1223</u>.
 - b) <u>Hubbell; HBL1223</u>.
 - c) <u>Leviton; 1223-2</u>.
 - d) Pass & Seymour; CSB20AC3.
 - 3) <u>Four Way:</u>
 - a) <u>Cooper; AH1224</u>.
 - b) <u>Hubbell; HBL1224</u>.
 - c) <u>Leviton; 1224-2</u>.
 - d) Pass & Seymour; CSB20AC4.

2.8 WALL PLATES

- A. Single and combination types shall match corresponding wiring devices.
 - 1. Plate-Securing Screws: Metal with head color to match plate finish.
 - 2. Material for Finished Spaces: 0.035-inch-thick, satin-finished, Type 302 stainless steel.
 - 3. Material for Unfinished Spaces: Galvanized steel.
- B. Wet-Location, Weatherproof "While in Use" cover: NEMA 250, complying with Type 3R, weather-resistant, non-metallic grey with solid grey non-metallic cover (no clear cover).

2.9 FINISHES

- A. Device Color:
 - 1. Wiring Devices Connected to Normal Power System: grey unless otherwise indicated or required by NFPA 70 or device listing.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.
- B. Coordination with Other Trades:

- 1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
- 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
- 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
- 4. Install wiring devices after all wall preparation, including painting, is complete.
- C. Conductors:
 - 1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
 - 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
 - 3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
- D. Device Installation:
 - 1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
 - 2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
 - 3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
 - 4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
 - 5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
 - 6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
 - 7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
 - 8. Tighten unused terminal screws on the device.
 - 9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.
- E. Receptacle Orientation:
 - 1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the right.
- F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.
- G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

3.2 GFCI RECEPTACLES

A. Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.

3.3 IDENTIFICATION

A. Comply with Section 260553 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

- A. Tests for Convenience Receptacles:
 - 1. Line Voltage: Acceptable range is 105 to 132 V.
 - 2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
 - 3. Ground Impedance: Values of up to 2 ohms are acceptable.
 - 4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
 - 5. Using the test plug, verify that the device and its outlet box are securely mounted.
 - 6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.
- B. Test straight-blade for the retention force of the grounding blade according to NFPA 99. Retention force shall be not less than 4 oz. .
- C. Wiring device will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

END OF SECTION 262726

SECTION 262813 - FUSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Cartridge fuses rated 600-V ac and less for use in enclosed switches and enclosed controllers.
 - 2. Plug fuses rated 125-V ac and less for use in plug-fuse-type enclosed switches.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material, dimensions, descriptions of individual components, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:
 - 1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.
 - a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
 - b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.
 - 2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
 - 3. Current-limitation curves for fuses with current-limiting characteristics.
 - 4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse.
 - 5. Coordination charts and tables and related data.
 - 6. Fuse sizes for elevator feeders and elevator disconnect switches.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - 1. Ambient temperature adjustment information.

- 2. Current-limitation curves for fuses with current-limiting characteristics.
- 3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse.
- 4. Coordination charts and tables and related data.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NEMA FU 1 for cartridge fuses.
- D. Comply with NFPA 70.

1.6 COORDINATION

A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. <u>Manufacturers</u>: Subject to compliance with requirements, provide products by one of the following:
 - 1. <u>Cooper Bussmann, Inc</u>.
 - 2. Edison Fuse, Inc.
 - 3. <u>Ferraz Shawmut, Inc</u>.
 - 4. <u>Littelfuse, Inc</u>.

2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

2.3 PLUG FUSES

A. Characteristics: UL 248-11, nonrenewable plug fuses; 125-V ac.

2.4 PLUG-FUSE ADAPTERS

A. Characteristics: Adapters for using Type S, rejection-base plug fuses in Edison-base fuseholders or sockets; ampere ratings matching fuse ratings; irremovable once installed.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.
- B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.
- C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

- A. Cartridge Fuses:
 - 1. Motor Branch Circuits: Class RK1, time delay.
 - 2. Control Circuits: Class CC, fast acting.
- B. Plug Fuses:
 - 1. Motor Branch Circuits: Edison-base type, dual-element time delay.

3.3 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.
- B. Install plug-fuse adapters in Edison-base fuseholders and sockets. Ensure that adapters are irremovable once installed.

3.4 IDENTIFICATION

A. Install labels complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems" and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block, socket, and holder. University of South Carolina Softball Stadium Construction BID SET END OF SECTION 262813 Architect's Project No. 11.122.00 State Project No. H27-6088-MJ 03/16/12

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Fusible switches.
 - 2. Nonfusible switches.
 - 3. Molded-case circuit breakers (MCCBs).
 - 4. Enclosures.

1.3 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

1.4 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Enclosed switches and circuit breakers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
 - 1. Enclosure types and details for types other than NEMA 250, Type 1.
 - 2. Current and voltage ratings.
 - 3. Short-circuit current ratings (interrupting and withstand, as appropriate).

- 4. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
- 5. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.
- B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Wiring Diagrams: For power, signal, and control wiring.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.
- B. Seismic Qualification Certificates: For enclosed switches and circuit breakers, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Field quality-control reports.
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- D. Manufacturer's field service report.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - 1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
 - 2. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.
1.8 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA or an NRTL.
 - 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
- B. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.
- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. Comply with NFPA 70.

1.9 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. <u>General Electric Company; GE Consumer & Industrial Electrical Distribution</u>.
 - 3. <u>Siemens Energy & Automation, Inc.</u>
 - 4. <u>Square D; a brand of Schneider Electric</u>.
- B. Type HD, Heavy Duty, Single Throw, 240 and 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Accessories:
 - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.

- 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
- 3. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.2 NONFUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. General Electric Company; GE Consumer & Industrial Electrical Distribution.
 - 3. <u>Siemens Energy & Automation, Inc</u>.
 - 4. <u>Square D; a brand of Schneider Electric</u>.
- B. Type HD, Heavy Duty, Single Throw, 240 and 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Accessories:
 - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 - 3. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.3 MOLDED-CASE CIRCUIT BREAKERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. <u>General Electric Company; GE Consumer & Industrial Electrical Distribution</u>.
 - 3. <u>Siemens Energy & Automation, Inc</u>.
 - 4. <u>Square D; a brand of Schneider Electric</u>.
- B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.
- C. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
- D. Features and Accessories:
 - 1. Standard frame sizes, trip ratings, and number of poles.
 - 2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.

- 3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
- 4. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
- 5. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
- 6. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.

2.4 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
 - 1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
 - 2. Outdoor Locations: NEMA 250, Type 3R.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- B. Comply with mounting and anchoring requirements specified in Section 260548 "Vibration and Seismic Controls for Electrical Systems."
- C. Install fuses in fusible devices.
- D. Comply with NECA 1.

3.3 IDENTIFICATION

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems."
 - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 - 2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- C. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 - 3. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

END OF SECTION 262816

SECTION 263600 - TRANSFER SWITCHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes installation of transfer switches rated 600 V and less, including the following:
 - 1. Automatic transfer switches.

PART 2 - PRODUCTS

2.1 AUTOMATIC TRANSFER-SWITCH

- A. Automatic transfer switches will be provided by others but installed by the Contractor. Generator will be provided and installed by others for connection by the Contractor.
- B. Contractor shall provide all wiring between transfer switch and generator including but not limited to control wiring, auxiliary power circuit, and power conductors. Contractor shall receive cutsheets of generator and automatic transfer switches for the coordination effort.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Contractor shall receive the design of each fastener and support to carry load indicated by seismic requirements and according to seismic-restraint details. See Section 260548 "Vibration and Seismic Controls for Electrical Systems." Contractor to install per these requirements.
- B. Identify components according to Section 260553 "Identification for Electrical Systems."

3.2 CONNECTIONS

- A. Wiring to Remote Components: Match type and number of cables and conductors to control and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.
- B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

C. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

- A. All tests and inspections will be provided by others. Contractor shall coordinate with provider of ATS and generator for the appropriate time to do testing. Atleast three weeks' notice shall be given to testing agency.
- B. Demonstration shall be provided by others.

END OF SECTION 263600

SECTION 265100 - INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Interior lighting fixtures, lamps, and ballasts.
 - 2. Exit signs.
 - 3. Lighting fixture supports.
 - 4. Time switches.
 - 5. Indoor occupancy sensors.
 - 6. Emergency Shunt Relays.
- B. Related Sections:
 - 1. Section 265668 "Exterior Athletic Lighting" for athletic lighting fixtures and their controls.

1.3 DEFINITIONS

- A. BF: Ballast factor.
- B. CCT: Correlated color temperature.
- C. CRI: Color-rendering index.
- D. HID: High-intensity discharge.
- E. LER: Luminaire efficacy rating.
- F. Lumen: Measured output of lamp and luminaire, or both.
- G. Luminaire: Complete lighting fixture, including ballast housing if provided.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:

- 1. Physical description of lighting fixture including dimensions.
- 2. Ballast, including BF.
- 3. Energy-efficiency data.
- 4. Life, output (lumens, CCT, and CRI), and energy-efficiency data for lamps including mercury content.
- 5. Photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing & Calculation Guides, of each lighting fixture type. The adjustment factors shall be for lamps, ballasts, and accessories identical to those indicated for the lighting fixture as applied in this Project.
- B. Shop Drawings: Show installation details for occupancy sensors.
 - 1. Interconnection diagrams showing field-installed wiring.
 - 2. Include diagrams for power, signal, and control wiring.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.
 - 1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.6 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.

1.7 COORDINATION

A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

1.8 WARRANTY

- A. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period for Emergency Lighting Unit Batteries: 1 years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining nine years.

2. Warranty Period for Emergency Fluorescent Ballast Batteries: one year from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining six years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide product indicated on the Lighting Fixture Schedule on the Drawings.

2.2 GENERAL REQUIREMENTS FOR LIGHTING FIXTURES AND COMPONENTS

- A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.
- B. Fluorescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.
- C. HID Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5B.
- D. Metal Parts: Free of burrs and sharp corners and edges.
- E. Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging.
- F. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- G. Diffusers and Globes:
 - 1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
 - a. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
 - b. UV stabilized.
 - 2. Glass: Annealed crystal glass unless otherwise indicated.
- H. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps and ballasts. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
 - 1. Label shall include the following lamp and ballast characteristics:
 - a. "USE ONLY" and include specific lamp type.

- b. Lamp diameter code (T-4, T-5, T-8, T-12, etc.), tube configuration (twin, quad, triple, etc.), base type, and nominal wattage for fluorescent and compact fluorescent luminaires.
- c. Lamp type, wattage, bulb type (ED17, BD56, etc.) and coating (clear or coated) for HID luminaires.
- d. Start type (preheat, rapid start, instant start, etc.) for fluorescent and compact fluorescent luminaires.
- e. ANSI ballast type (M98, M57, etc.) for HID luminaires.
- f. CCT and CRI for all luminaires.

2.3 BALLASTS FOR LINEAR FLUORESCENT LAMPS

- A. General Requirements for Electronic Ballasts:
 - 1. Comply with UL 935 and with ANSI C82.11.
 - 2. Designed for type and quantity of lamps served.
 - 3. Ballasts shall be designed for full light output unless another BF, dimmer, or bi-level control is indicated.
 - 4. Sound Rating: Class A.
 - 5. Total Harmonic Distortion Rating: Less than 10 percent.
 - 6. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
 - 7. BF: 0.88 or higher.
 - 8. Power Factor: 0.95 or higher.
 - 9. Parallel Lamp Circuits: Multiple lamp ballasts shall comply with ANSI C82.11 and shall be connected to maintain full light output on surviving lamps if one or more lamps fail.
 - 10. Temperatures 0 Deg F and Higher: Electronic type rated for 0 deg F starting and operating temperature with indicated lamp types.
- B. Luminaires controlled by occupancy sensors shall have programmed-start ballasts.
- C. Electronic Programmed-Start Ballasts for T8 Lamps: Comply with ANSI C82.11 and the following:
 - 1. Lamp end-of-life detection and shutdown circuit for T5 diameter lamps.
 - 2. Automatic lamp starting after lamp replacement.

2.4 BALLASTS FOR COMPACT FLUORESCENT LAMPS

- A. Description: Electronic-programmed rapid-start type, complying with UL 935 and with ANSI C 82.11, designed for type and quantity of lamps indicated. Ballast shall be designed for full light output unless dimmer or bi-level control is indicated:
 - 1. Lamp end-of-life detection and shutdown circuit.
 - 2. Automatic lamp starting after lamp replacement.
 - 3. Sound Rating: Class A.
 - 4. Total Harmonic Distortion Rating: Less than 20 percent.
 - 5. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
 - 6. Operating Frequency: 20 kHz or higher.

- 7. Lamp Current Crest Factor: 1.7 or less.
- 8. BF: 0.95 or higher unless otherwise indicated.
- 9. Power Factor: 0.95 or higher.
- 10. Interference: Comply with 47 CFR 18, Ch. 1, Subpart C, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.

2.5 BALLASTS FOR HID LAMPS

- A. Electronic Ballast for Metal-Halide Lamps: Include the following features unless otherwise indicated:
 - 1. Minimum Starting Temperature: Minus 20 deg F for single-lamp ballasts.
 - 2. Rated Ambient Operating Temperature: 130 deg F.
 - 3. Lamp end-of-life detection and shutdown circuit.
 - 4. Sound Rating: Class A.
 - 5. Total Harmonic Distortion Rating: Less than 20 percent.
 - 6. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
 - 7. Lamp Current Crest Factor: 1.5 or less.
 - 8. Power Factor: 0.90 or higher.
 - 9. Interference: Comply with 47 CFR 18, Ch. 1, Subpart C, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.
 - 10. Protection: Class P thermal cutout.

2.6 EXIT SIGNS

- A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.
- B. Internally Lighted Signs:
 1. Lamps for AC Operation: LEDs, 50,000 hours minimum rated lamp life.

2.7 FLUORESCENT LAMPS

- A. T8 rapid-start lamps, rated 25 W maximum, nominal length of 48 inches, 2800 initial lumens (minimum), CRI 75 (minimum), color temperature 3500 K, and average rated life 20,000 hours unless otherwise indicated.
- B. Compact Fluorescent Lamps: 4-Pin, CRI 80 (minimum), color temperature 3500 K, average rated life of 10,000 hours at three hours operation per start, and suitable for use with dimming ballasts unless otherwise indicated.
 - 1. 13 W: T4, double or triple tube, rated 900 initial lumens (minimum).
 - 2. 18 W: T4, double or triple tube, rated 1200 initial lumens (minimum).
 - 3. 26 W: T4, double or triple tube, rated 1800 initial lumens (minimum).
 - 4. 32 W: T4, triple tube, rated 2400 initial lumens (minimum).
 - 5. 42 W: T4, triple tube, rated 3200 initial lumens (minimum).
 - 6. 57 W: T4, triple tube, rated 4300 initial lumens (minimum).
 - 7. 70 W: T4, triple tube, rated 5200 initial lumens (minimum).

- 2.8 HID LAMPS
 - A. Metal-Halide Lamps: ANSI C78.43, with minimum CRI 65, and color temperature 4000 K.
 - B. Pulse-Start, Metal-Halide Lamps: Minimum CRI 65, and color temperature 4000 K.
 - C. Ceramic, Pulse-Start, Metal-Halide Lamps: Minimum CRI 80, and color temperature 4000 K.

2.9 LIGHTING FIXTURE SUPPORT COMPONENTS

- A. Comply with Section 260529 "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.
- C. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.
- D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage.
- E. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

2.10 TIME SWITCHES

A. Subject to compliance with requirements, provide an Internatic ET365 astronomical time clock w/ HOA switch for easy off for game days.

2.11 INDOOR OCCUPANCY SENSORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. <u>Cooper Industries, Inc</u>.
 - 2. <u>Hubbell Building Automation, Inc</u>.
 - 3. Leviton Mfg. Company Inc.
 - 4. <u>Lightolier Controls</u>.
 - 5. <u>Lithonia Lighting; Acuity Lighting Group, Inc</u>.
 - 6. <u>Lutron Electronics Co., Inc</u>.
 - 7. <u>NSi Industries LLC; TORK Products</u>.
 - 8. <u>Sensor Switch, Inc</u>.
 - 9. <u>Square D; a brand of Schneider Electric</u>.
 - 10. <u>Watt Stopper</u>.
- B. General Requirements for Sensors: Wall- or ceiling-mounted, solid-state indoor occupancy sensors with a separate power pack.
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

- 2. Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
- 3. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor is powered from the power pack.
- 4. Power Pack: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
- 5. Mounting:
 - a. Sensor: Suitable for mounting in any position on a standard outlet box.
 - b. Relay: Externally mounted through a 1/2-inch (13-mm) knockout in a standard electrical enclosure.
 - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
- 6. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
- 7. Bypass Switch: Override the "on" function in case of sensor failure.
- 8. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc (21.5 to 2152 lux); turn lights off when selected lighting level is present.
- C. Dual-Technology Type: Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.
 - 1. Sensitivity Adjustment: Separate for each sensing technology.
 - 2. Detector Sensitivity: Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm), and detect a person of average size and weight moving not less than 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).
 - 3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.

2.12 EMERGENCY SHUNT RELAY (UL924 Relay)

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Lighting Control and Design; Acuity Lighting Group, Inc.
 - 2. <u>Watt Stopper</u>.
- B. Description: Normally closed, electrically held relay, arranged for wiring in parallel with manual or automatic switching contacts; complying with UL 924.
 - 1. Coil Rating: 277 V.

3.1 INSTALLATION

A. Lighting fixtures:

- 1. Set level, plumb, and square with ceilings and walls unless otherwise indicated.
- 2. Install lamps in each luminaire.
- B. Temporary Lighting: If it is necessary, and approved by Architect, to use permanent luminaires for temporary lighting, install and energize the minimum number of luminaires necessary. When construction is sufficiently complete, remove the temporary luminaires, disassemble, clean thoroughly, install new lamps, and reinstall.
- C. Lay-in Ceiling Lighting Fixtures Supports: Use grid as a support element.
 - 1. Install ceiling support system rods or wires, independent of the ceiling suspension devices, for each fixture. Locate not more than 6 inches from lighting fixture corners.
 - 2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
 - 3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.
 - 4. Install at least one independent support rod or wire from structure to a tab on lighting fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.
- D. Suspended Lighting Fixture Support:
 - 1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
 - 2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
 - 3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
 - 4. Do not use grid as support for pendant luminaires. Connect support wires or rods to building structure.
- E. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.2 SENSOR INSTALLATION

- A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.
- B. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.3 WIRING INSTALLATION

- A. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch (13 mm).
- B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpowerlimited conductors according to conductor manufacturer's written instructions.
- C. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.
- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.4 IDENTIFICATION

A. Install labels with panel and circuit numbers on concealed junction and outlet boxes. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.5 STARTUP SERVICE

- A. Burn-in all lamps that require specific aging period to operate properly, prior to occupancy by Owner. Burn-in fluorescent and compact fluorescent lamps intended to be dimmed, for at least 100 hours at full voltage.
- B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

END OF SECTION 265100

SECTION 265600 - EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Exterior luminaires with lamps and ballasts.
 - 2. Luminaire-mounted photoelectric relays.
 - 3. Poles and accessories.

1.3 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color-rendering index.
- C. HID: High-intensity discharge.
- D. LER: Luminaire efficacy rating.
- E. Luminaire: Complete lighting fixture, including ballast housing if provided.
- F. Pole: Luminaire support structure, including tower used for large area illumination.
- G. Standard: Same definition as "Pole" above.

1.4 ACTION SUBMITTALS

- A. Product Data: For each luminaire, pole, and support component, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:
 - 1. Physical description of luminaire, including materials, dimensions, effective projected area, and verification of indicated parameters.
 - 2. Details of attaching luminaires and accessories.
 - 3. Details of installation and construction.
 - 4. Luminaire materials.
 - 5. Photometric data based on laboratory tests of each luminaire type, complete with indicated lamps, ballasts, and accessories.

- a. Testing Agency Certified Data: For indicated luminaires, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.
- 6. Photoelectric relays.
- 7. Ballasts, including energy-efficiency data.
- 8. Lamps, including life, output, CCT, CRI, lumens, and energy-efficiency data.
- 9. Materials, dimensions, and finishes of poles.
- 10. Means of attaching luminaires to supports, and indication that attachment is suitable for components involved.
- 11. Anchor bolts for poles.

1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For luminaires and poles to include in emergency, operation, and maintenance manuals.
- 1.7 QUALITY ASSURANCE
 - A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.
 - B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - C. Comply with IEEE C2, "National Electrical Safety Code."
 - D. Comply with NFPA 70.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Package aluminum poles for shipping according to ASTM B 660.
- B. Store poles on decay-resistant-treated skids at least 12 inches above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.
- C. Retain factory-applied pole wrappings on metal poles until right before pole installation. For poles with nonmetallic finishes, handle with web fabric straps.

1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace products that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs or alterations from special warranty coverage.
 - 1. Warranty Period for Luminaires: two years from date of Substantial Completion.
 - 2. Warranty Period for Metal Corrosion: Two years from date of Substantial Completion.
 - 3. Warranty Period for Color Retention: Two years from date of Substantial Completion.
 - 4. Warranty Period for Poles: Repair or replace lighting poles and standards that fail in finish, materials, and workmanship within manufacturer's standard warranty period, but not less than two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide product indicated on Drawings.

2.2 GENERAL REQUIREMENTS FOR LUMINAIRES

- A. Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.
 1. LER Tests HID Fixtures: Where LER is specified, test according to NEMA LE 5B.
- B. Lateral Light Distribution Patterns: Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.
- C. Metal Parts: Free of burrs and sharp corners and edges.
- D. Sheet Metal Components: Corrosion-resistant aluminum unless otherwise indicated. Form and support to prevent warping and sagging.
- E. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.
- F. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.
- G. Exposed Hardware Material: Stainless steel.
- H. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

- I. Light Shields: Metal baffles, factory installed and field adjustable, arranged to block light distribution to indicated portion of normally illuminated area or field.
- J. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:
 - 1. White Surfaces: 85 percent.
 - 2. Specular Surfaces: 83 percent.
 - 3. Diffusing Specular Surfaces: 75 percent.
- K. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.
- L. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.
- M. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps and ballasts. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
 - 1. Label shall include the following lamp and ballast characteristics:
 - a. "USES ONLY" and include specific lamp type.
 - b. Lamp type, wattage, bulb type (ED17, BD56, etc.) and coating (clear or coated) for HID luminaires.
 - c. ANSI ballast type (M98, M57, etc.) for HID luminaires.
 - d. CCT and CRI for all luminaires.

2.3 LUMINAIRE-MOUNTED PHOTOELECTRIC RELAYS

- A. Comply with UL 773 or UL 773A.
- B. Contact Relays: Factory mounted, single throw, designed to fail in the on position, and factory set to turn light unit on at 1.5 to 3 fc and off at 4.5 to 10 fc with 15-second minimum time delay
- C. Relay with locking-type receptacle shall comply with ANSI C136.10.1. Adjustable window slide for adjusting on-off set points.

2.4 BALLASTS FOR HID LAMPS

- A. Comply with ANSI C82.4 and UL 1029 and capable of open-circuit operation without reduction of average lamp life. Include the following features unless otherwise indicated:
 - 1. Ballast Circuit: Constant-wattage autotransformer or regulating high-power-factor type.
 - 2. Minimum Starting Temperature: Minus 22 deg F
 - 3. Normal Ambient Operating Temperature: 104 deg F.
- B. Provide arc keeper where indicated on lighting fixture schedule.

2.5 HID LAMPS

- A. Metal-Halide Lamps: ANSI C78.43, with minimum CRI 65, and CCT color temperature 4000 K.
- B. Pulse-Start, Metal-Halide Lamps: Minimum CRI 65, and CCT color temperature 4000 K.
- C. Ceramic, Pulse-Start, Metal-Halide Lamps: Minimum CRI 80, and CCT color temperature 4000 K.

2.6 GENERAL REQUIREMENTS FOR POLES AND SUPPORT COMPONENTS

- A. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts unless otherwise indicated.
- B. Mountings, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support components.
 - 1. Materials: Shall not cause galvanic action at contact points.
 - 2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication unless otherwise indicated.
 - 3. Anchor-Bolt Template: Plywood or steel.

2.7 ALUMINUM POLES

- A. Poles: Seamless, extruded structural tube complying with ASTM B 429/B 429M, Alloy 6063-T6 with access handhole in pole wall.
- B. Poles: ASTM B 209, 5052-H34 marine sheet alloy with access handhole in pole wall.
 - 1. Shape: See Lighting Fixture Schedule on Drawings.
 - 2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.
- C. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.
- D. Grounding and Bonding Lugs: Welded 1/2-inch threaded lug, complying with requirements in Section 260526 "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.
- E. Brackets for Luminaires: Detachable, with pole and adapter fittings of cast aluminum. Adapter fitting welded to pole and bracket, then bolted together with stainless-steel bolts.
 - 1. Tapered oval cross section, with straight tubular end section to accommodate luminaire.
 - 2. Finish: Same as pole.
- F. Aluminum Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

PART 3 - EXECUTION

3.1 LUMINAIRE INSTALLATION

- A. Install lamps in each luminaire.
- B. Fasten luminaire to indicated structural supports.
 - 1. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.

3.2 POLE INSTALLATION

- A. Alignment: Align pole foundations and poles for optimum directional alignment of luminaires and their mounting provisions on the pole.
- B. Poles shall be installed straight (90 degrees with earth) in all directions.

3.3 CORROSION PREVENTION

- A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.
- B. Steel Conduits: Comply with Section 260533 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch- thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.4 GROUNDING

- A. Ground metal poles and support structures according to Section 260526 "Grounding and Bonding for Electrical Systems."
 - 1. Install grounding electrode for each pole unless otherwise indicated.
 - 2. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.

3.5 FIELD QUALITY CONTROL

- A. Inspect each installed fixture for damage. Replace damaged fixtures and components.
- B. Illumination Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source.

- 1. Verify operation of photoelectric controls.
- C. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

END OF SECTION 265600

SECTION 265610 SOFTBALL FIELD LIGHTING SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 WORK INCLUDED

- A. The Contractor shall provide all labor, materials, tools, transportation, equipment, insurance, temporary protection, permits, and all necessary and miscellaneous items required to provide the sports lighting system shown on the plans and described herein complete and in good operating condition whether or not these miscellaneous items are specifically described in these Specifications or shown on the Drawings.
- B. Work of this Section to include, but not be limited to: The installation of a complete softball field lighting system in accordance with the criteria set forth in the drawings and as specified herein. Provide necessary equipment for unloading, assembling, and installing: field lighting fixture assemblies; pole bases for field lighting fixture assemblies; underground feeders to, and final connections at each field lighting fixture assembly; lighting control equipment; testing/adjusting each field lighting fixture.
- C. Install all work in accordance with all applicable codes and prepare additional Design Drawings and Shop Drawings as necessary to obtain approval of public authorities having jurisdiction over this Project.

1.3 SUBMITTALS

- A. Submittal Package: Submit the shop drawings, product data, samples, candlepower distribution curves, and quality control submittals specified below at the same time, as a complete package.
- B. Shop Drawings: For poles, bases, canopy mounted lights, and enclosures.
- C. Product Data: Catalog sheets, specifications, and installation instructions for all fixtures and accessories to be used on the project.
 - 1. For each pole, include data which shows that the effective projected area rating of the pole (at the required wind velocity) is greater than the total effective projected area of luminaries, brackets, and other equipment mounted on the pole.
 - 2. Controller, include project specific schematic diagram, description of operation, and shop drawings for all enclosures.
- D. Pole Foundations: Light pole manufacturer shall provide the foundation design for each different light pole application. The design shall be stamped and signed by a professional engineer licensed

SOFTBALL FIELD LIGHTING SYSTEM

in the state of the installation. Provide shop drawings to the Owner's Representative prior to commencement of work.

- E. Candlepower Distribution Curves: For each type fixture.
- F. Quality Control Submittals:
 - 1. Company Field Advisor Data:
 - a. Name, business address and telephone number of Company Field Advisor secured for the required services.
 - b. Certified statement from the Company listing the qualifications of the Company Field Advisor and approval from the lighting system manufacturer.
 - 2. List of Completed Installation: Furnish the name, address, and telephone number at least 5 comparable installations which can prove that the proposed products have operated satisfactorily for 3 years.
- G. Photometric Plan: Submit a photometric plan showing initial and maintained foot candles on a 30' grid. Include measurements at all field edges (along the fence line).

1.4 QUALITY ASSURANCE

- A. Company Field Advisor: Provide the services of a Company Field Advisor for a minimum of 16 working hours for the following:
 - 1. Determine and recommend final luminaire aiming points.
 - 2. Render advice and witness completion of luminaire aiming at night.
- B. All equipment shall be new and of high quality. All equipment furnished under these Specifications shall be listed by Underwriter's Laboratories and bear the UL label.
 - 1. The lighting equipment shall have a UL listing for all electrical components from its connection to the feeder conductors, to its completion at the lamp socket including all connections. This listing shall be based upon UL testing and evaluation of the compatibility of the enclosures and the components for use in combination in this application in addition to the individual components being UL listed or recognized.
- C. The lighting fixture/pole manufacturer shall furnish to the Contractor all equipment as outlined in the following Specifications and Drawings. The Contractor shall install the equipment and provide all wiring and conduit required to interconnect the various components.
- D. All electrical equipment shall be located as indicated in the Specifications and on the Drawings. It is the responsibility of the Contractor to verify actual field conditions to determine exact locations and avoid interference with existing systems and with new installations. Final locations for the components specified herein will be verified by the Owner's Representative prior to installation.

E. Manufacturer's Guarantee: The manufacturer shall submit in writing a letter guaranteeing compliance to the specifications for light levels, light loss factor, and uniformities.

1.5 INSPECTION AND TESTING PROCEDURES

- A. The lighting manufacturer shall guarantee the specified illumination levels and uniformity ratios for <u>10 years</u> (based on 300 hours per year) of operation. The measured illumination levels must be equal to or greater than the specified constant average illumination levels. Corrective action shall be taken, by the Manufacturer, to bring the installation into conformance with these criteria.
- B. Test the system with entire facility illuminated.
- C. Horizontal foot-candle readings shall be taken with the meter positioned horizontal 36 inches above grade.
- D. Testing equipment for measurement of foot-candle levels shall be a United Technology Model 61, a calibrated Gossen Panalux Electronic 2, or an approved equal. The testing equipment shall be identified with the latest calibration date.
- E. For final approval of the project the manufacturer shall provide a final report from the test results that shall provide the following items:
 - 1. Identification of number and location of the test stations.
 - 2. Actual horizontal foot-candle readings taken at each test station.
 - 3. Number of hours of operation.
- F. Point by Point Analysis: Measurement of light shall be demonstrated on a computer generated model which consists of a grid of a specified number of points covering a stated area on an equally spaced grid as defined by I.E.S. Point by point analysis shall be on a maximum of A 30' x 30' grid. Include measurements along all field edges at the fence line.

1.6 MANUFACTURER'S WARRANTY

A. The system warranty shall be 10 years parts, and 2 years labor, with lamps provided for 2 years. Individual outages shall be replaced in the first year. For outages occurring between year 1 and 2, manufacturer shall provide the lamp, however installation will be at the owner's expense.

PART 2 - PRODUCTS

2.1 SPORTS LIGHTING SYSTEM

- A. Provide a complete Sports Lighting system meeting the following criteria:
 - 1. Light Poles (6 poles located per plans) and canopy mounted lights behind home plate.
 - a. Effective projected area (sq ft) rating of each pole greater than the total effective projected area of luminaries, brackets and other equipment mounted on pole.

SOFTBALL FIELD LIGHTING SYSTEM

Poles shall be designed to withstand a minimum 100 MPH winds based on AASHTO design criteria (latest edition). Pole stress allowances shall be based on AASHTO design criteria.

- b. Poles shall be hot dipped galvanized steel, with either a reinforced concrete anchor base foundation connecting to a baseplate pole, or a prestressed concrete pole base, with a slip fit connection to a steel pole. For corrosion purposes, no portion of the steel pole shall be within 12 inches of the field surface, and no portions of the steel pole can extend below grade. Direct buried steel poles, encased steel poles, and steel pole bases are not allowed.
- c. Minimum 4 x 6 inch handhole or larger as required to work with conductors specified. Handhole cover attached to pole with vandal resistant fasteners. Grounding lug at base of pole.

2. Foundations

- a. The lighting system shall be designed so that the foundation will withstand winds of 100 mph based upon AASHTO design guidelines (latest edition) and in conformance with the 50 year mean recurrent Isotach wind map data. Foundation design is to be provided by the light pole manufacturer with certification by a Professional Engineer, licensed in the state of the installation. Direct burial steel poles will not be accepted
- b. Soil Conditions: The design criteria for these specifications are based on soil design parameters as outlined in the geotechnical report.
- c. Submit shop drawings to Project Engineer for review and approval prior to commencement of installation.
- 3. Lighting Performance
 - a. The lighting system shall provide 100 outfield & 70 infield horizontal footcandles average maintained or constant illumination. The system shall meet NCCA Best Lighting Practices for regional broadcast inter-collegial play For constant illumination, the system shall utilize automatic power adjustments to provide the target light levels, as indicated in the IESNA Lighting Handbook 9th Edition Lighting Controls Section Pages 27-2 & 27-3 Lumen Maintenance Control Strategy. Those bidding a constant light system, shall provide an independent test report certifying the system meets the lumen maintenance control strategy above and verifying the field performance of the system for the duration of the useful life of the lamp based on lamp replacement hours. Report shall be signed by a licensed professional engineer with outdoor lighting experience.
 - b. For systems that are not Constant illumination, the maintained lights levels shall be designed based on a .70 Recoverable Light Loss Factor, per the NCAA Best Lighting Practices. Both an initial and maintained light level design shall be

University of South Carolina Softball Stadium Construction BID SET

provided, and the initial design shall be multiplied by .70 to determine the maintained light levels. Tilt and ballast factors are a part of both the initial and maintained light levels.

Area of Lighting	Average Constant	Maximum to Minimum	Grid Points Per
	Light Levels	Uniformity Ratio	Field
Infield	100 footcandles	1.5:1	25
Outfield	70 footcandles	2:1	82

- c. Emergency exiting lighting: Provide 1 footcandle average illumination to seating bowl with 0.1 footcandle minimum lighting from the 3B and 1B light poles (see electric plans).
- 4. Life Cycle Cost
 - a. Energy Consumption: The System shall be designed for maximum efficiency and low life cycle cost.
- 5. Uniformities
 - a. The uniformity of the courts shall be measured by comparing the maximum reading to the minimum reading.
- 6. Weight Reduction of the Crossarms
 - a. The ballasts shall be mounted in an electrical components enclosure on the pole 10' above grade and separate from the fixture mounting.
- 7. Structural Strength
 - a. The crossarm, reflector and its attachment to the pole shall be provided by the manufacturer such that it will structurally withstand winds of 150 m.p.h. without misalignment of any luminaire and without any damage to the crossarms or its components. Luminaries shall be attached to the crossarm by a minimum of two bolts, which shall be stainless steel and coated with a clear thermoset polymer coating. There shall be no penetrations of the top or sides of the crossarm.
- 8. Mounting Heights
 - a. In order to obtain proper aiming angles for reduced glare and playability, the pole mounting heights from the playing field surface shall be as indicated on light fixture schedule.
- 9. Aiming Recapturing Device
 - a. Light fixtures shall have a positive latching device for each luminaire on the assembly. The device shall provide for automatic repositioning of the aiming after relamping. In addition, provide a stainless steel bolt and nut to secure the alignment.

- 10. Enclosed Wiring
 - a. All wiring shall be contained inside the crossarms, enclosures and pole.
- 11. Operating Temperatures of Electrical Components Enclosure
 - a. The ambient air temperature of the electrical components enclosure shall not exceed 90°C.
- 12. Knuckle and Cone Assembly
 - a. The knuckle and cone assembly for each fixture shall be of die cast aluminum construction and anodized to mil-A-8625E specifications and coated with polyurethane.
- 13. Fasteners, Bolts and Hinges
 - a. All latches, hinges and non-current carrying fasteners shall be stainless steel and shall further be coated with a clear thermoset polymer coating.
- 14. Electrical Components Enclosure
 - a. The electrical components enclosure shall be a NEMA 3R rated gasketed enclosure to house the ballasts, capacitors, fuses, thermal magnetic circuit breakers, distribution lugs, etc.
- 15. Factory Assembled Wire Harness
 - a. Provide internal (pole) wire harness assembled in the factory as a part of the lighting equipment to insure quality and consistency. Wire harness will be covered under the manufacturer's equipment warranty. Minimum size #14 AWG.
 - b. The wire harness shall be supported at the top of the pole by a stainless steel wire mesh grip matched to the size of the harness. There shall be not more than 13 conductors supported by a single wire mesh grip. If the harness is longer the 70 ft., an interim wire mesh grip support shall be located approximately half way down the pole.
- 16. Lightning Protection
 - a. All structures shall be equipped with lightning protection meeting standards established by NFPA 780.

SOFTBALL FIELD LIGHTING SYSTEM

- 17. Disconnecting Device
 - a. Each pole shall include, in an electrical enclosure, UL listed thermal magnetic circuit breaker or safety switches such that electrical power to all equipment on the pole served by the feeder circuit shall be disengaged by the operation of one switch. The breaker shall be located in a compartment separated from any capacitors or ballasts. Provide distribution terminal blocks which shall be factory wired from the breaker to the blocks. These blocks shall provide for termination of all ballast connection wiring. Provide fuse blocks and fuses for each ungrounded conductor feeding each ballast.
- 18. Lighting Controls & Contactor Cabinets
 - a. 480 volt AC, with number of poles as indicated on Drawings. Normally open, electrically held, 120 volt coil, with "On-Off Auto" selector switch. Components installed in NEMA enclosure with hinged, lockable cover and engraved nameplate "SPORTS LIGHTING CONTROL PANEL".
- 19. Metal Halide Luminaries
 - a. Sports Lighting Fixtures: Metal halide lamp, 1500W lamp based on a maximum of 155,000 Lumens, with assembly complete with reflector, glass lens, factory wiring through cross arms. UL listing for wet locations. 1000W lamps for mounting on the roof canopy for the area immediately behind home plate.
 - b. Constant Wattage Auto Regulating metal halide lamp ballast which maintains lamp wattage within \pm 10 percent upon \pm 10 percent variation in line voltage and with starting current lower than operating current. UL rated and listed for 40 degrees C ambient temperature, start and operate to -20 degrees F. Suitable for operation on 60 Hz circuit, voltage rating to suit branch circuit voltage.
 - c. Emergency Lights: Install two 1500w 277V quartz flood aimed toward bleachers. Provide separate 1" conduit within pole per emergency fixtures. Install at 87' on poles B1 and B2.
- 20. Lighting system shall be remote ballast, factory aimed, with disconnects win the bottom remote ballast box, wire harnesses with individual circuits for each fixture, and individual fuses for each fixture. System shall be designed using nominally rated 1,500 watt metal halide lamps. Mounting heights shall be 90 ft. above grade for poles A1, A2, B1 & B2. Mounting heights shall be 70' above grade for poles C1 and C2.
- 21. Spill & Glare Control
 - a. Control of spill light and glare is very important. In addition to offsite control, glare control is important for playability. Each fixture shall include internal reflector strips, panels, or visors, as well as external visors. In addition the photometrics of the light fixture shall be protected by either a double jacketed hail shroud for spun aluminum reflectors, or by a diecast outer shell to protect reflector strips.

- 22. Speaker Hand Holes and Conduit: Provide HH at 25' AFF on each pole. Provide 1" rigid conduit inside pole to HH.
- 23. Climbing Pegs and Maintenance Platforms:
 - a. Provide climbing pegs at Sports Lighting Poles A1, A2, B1 and B2.
 - b. Provide all equipment/materials for maintenance platforms at sports lighting poles B1 and B2.
- B. The approved systems for this project bid are:
 - 1. Musco Light Structure Green Remote Ballast System with GlareControl
 - 2. General Electric Remote Ballast System with Ultra Sport Fixtures.
 - 3. Hubbell Sportsliter Remote Ballast System with SG-V Fixtures.

2.2 REMOTE MONITORING SYSTEM

- A. Controls and Monitoring Cabinet to provide on-off control and monitoring of the lighting system, constructed of NEMA Type 4 aluminum. Communication method shall be provided by manufacturer.
- B. Remote Monitoring System: System shall monitor lighting performance and notify manufacturer if individual luminaire outage is detected so that appropriate maintenance can be scheduled. The manufacturer shall notify the owner of outages within 24 hours, or the next business day. The controller shall determine switch position (Manual or Auto) and contactor status (open or closed). The controller shall report voltage, ampage, hours of use, leakage to ground, current, and grounding.
- C. Manual Off-On-Auto Selector Switches (LCC Mounted): For on-site manual control, three position selector switches (Off-On-Auto) shall be factory-mounted through the Lighting Contactor Cabinet door. The switches shall be keyed and maintain position, with make-before-break contacts. A legend plate shall clearly identify the zone and position of each switch. Switches shall be factory-wired to the control terminal blocks.
- D. The OFF-ON-AUTO switches shall operate as follows: The three position switch will control each lighting zone which controls the contactor(s) directly. In the OFF position all contacts are open. In the ON position the ON set of contacts close, closing the circuit to the control relay and closing the contactor. In the AUTO position, the AUTO contacts are closed providing power to the common of the Remote Equipment Controller (REC) relay. The REC program will close contacts (COM & NO) closing the contactor. The ON contacts are open in this position. The contacts on the OFF-ON-AUTO switch are make-before-break so that the switch may be moved between ON and AUTO without de-energizing the circuit.
- E. Remote Lighting Control System: System shall include lighting contactors. System shall allow owner and users with a security code to schedule on/off system operation via a web site, phone, fax or email up to ten years in advance. Manufacturer shall provide and maintain a two-way

TCP/IP communication link. Trained staff shall be available 24/7 to provide scheduling support and assist with reporting needs.

- F. The owner may assign various security levels to schedulers by function and/or fields. This function must be flexible to allow a range of privileges such as full scheduling capabilities for all fields, to only having permission to execute "early off" commands by phone.
- G. On site equipment shall include Manual Off-On-Auto Switches to allow for maintenance, and shall accept and store 7-day schedules. The controller shall be protected against power outages / memory loss and shall reboot once power is regained and execute any commands that would have occurred during outage.
- H. Management Tools: Manufacturer shall provide a web-based database of actual field usage and provide reports by facility and user group.
- I. Communication Costs: Manufacturer shall include communication costs for operating the controls and monitoring system for a period of 10 years.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before performing any Work, lay out the proposed routing for the conduits, location of light poles, etc. and have it approved by the Owner's Representative and Company Field Adviser.

3.2 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Packaging and Transportation:
 - 1. Require supplier to package finished products in boxes or crates for protection during shipment, handling and storage. Protect sensitive products against exposure to elements and moisture.
 - 2. Protect sensitive equipment and finishes against impact, abrasion and other damage.
 - 3. Remove and replace with new, products that are damaged prior to final acceptance by Owner.
- B. Delivery and Receiving:
 - 1. Arrange delivery of products in accordance with construction schedule. Allow time for inspection prior to installation.
 - 2. Coordinate deliveries to avoid conflict with work and conditions at site, limitations on storage space and availability of personnel and handling equipment.

- 3. Deliver products in undamaged, dry conditions, in original unopened containers or packaging with identifying labels intact and legible.
- 4. Clearly mark partial deliveries of component parts of equipment to identify equipment and contents to permit easy accumulation of parts and to facilitate assembly.
- 5. Immediately on deliver, inspect shipment to assure:
 - a. Product complies with requirements of Contract Documents and reviewed submittals.
 - b. Quantities are correct.
 - c. Accessories and installation hardware are correct.
 - d. Containers and packages are intact and labeled.
 - e. Products are protected and undamaged.
- C. Product Handling:
 - 1. Provide equipment and personnel to handle products by methods to prevent soiling and damage.
 - 2. Provide additional protection during handling to prevent marring and otherwise damaging products, packaging and surrounding surfaces.
 - 3. Handle product by methods to avoid bending or overstressing. Lift large and heavy components only at designated lift points.
- D. Storage:
 - 1. Store products, immediately on delivery, in accordance with manufacturer's instructions, with seals and labels intact. Protect until installed.
 - 2. Arrange storage to provide access for maintenance of stored items and for inspection.
 - 3. Exterior storage:
 - a. Provide substantial platforms, blocking or skids to support fabricated products above ground; slope to provide drainage.
 - b. Protect products form soiling and staining.
 - c. For products subject to discoloration or deterioration form exposure to elements, cover with impervious sheet material.
 - d. Provide ventilation to avoid condensation.

- e. Store loose granular materials on clean, solid surfaces such as rigid sheet materials or pavement. Prevent mixing with foreign matter.
- f. Prevent mixing of refuse or chemically injurious materials or liquids with building materials.
- 4. Periodically inspect stored products to verify proper storage.

3.3 INSTALLATION

- A. Light Poles
 - 1. Install each light pole in accordance with the manufacturer's recommendations, and the approved shop drawings.
 - 2. Install light pole vertical. Prepare a level surface on/in compacted earth, undisturbed earth or concrete footing. Set bases on the prepared surface. Have all bases checked and approved by the Director's Representative for proper level and elevation prior to making any conduit connections.
- B. Canopy Lights
 - 1. Install canopy mounted fixtures securely to the canopy frame behind home plate in accordance with manufacturer's recommendations.
- C. Conduit System
 - 1. Use rigid galvanized steel conduit and rigid nonmetallic conduit as specified or indicated. Where conduits enter concrete light pole bases, provide rigid galvanized steel conduit.
 - 2. All electrical service from the panel box to the poles is to be located below grade.
 - 3. Cleaning Conduits: Take precautions to prevent foreign matter from entering conduits during installation. After installation, clean conduits with tools designed for the purpose.
- D. Grounding
 - 1. Provide a equipment grounding conductor installed within each conduit. Connect equipment grounding conductor to ballast enclosure and ground lug on pole.
 - 2. Provide a ground rod at each pole. Connect grounding electrode conductor to ground lug on pole.

3.4 CLEANUP

A. Remove excess materials and leave project site in a clean, neat, undamaged condition.

SOFTBALL FIELD LIGHTING SYSTEM

3.5 ACCEPTANCE

A. Basis of acceptance for sports field lighting shall be the complete installation of all items specified herein in accordance with the plans, specifications, approved shop drawings, and to the satisfaction of the Owner's Representative and Company Field Advisor.

END OF SECTION
SECTION 270536 - CABLE TRAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:1. Wire-basket cable trays.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of cable tray.
 - 1. Include data indicating dimensions and finishes for each type of cable tray indicated.
- B. Shop Drawings: For each type of cable tray.
 - 1. Show fabrication and installation details of cable trays, including plans, elevations, and sections of components and attachments to other construction elements. Designate components and accessories, including clamps, brackets, hanger rods, splice-plate connectors, expansion-joint assemblies, straight lengths, and fittings.
- C. Delegated-Design Submittal: For seismic restraints.
 - 1. Seismic-Restraint Details: Signed and sealed by a qualified professional engineer, licensed in the state where Project is located, who is responsible for their preparation.
 - 2. Design Calculations: Calculate requirements for selecting seismic restraints.
 - 3. Detail fabrication, including anchorages and attachments to structure and to supported cable trays.

1.4 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Certificates: For cable trays, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Field quality-control reports.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design cable tray supports and seismic bracing.
- B. Seismic Performance: Cable trays and supports shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the cable trays will remain in place without separation of any parts when subjected to the seismic forces specified."

2.2 GENERAL REQUIREMENTS FOR CABLE TRAYS

- A. Cable Trays and Accessories: Identified as defined in NFPA 70 and marked for intended location, application, and grounding.
 - 1. Source Limitations: Obtain cable trays and components from single manufacturer.
- B. Sizes and Configurations: See Drawings for specific requirements for types, materials, sizes, and configurations.

2.3 WIRE-BASKET CABLE TRAYS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. <u>Allied Tube & Conduit; a Tyco International Ltd. Co</u>.
 - 2. <u>Cablofil/Legrande</u>.
 - 3. <u>Chalfant Manufacturing Company</u>.
 - 4. <u>Cooper B-Line, Inc</u>.
 - 5. <u>Enduro Systems, Inc</u>.
 - 6. <u>Mono-Systems, Inc</u>.
 - 7. <u>MP Husky</u>.
 - 8. <u>Niedax-Kleinhuis USA, Inc</u>.
 - 9. <u>Snaketray</u>.
 - 10. <u>Wiremaid Products Division; Vutec Corporation</u>.
- B. Description:
 - 1. Configuration: Wires are formed into a standard 2-by-4-inch wire mesh pattern with intersecting wires welded together. Mesh sections must have at least one bottom longitudinal wire along entire length of section.

- 2. Materials: High-strength-steel longitudinal wires with no bends. Metal, suitable for indoors, and protected against corrosion by electroplated zinc galvanizing, complying with ASTM B 633, Type 1, not less than 0.000472 inch thick
- 3. Safety Provisions: Wire ends along wire-basket sides (flanges) rounded during manufacturing to maintain integrity of cables and installer safety.
- 4. Sizes:
 - a. Straight sections shall be furnished in standard 118-inch lengths.
 - b. Wire-Basket Depth: 4-inchusable loading depth by 12 inches wide.
- 5. Connector Assemblies: Bolt welded to plate shaped to fit around adjoining tray wires and mating plate. Mechanically joins adjacent tray wires to splice sections together or to create horizontal fittings.
- 6. Connector Assembly Capacity: Splices located within support span shall not diminish rated loading capacity of cable tray.

2.4 CABLE TRAY ACCESSORIES

- A. Fittings: Tees, crosses, risers, elbows, and other fittings as indicated, of same materials and finishes as cable tray.
- B. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.

2.5 WARNING SIGNS

- A. Lettering: 1-1/2-inch- high, black letters on yellow background with legend "Warning! Not To Be Used as Walkway, Ladder, or Support for Ladders or Personnel."
- B. Comply with requirements for fasteners in Section 260553 "Identification for Electrical Systems."

2.6 SOURCE QUALITY CONTROL

A. Testing: Test and inspect cable trays according to NEMA VE 1.

PART 3 - EXECUTION

3.1 CABLE TRAY INSTALLATION

- A. Install cable trays according to NEMA VE 2 and TIA/EIA-569-A-7.
- B. Install cable trays as a complete system, including fasteners, hold-down clips, support systems, barrier strips, adjustable horizontal and vertical splice plates, elbows, reducers, tees, crosses, cable dropouts, adapters, covers, and bonding.

- C. Install cable trays so that the tray is accessible for cable installation and all splices are accessible for inspection and adjustment.
- D. Remove burrs and sharp edges from cable trays.
- E. Join aluminum cable tray with splice plates; use four square neck-carriage bolts and locknuts.
- F. Fasten cable tray supports to building structure and install seismic restraints.
- G. Design fasteners and supports to carry cable tray, the cables, and a concentrated load of 200 lb. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems." Comply with seismic-restraint details according to Section 260548 "Vibration and Seismic Controls for Electrical Systems."
- H. Place supports so that spans do not exceed maximum spans on schedules and provide clearances shown on Drawings. Install intermediate supports when cable weight exceeds the load-carrying capacity of the tray rungs.
- I. Construct supports from channel members, threaded rods, and other appurtenances furnished by cable tray manufacturer. Arrange supports in trapeze or wall-bracket form as required by application.
- J. Support bus assembly to prevent twisting from eccentric loading.
- K. Install center-hung supports for single-rail trays designed for 60 versus 40 percent eccentric loading condition, with a safety factor of 3.
- L. Locate and install supports according to NEMA VE 2. Do not install more than one cable tray splice between supports.
- M. Support wire-basket cable trays with center support hangers, trapeze hangers or wall brackets.
- N. Support center support hangers or trapeze hangers for wire-basket trays with 1/4-inch- diameter rods.
- O. Make connections to equipment with flanged fittings fastened to cable trays and to equipment. Support cable trays independent of fittings. Do not carry weight of cable trays on equipment enclosure.
- P. Install expansion connectors where cable trays cross building expansion joints and in cable tray runs that exceed dimensions recommended in NEMA VE 2. Space connectors and set gaps according to applicable standard.
- Q. Make changes in direction and elevation using manufacturer's recommended fittings.
- R. Make cable tray connections using manufacturer's recommended fittings.
- S. Seal penetrations through fire and smoke barriers. Comply with requirements in Section 078413 "Penetration Firestopping."

- T. Install capped metal sleeves for future cables through firestop-sealed cable tray penetrations of fire and smoke barriers.
- U. Install cable trays with enough workspace to permit access for installing cables.
- V. Install warning signs in visible locations on or near cable trays after cable tray installation.

3.2 CABLE TRAY GROUNDING

- A. Ground cable trays according to NFPA 70 unless additional grounding is specified. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Cable trays with communications cable shall be bonded together with splice plates listed for grounding purposes or with listed bonding jumpers.
- C. Cable trays with control conductors shall be bonded together with splice plates listed for grounding purposes or with listed bonding jumpers.
- D. When using epoxy- or powder-coat painted cable trays as a grounding conductor, completely remove coating at all splice contact points or ground connector attachment. After completing splice-to-grounding bolt attachment, repair the coated surfaces with coating materials recommended by cable tray manufacturer.
- E. Bond cable trays to power source for cables contained within with bonding conductors sized according to NFPA 70, Article 250.122, "Size of Equipment Grounding Conductors."

3.3 CONNECTIONS

- A. Remove paint from all connection points before making connections. Repair paint after the connections are completed.
- B. Connect pathways to cable trays according to requirements in NEMA VE 2 and NEMA FG 1.

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. After installing cable trays and after electrical circuitry has been energized, survey for compliance with requirements.
 - 2. Visually inspect cable insulation for damage. Correct sharp corners, protuberances in cable trays, vibrations, and thermal expansion and contraction conditions, which may cause or have caused damage.
 - 3. Verify that the number, size, and voltage of cables in cable trays do not exceed that permitted by NFPA 70. Verify that communications or data-processing circuits are separated from power circuits by barriers or are installed in separate cable trays.
 - 4. Verify that there are no intruding items such as pipes, hangers, or other equipment in the cable tray.

- 5. Remove dust deposits, industrial process materials, trash of any description, and any blockage of tray ventilation.
- 6. Visually inspect each cable tray joint and each ground connection for mechanical continuity. Check bolted connections between sections for corrosion. Clean and retorque in suspect areas.
- 7. Check for improperly sized or installed bonding jumpers.
- 8. Check for missing, incorrect, or damaged bolts, bolt heads, or nuts. When found, replace with specified hardware.
- 9. Perform visual and mechanical checks for adequacy of cable tray grounding; verify that all takeoff raceways are bonded to cable trays. Test entire cable tray system for continuity. Maximum allowable resistance is 1 ohm.
- B. Prepare test and inspection reports.

END OF SECTION 270536

SECTION 283111 - DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Fire-alarm control unit.
 - 2. Manual fire-alarm boxes.
 - 3. System smoke detectors.
 - 4. Heat detectors.
 - 5. Notification appliances.
 - 6. Voice communication system.
 - 7. Remote annunciator.
 - 8. Addressable interface device.
 - 9. Digital alarm communicator transmitter.

1.3 DEFINITIONS

- A. LED: Light-emitting diode.
- B. NICET: National Institute for Certification in Engineering Technologies.

1.4 SYSTEM DESCRIPTION

A. Noncoded, UL-certified addressable system, with multiplexed signal transmission, dedicated to fire-alarm service only.

1.5 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Fire-alarm control unit and raceways shall withstand the effects of earthquake motions determined according to IBC 2009.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For fire-alarm system. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Comply with recommendations in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72.
 - 2. Include voltage drop calculations for notification appliance circuits.
 - 3. Include battery-size calculations.
 - 4. Include performance parameters and installation details for each detector, verifying that each detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
 - 5. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale and coordinating installation of duct smoke detectors and access to them. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators. Locate detectors according to manufacturer's written recommendations.
 - 6. Include voice/alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
 - 7. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits.
- C. General Submittal Requirements:
 - 1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Architect.
 - 2. Shop Drawings shall be prepared by persons with the following qualifications:
 - a. Trained and certified by manufacturer in fire-alarm system design.
 - b. NICET-certified fire-alarm technician, Level III minimum.
 - c. Licensed or certified by authorities having jurisdiction.

1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Seismic Qualification Certificates: For fire-alarm control unit, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Field quality-control reports.

1.8 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," deliver copies to authorities having jurisdiction and include the following:
 - 1. Comply with the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
 - 2. Provide "Record of Completion Documents" according to NFPA 72 article "Permanent Records" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter.
 - 3. Record copy of site-specific software.
 - 4. Provide "Maintenance, Inspection and Testing Records" according to NFPA 72 article of the same name and include the following:
 - a. Frequency of testing of installed components.
 - b. Frequency of inspection of installed components.
 - c. Requirements and recommendations related to results of maintenance.
 - d. Manufacturer's user training manuals.
 - 5. Manufacturer's required maintenance related to system warranty requirements.
 - 6. Abbreviated operating instructions for mounting at fire-alarm control unit.
- B. Software and Firmware Operational Documentation:
 - 1. Software operating and upgrade manuals.
 - 2. Program Software Backup: On magnetic media or compact disk, complete with data files.
 - 3. Device address list.
 - 4. Printout of software application and graphic screens.

1.9 QUALITY ASSURANCE

- A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.
- B. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level III technician.
- C. Source Limitations for Fire-Alarm System and Components: Obtain fire-alarm system from single source from single manufacturer. Components shall be compatible with, and operate as, an extension of existing system.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. NFPA Certification: Obtain certification according to NFPA 72 by a UL-listed alarm company.

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Edwards System Technologies (EST)
 - 2. Fire Control Instruments, Inc.; a Honeywell company.
 - 3. NOTIFIER; a Honeywell company.
 - 4. Simple Grinnell; a Tyco company.

2.2 SYSTEMS OPERATIONAL DESCRIPTION

- A. Fire-alarm signal initiation shall be by one or more of the following devices:
 - 1. Manual stations.
 - 2. Heat detectors.
 - 3. Smoke detectors.
 - 4. Duct smoke detectors.
 - 5. Verified automatic alarm operation of smoke detectors.
 - 6. Automatic sprinkler system water flow.
 - 7. Heat detectors in elevator shaft and pit.
 - 8. Fire standpipe system.
- B. Fire-alarm signal shall initiate the following actions:
 - 1. Continuously operate alarm notification appliances.
 - 2. Identify alarm at fire-alarm control unit and remote annunciators.
 - 3. Transmit an alarm signal to the remote alarm receiving station.
 - 4. Unlock electric door locks in designated egress paths.
 - 5. Release fire and smoke doors held open by magnetic door holders.
 - 6. Activate voice/alarm communication system.
 - 7. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
 - 8. Close smoke dampers in air ducts of designated air-conditioning duct systems.
 - 9. Recall elevators to primary or alternate recall floors.
 - 10. Record events in the system memory.
- C. Supervisory signal initiation shall be by one or more of the following devices and actions:
 - 1. Valve supervisory switch.
 - 2. Elevator shunt-trip supervision.
 - 3. Low-air-pressure switch of a dry-pipe sprinkler system
- D. System trouble signal initiation shall be by one or more of the following devices and actions:
 - 1. Open circuits, shorts, and grounds in designated circuits.
 - 2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
 - 3. Loss of primary power at fire-alarm control unit.

- 4. Ground or a single break in fire-alarm control unit internal circuits.
- 5. Abnormal ac voltage at fire-alarm control unit.
- 6. Break in standby battery circuitry.
- 7. Failure of battery charging.
- 8. Abnormal position of any switch at fire-alarm control unit or annunciator.
- 9. Low-air-pressure switch operation on a dry-pipe or preaction sprinkler system.
- E. System Trouble and Supervisory Signal Actions: Initiate notification appliance and annunciate at fire-alarm control unit and remote annunciators.

2.3 FIRE-ALARM CONTROL UNIT

- A. General Requirements for Fire-Alarm Control Unit:
 - 1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864 and listed and labeled by an NRTL.
 - a. System software and programs shall be held in flash electrically erasable programmable read-only memory (EEPROM), retaining the information through failure of primary and secondary power supplies.
 - b. Include a real-time clock for time annotation of events on the event recorder and printer.
 - 2. Addressable initiation devices that communicate device identity and status.
 - a. Smoke sensors shall additionally communicate sensitivity setting.
 - b. Temperature sensors shall additionally test for and communicate the sensitivity range of the device.
 - 3. Addressable control circuits for operation of mechanical equipment.
- B. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.
 - 1. Annunciator and Display: Liquid-crystal type, 3 line(s) of 40 characters, minimum.
 - 2. Keypad: Arranged to permit entry and execution of programming, display, and control commands.
- C. Circuits:
 - 1. Initiating Device, Notification Appliance, and Signaling Line Circuits: NFPA 72, Class B.
 - a. Initiating Device Circuits: Style B.
 - b. Notification Appliance Circuits: Style B.
 - c. Signaling Line Circuits: Style 4.

- 2. Serial Interfaces: Two RS-232 ports for printers.
- 3. Provide surge protection on circuits that exit the main building to the batting cages. Provide on both sides of the circuit.
- D. Elevator Recall:
 - 1. Smoke detectors at the following locations shall initiate automatic elevator recall.
 - a. Elevator lobby detectors except the lobby detector on the designated floor.
 - b. Smoke detector in elevator machine room.
 - c. Smoke detectors in elevator hoistway.
 - 2. Elevator lobby detectors located on the designated recall floors shall be programmed to move the cars to the alternate recall floor.
 - 3. Water-flow alarm connected to sprinkler in an elevator shaft and elevator machine room shall shut down elevators associated with the location without time delay.
 - a. Water-flow switch associated with the sprinkler in the elevator pit may have a delay to allow elevators to move to the designated floor.
- E. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.
- F. Voice/Alarm Signaling Service: Central emergency communication system with microphones, preamplifiers, amplifiers, and tone generators provided as a special module.
 - 1. Indicated number of alarm channels for automatic, simultaneous transmission of different announcements to different zones or for manual transmission of announcements by use of the central-control microphone. Amplifiers shall comply with UL 1711 and be listed by an NRTL.
 - a. Allow the application of and evacuation signal to indicated number of zones and, at same time, allow voice paging to the other zones selectively or in any combination.
 - b. Programmable tone and message sequence selection.
 - c. Standard digitally recorded messages for "Evacuation" and "All Clear."
 - d. Generate tones to be sequenced with audio messages of type recommended by NFPA 72 and that are compatible with tone patterns of notification appliance circuits of fire-alarm control unit.
 - 2. Status Annunciator: Indicate the status of various voice/alarm speaker zones and the status of firefighters' two-way telephone communication zones.
 - 3. Preamplifiers, amplifiers, and tone generators shall automatically transfer to backup units, on primary equipment failure.
 - 4. Tie-in to Softball PA system is not required. USC has a protocol in place that will silence the PA system when fire alarm control panel is in alarm.
- G. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory signals supervisory and digital alarm communicator transmitters shall be powered by 24-V dc source.

- 1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the powersupply module rating.
- H. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.
 - 1. Batteries: Sealed lead calcium.
- I. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

2.4 MANUAL FIRE-ALARM BOXES

- A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.
 - 1. Double-action mechanism requiring two actions to initiate an alarm, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
 - 2. Station Reset: Key- or wrench-operated switch.
 - 3. Indoor Protective Shield: Factory-fabricated clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm. Lifting the cover actuates an integral battery-powered audible horn intended to discourage false-alarm operation.
 - 4. Weatherproof Protective Shield: Factory-fabricated clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm.

2.5 SYSTEM SMOKE DETECTORS

- A. General Requirements for System Smoke Detectors:
 - 1. Comply with UL 268; operating at 24-V dc, nominal.
 - 2. Detectors shall be two-wire type.
 - 3. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
 - 4. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
 - 5. Integral Visual-Indicating Light: LED type indicating detector has operated and poweron status.
- B. Photoelectric Smoke Detectors:
 - 1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
 - 2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

- a. Primary status.
- b. Device type.
- c. Present average value.
- d. Present sensitivity selected.
- e. Sensor range (normal, dirty, etc.).
- C. Ionization Smoke Detector:
 - 1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
 - 2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
 - a. Primary status.
 - b. Device type.
 - c. Present average value.
 - d. Present sensitivity selected.
 - e. Sensor range (normal, dirty, etc.).
- D. Duct Smoke Detectors: Photoelectric type complying with UL 268A.
 - 1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
 - 2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
 - a. Primary status.
 - b. Device type.
 - c. Present average value.
 - d. Present sensitivity selected.
 - e. Sensor range (normal, dirty, etc.).
 - 3. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector.
 - 4. Each sensor shall have multiple levels of detection sensitivity.
 - 5. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
 - 6. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.

2.6 HEAT DETECTORS

- A. General Requirements for Heat Detectors: Comply with UL 521.
- B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F (57 deg C) or a rate of rise that exceeds 15 deg F (8 deg C) per minute unless otherwise indicated.
 - 1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
 - 2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

- C. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of 190 deg F (88 deg C).
 - 1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
 - 2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

2.7 NOTIFICATION APPLIANCES

- A. General Requirements for Notification Appliances: Individually addressed, connected to a signaling line circuit, equipped for mounting as indicated and with screw terminals for system connections.
 - 1. Combination Devices: Factory-integrated audible and visible devices in a singlemounting assembly, equipped for mounting as indicated and with screw terminals for system connections.
- B. Weatherproof Protective Shield: Factory-fabricated clear plastic enclosure hinged at the top to permit lifting for access. Provide where indicated on drawings.
- C. Visible Notification Appliances: Xenon strobe lights comply with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- (25-mm-) high letters on the lens.
 - 1. Rated Light Output:
 - a. 15/30/75/110 cd, selectable in the field.
 - 2. Mounting: Wall mounted unless otherwise indicated.
 - 3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
 - 4. Flashing shall be in a temporal pattern, synchronized with other units.
 - 5. Strobe Leads: Factory connected to screw terminals.
 - 6. Mounting Faceplate: Factory finished, white.
- D. Voice/Tone Notification Appliances:
 - 1. Appliances shall comply with UL 1480 and shall be listed and labeled by an NRTL.
 - 2. High-Range Units: Rated 2 to 15 W.
 - 3. Low-Range Units: Rated 1 to 2 W.
 - 4. Mounting: Flush or surface mounted and bidirectional.
 - 5. Matching Transformers: Tap range matched to acoustical environment of speaker location.
 - 6. Factory finished, white.
- E. Speaker/Strobe Clusters
 - 1. The Cluster Speaker Strobe shall be designed for exterior mounting for high ambient noise environments. The speaker strobe shall be supplied with UL Standard 1480 listed horn(s) and one UL Standard 1971 listed ceiling strobe mounted to a NEMA 3R steel enclosure. The strobe shall be a selectable 115 or 177 candela synchronizable strobe. The Cluster Speaker and Strobe shall be fully assembled. The Cluster Speaker and Strobe

shall be capable of use for UL Required Fire Life Safety applications. The Cluster Speaker and strobe wiring shall be able to be monitored for integrity by the Control Panel.

- 2. Color: Factory finished, beige.
- 2.8 Voice communication system
 - A. The system shall be a multi-purpose NFPA compliant, supervised, general-purpose audio, and fire/emergency evacuation system. Basis of design shall be the Cooper Wheelock SP-40S Safepath4. Provide all components necessary for a complete voice communications system including boosters and splitters.
 - B. The system shall be a single channel voice evacuation system incorporating supervision during the broadcasting of background music and general paging.
 - C. The system shall be capable of delivering 40 watts of supervised high fidelity audio power and 2 amps of supervised 24 VDC synchronized strobe power. Minimum supervised audio power shall be 40 watts, expandable to 5280 watts, depending on system configuration and with additional modules and power boosters. Supervised 24 VDC synchronized strobe power shall be 2 amps, expandable to the requirements of the installation. The system shall be capable of operating from a 120 VAC power source and have 24 VDC battery backup. Standard on-board system features shall include: digital voice messaging, a hand-held push-to-talk microphone with override priority, and a power supply/battery charger. The system shall be capable of interfacing with telephone systems for general paging announcements and will have night ringer capabilities. Form C contacts shall be provided for system alarm and trouble conditions. The system shall have an internal sounder to indicate trouble, and shall be capable of being silenced using a trouble acknowledge switch button.
 - D. The system shall have 8 message contacts with contact closure activation. The system shall have thirteen priority ordered inputs, including: On Board Microphone, Auxiliary Input (Line Level), 8 Digital Messages, Night Ringer Input, Telephone Paging Input, and Background Music Input.
 - E. The panel shall have power-limited circuitry with an internal battery charger and power supply. The power supply/charger section shall be able to charge 24 VDC batteries with a maximum capacity of 33 amp hours. Up to two 12 VDC, 12 AH batteries may be housed in the enclosure. Batteries larger than 12 Ah shall be housed in a separate enclosure such as the Cooper Wheelock BATC or equivalent. Batteries shall be supplied separately.
 - F. The system shall have power limited circuitry and class B wiring. Wiring terminal blocks will be removable and accept #22 #12 AWG wire. Audio output voltage shall be selectable for 25V or 70.7V. The voice (live microphone or recorded message) frequency response shall be 275 Hz 6.5 kHz, background music frequency response shall be 100 Hz 15 kHz. Stand by current draw shall be 140mA. Alarm current draw shall be 4.7 amps. The signal to noise ratio shall be better than 65 dB, dynamic range shall be better than 65 dB, total harmonic distortion shall be less than 2%.
 - G. The system shall be wall mountable, enclosed in a steel locking enclosure. The required batteries for 40-watt systems shall fit inside the enclosure. Approvals for the system shall

include: UL Standard 864, 9th edition, UL Standard 1711, and FCC part 15. The system shall be OSHA 1910.165 and ADA compliant. The system shall carry a 3 Year Warranty.

- H. Audio Boosters
 - 1. Audio Boosters shall be NFPA compliant supervised audio and supervised 24VDC synchronized strobe power boosters. The basis of design is the Wheelock SPB-320, SPB-160 and SPB-80/4 audio boosters. The booster shall have 24VDC battery backup capabilities. The booster shall have the capability to supervise the circuitry during playback of background music. The booster shall have the capability to be inter-connected to accommodate large installations with supervised audio power and also supervised and synchronized strobe power requirements.
 - 2. Each booster shall use 1.2 or 2.4 watts of audio input power to properly operate and provide additional supervised audio output power. A combination of boosters can be added together to provide for a maximum of 5,280 watts of supervised audio power. Additional strobe power can be obtained via a combination of boosters. The audio section of the booster shall be connected via a selectable 70V or 25V input from the Wheelock SP40S. The strobe section of the booster shall be divided into two sections each supplying two Amps of 24VDC, NAC, supervised, synchronizable, power limited, Class B strobe outputs, with selectable outputs offering Wheelock sync, pass through, or constant DC and can be activated via 8-33VDC NAC input or contact closure.
 - 3. The internal battery charger/power supply shall be capable of charging 24 VDC batteries with a maximum capacity of 33 amp hours. The enclosure shall be capable of housing the correct number of 12 VDC rechargeable batteries or an external battery enclosure(s) if necessary.
 - 4. The boosters shall have power-limited circuitry and be a class D amplifier with an internal battery charger and power supply. The booster shall operate on 120VAC, 4,5A, 60 Hz input. The booster shall be wall mountable, enclosed in a steel locking enclosure, with a red finish. Approvals for the booster shall include; UL Standard 864, 9th edition, and UL Standard 1711. The booster shall be OSHA 1910.165 and ADA compliant. The booster shall carry a 3 year warranty.
- I. Supervised volume control
 - 1. Provide manual volume control for telephone paging and background music for a specific speaker or speaker zone. The selected adjustment will not affect the volume setting of emergency prerecorded messages or live microphone usage. Volume control shall be located adjacent to the voice communication enclosure.

2.9 REMOTE ANNUNCIATOR

- A. Description: Annunciator functions shall match those of fire-alarm control unit for alarm, supervisory, and trouble indications. Manual switching functions shall match those of fire-alarm control unit, including acknowledging, silencing, resetting, and testing.
 - 1. Mounting: Flush cabinet, NEMA 250, Type 1.
- B. Display Type and Functional Performance: Alphanumeric display and LED indicating lights shall match those of fire-alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

2.10 ADDRESSABLE INTERFACE DEVICE

- A. Description: Microelectronic monitor module, NRTL listed for use in providing a system address for alarm-initiating devices for wired applications with normally open contacts.
- B. Integral Relay: Capable of providing a direct signal to elevator controller to initiate elevator recall.

2.11 DIGITAL ALARM COMMUNICATOR TRANSMITTER

- A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632 and be listed and labeled by an NRTL.
- B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from firealarm control unit and automatically capture two telephone line(s) and dial a preset number for a remote central station. When contact is made with central station(s), signals shall be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. Transmitter shall automatically report telephone service restoration to the central station. If service is lost on both telephone lines, transmitter shall initiate the local trouble signal.
- C. Local functions and display at the digital alarm communicator transmitter shall include the following:
 - 1. Verification that both telephone lines are available.
 - 2. Programming device.
 - 3. LED display.
 - 4. Manual test report function and manual transmission clear indication.
 - 5. Communications failure with the central station or fire-alarm control unit.
- D. Digital data transmission shall include the following:
 - 1. Address of the alarm-initiating device.
 - 2. Address of the supervisory signal.
 - 3. Address of the trouble-initiating device.
 - 4. Loss of ac supply or loss of power.
 - 5. Low battery.
 - 6. Abnormal test signal.
 - 7. Communication bus failure.
- E. Secondary Power: Integral rechargeable battery and automatic charger.
- F. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

2.12 DEVICE GUARDS

A. Description: Welded wire mesh of size and shape for the manual station, smoke detector, gong, or other device requiring protection.

- 1. Factory fabricated and furnished by manufacturer of device.
- 2. Finish: Paint of color to match the protected device.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

- A. Comply with NFPA 72 for installation of fire-alarm equipment.
- B. Install wall-mounted equipment, with tops of cabinets not more than 72 inches (1830 mm) above the finished floor.
 - 1. Comply with requirements for seismic-restraint devices specified in Section 260548 "Vibration and Seismic Controls for Electrical Systems."
- C. Smoke- or Heat-Detector Spacing:
 - 1. Comply with NFPA 72, "Smoke-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for smoke-detector spacing.
 - 2. Comply with NFPA 72, "Heat-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for heat-detector spacing.
 - 3. Smooth ceiling spacing shall not exceed 30 feet (9 m).
 - 4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Appendix Ain NFPA 72.
 - 5. HVAC: Locate detectors not closer than 3 feet (1 m) from air-supply diffuser or returnair opening.
 - 6. Lighting Fixtures: Locate detectors not closer than 12 inches (300 mm) from any part of a lighting fixture.
- D. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct.
- E. Heat Detectors in Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location.
- F. Remote Status and Alarm Indicators: Install near each smoke detector and each sprinkler waterflow switch and valve-tamper switch that is not readily visible from normal viewing position.
- G. Audible Alarm-Indicating Devices: Install not less than 6 inches (150 mm) below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.
- H. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches (150 mm) below the ceiling.
- I. Device Location-Indicating Lights: Locate in public space near the device they monitor.
- J. Fire-Alarm Control Unit: Surface mounted, with tops of cabinets not more than 72 inches (1830 mm) above the finished floor.

K. Annunciator: Install with top of panel not more than 72 inches (1830 mm) above the finished floor.

3.2 CONNECTIONS

- A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Section 087100 "Door Hardware." Connect hardware and devices to fire-alarm system.
 - 1. Verify that hardware and devices are NRTL listed for use with fire-alarm system in this Section before making connections.
- B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 3 feet (1 m) from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
 - 1. Smoke dampers in air ducts of designated air-conditioning duct systems.
 - 2. Alarm-initiating connection to elevator recall system and components.
 - 3. Supervisory connections at valve supervisory switches.
 - 4. Supervisory connections at elevator shunt trip breaker.

3.3 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Install framed instructions in a location visible from fire-alarm control unit.

3.4 GROUNDING

- A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.
- B. Provide surge protection on circuits that exit the main building to the batting cages.

3.5 FIELD QUALITY CONTROL

- A. Field tests shall be witnessed by authorities having jurisdiction.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Tests and Inspections:

- 1. Visual Inspection: Conduct visual inspection prior to testing.
 - a. Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter.
 - b. Comply with "Visual Inspection Frequencies" Table in the "Inspection" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.
- 2. System Testing: Comply with "Test Methods" Table in the "Testing" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
- 3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
- 4. Test audible appliances for the private operating mode according to manufacturer's written instructions.
- 5. Test visible appliances for the public operating mode according to manufacturer's written instructions.
- 6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
- E. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.
- F. Fire-alarm system will be considered defective if it does not pass tests and inspections.
- G. Prepare test and inspection reports.
- H. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.
- I. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

END OF SECTION 283111

Section 311100 - CLEARING AND GRUBBING

PART ONE-GENERAL

1.1 Description

- A. Work included: Remove trees, underbrush, undesirable growth, stumps, roots, etc., from the area to the limits shown on the Drawings, as specified herein, and as needed to meet the requirements of the construction shown in the Contract Documents.
- B. Related work:
 - 1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.
 - 2. Section 312513 Erosion and Sediment Control.
 - 3. Section 312200 Site Grading

1.2 Quality Assurance

- A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- B. Use equipment adequate in size, capacity and numbers to accomplish the work in a timely manner.
- C. Comply with requirements of governmental agencies having jurisdiction.

PART TWO-PRODUCTS

No products are required for this work.

PART THREE-EXECUTION

3.1 Area Included

A. All streets, parking areas, building pads, and any other areas as indicated on the Drawings.

3.2 **Procedures**

- A. Clearing and grubbing: The entire area within the limit lines described above shall be cleared and grubbed. Remove all vegetation, trees, brush, stumps, etc., from the area. All debris from this operation shall be disposed of off the Owner's property.
- B. Burning: Will not be allowed on the Owner's property.
- C. Erosion control: Construct and maintain erosion control as shown on the Drawings and in accordance with Section 312513: Erosion and Sediment Control, and the City of Columbia's requirements.

3.3 Measurement and Payment

A. No separate measurement or direct payment will be made for the work under this Section and all costs for same shall be included in the price bid for the item to which it pertains.

END OF SECTION 311100

Section 312200 - SITE GRADING

PART 1 - GENERAL

1.1 Description

- Work included: Cut, fill, excavate, backfill, compact and grade the site as necessary to bring the A. open areas to the lines and grades shown on the drawings. This specification is to be applied to all areas outside the playing field shown on the drawings.
 - 1. The work includes, but is not necessarily limited to:
 - Excavations and formations of embankments. а
 - Dressing of graded areas, shoulders and ditches. b.
 - 2. Classification: All excavation is unclassified and excavation of every description, regardless of material encountered within the grading limits of the project, shall be performed to the lines and grades indicated.
- B. Related work:
 - Documents affecting work of this Section include, but are not necessarily limited to, 1. General Conditions, Supplementary Conditions, and Sections in Division 1 of these specifications.
 - 2. 3. Section 311100 - Clearing and Grubbing.
 - Section 312513 Erosion and Sediment Control.
- C. **Definitions:**
 - Open areas: Open areas shall be those areas that do not include the playing field. 1.
 - 2. 3. Maximum density: Maximum weight in pounds per cubic foot of a specific material.
 - Optimum moisture: Percentage of water in a specific material at maximum density.
 - 4. Rock excavation: Excavation of any hard natural substance which requires the use of explosives and/or special impact tools such as jack hammers, sledges, chisels or similar devices specifically designed for use in cutting or breaking rock, but exclusive of trench excavating machinery. To be considered as rock excavation, the material shall be continuous; individual boulders or rocks in soil will not be considered rock excavation.
 - 5. Muck: Materials unsuitable for foundation because of organic content, saturation to the extent that it is somewhat fluid and must be removed by dragline, dredge or other special equipment, are designated as muck. No extra payment will be made for muck removal.
 - Unsuitable material: Unsuitable material is defined as earth material unsatisfactory for 6. its intended use and as classified by the soils technician. In addition to organic matter, sod, muck, roots and rubbish, highly plastic clay soils of the CH and MH descriptions, and organic soils of the OL and OH descriptions, as defined in the Unified Soil Classification System shall be considered as unsuitable material.
 - Suitable material: Where the term suitable material is used in specification sections 7. pertaining to earthwork, it means earth or materials designated as being suitable for their intended use by soils technicians or the Engineer. Suitable material shall be designated as meeting the requirements of the Unified Soil Classification System types SW, GW,
 - GC, SC, SM, ML, CL or as designated in these specifications. Select material: Select material is defined as granular material to be used where 8. indicated on the drawings or where specified herein consisting of soils conforming to the Unified Soil Classification types SW, SM, GW or GM or as otherwise approved by the Engineer as select fill. Select material shall contain no stones or rubble larger than 1-1/2" in diameter.
 - 9. Crushed stone (gravel): Crushed stone shall be No. 57 aggregate or equal conforming to ASTM C-33.
 - 10. Excavation: Excavation is defined as unclassified excavation of every description regardless of materials encountered.

The Contractor must determine for himself the volume of material required by the site. D.

1.2 **Quality Assurance**

- A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- B. Comply with requirements of governmental agencies having jurisdiction.
- C. A testing laboratory retained by the Owner will make such tests as are deemed advisable. The Contractor shall schedule his work so as to permit a reasonable time for testing before placing succeeding lifts of fill material and shall keep the laboratory informed of his progress. The cost of the initial tests shall be paid for by the Owner. Subsequent tests required as a result of improper compaction shall be paid for by the Contractor.

1.3 **Product Handling**

Comply with pertinent provisions of Section 016000. A.

PART 2 - PRODUCTS

2.1 Soil Materials

- Α. Soil material used as fill, backfill, subgrade for structures or pavements, embankments, or site grading shall consist of suitable material as found available on site until such supply of on-site material is depleted.
 - Provide suitable material free from organic matter and deleterious substances, containing 1. no rocks or lumps over 6" in greatest dimension, and with not more than 15% of the rocks or lumps larger than 2-1/2" in their greatest dimension. Do not permit rocks having a dimension greater than 1" in the upper 6" of fill or
 - 2. embankment.
- B. Should the quantity of suitable on-site material be insufficient to complete the work, suitable borrow material as approved by the Engineer shall be provided by the Contractor at no additional expense to the Owner.
- C. Select materials may be provided from on-site if acceptable material as approved by the Engineer is available on site. Otherwise approved select material shall be provided by the Contractor from an off-site source.

2.2 Topsoil

- A. Use topsoil consisting of material removed from the top 3" to 6" of existing on-site soils.
- B. Use topsoil containing no stones, roots or large clods of soil.
- C. Stockpile topsoil separate from other excavated material.

2.3 Weed Killer

Provide a dry, free-flowing, dust free chemical compound, soluble in water, capable of inhibiting A. growth of vegetation and approved for use on this work by governmental agencies having jurisdiction as well as the Owner.

2.4 Equipment

A. Use equipment adequate in size, capacity and numbers to accomplish the work in a timely manner without undue waste or damage of material.

PART 3 - EXECUTION

3.1 Surface Conditions

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.

3.2 **Preparation**

- A. Clearing and grubbing: Clear and grub areas to be graded prior to commencement of the grading operations.
- B. Complete any demolition and/or removal work as may be required prior to grading operations.
- C. Dispose of all clearing, grubbing and demolition debris and other deleterious material off the project site. Vegetation, roots, brush, rubbish, stumps, etc. may not be burned on-site. No burning is permitted on-site.
- E. Topsoil: Strip topsoil to a maximum depth of 3" to 6" without contamination from the subsoil and stockpile topsoil separate from other excavated materials.
 - 1. Transport and deposit topsoil in storage piles convenient to areas that are to receive topsoil or in other locations as indicated or approved by the Engineer.
 - 2. Deposit topsoil in areas that are already graded and will not be disturbed by on-going construction.
 - 3. Dispose of unsuitable or unusable stripped material off-site or as otherwise directed by the Engineer.
- F. Sampling and preliminary testing:
 - 1. Prior to beginning the grading operations, the Contractor shall submit to the Engineer his proposed sequence of excavation operations.
 - 2. Based upon the sequence of excavation, samples of the fill materials will be obtained as excavation proceeds and tested for grain size permeability and moisture density relationship using the Standard Proctor Method (ASTM D698, Method A).
 - 3. Allow sufficient time for completion of laboratory tests before any fill operations begin, using the soils being tested.

3.3 Finish Elevations and Lines

- A. Construct areas outside of building or structure lines true to grades shown.
 - 1. Where no grade is indicated, shape finish surface to drain away from buildings or structures, as approved by the Engineer.
- B. Degree of finish shall be that ordinarily obtainable from bladegrader, supplemented with hand raking and finishing.
- C. Finish surfaces to within 0.10' above or below the established grade or approved cross section.

3.4 General Procedures

- A. Existing utilities:
 - 1. Unless shown to be removed, locate and protect active utility lines shown on the drawings or otherwise made known to the Contractor prior to excavating. If damaged, repair or replace at no additional cost to the Owner.
 - 2. If active utility lines are encountered and are not shown on the drawings or otherwise made known to the Contractor, promptly notify the Engineer and take necessary steps to assure that service is not interrupted.
 - 3. If service is interrupted as a result of work under this Section, immediately restore service by repairing the damaged utility at no additional cost to the Owner.
 - 4. If existing utilities are found to interfere with the permanent facilities being constructed under this Section, immediately notify the Engineer and secure his instructions.
 - 5. Do not proceed with permanent relocation of utilities until written instructions are received from the Engineer.
- B. Protection of persons and property:
 - 1. Barricade open holes and depressions occurring as part of this Work, and post warning lights on property adjacent to or with public access.
 - 2. Operate warning lights during hours from dusk to dawn each day and as otherwise required.
 - 3. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, washout and other hazards created by operations under this Section.
- C. Use means necessary to prevent dust becoming a nuisance to the public, to neighbors, and to other work being performed on or near the site.
- D. Maintain access to adjacent areas at all times.
- E. Excavate and backfill in a manner and sequence that will provide proper drainage at all times.

3.5 Excavating (Cuts)

- A. Perform excavating of every type of material encountered within the limits of the Work to the lines, grades and elevations indicated and specified herein.
- B. Suitable excavated materials:
 - 1. Use all suitable materials removed from the excavation as far as practicable in the formation of the embankments, subgrades, shoulders, building sites and other places as directed.
 - 2. Unless otherwise indicated on the drawings or approved by the Engineer, surplus suitable material shall be removed from the site and disposed of by the Contractor.
- C. Unsuitable excavated material: Remove from the site and dispose of all unsuitable material unless otherwise approved by the Engineer.
- D. Rock excavation:
 - 1. Notify the Engineer upon encountering rock or similar material which cannot be removed or excavated by conventional earth moving or ripping equipment.
 - 2. Do not use explosives without written permission from the Engineer.

- 3. When explosives are permitted, use only experienced powdermen or persons who are licensed or otherwise authorized to use explosives. Store, handle and use explosives in strict accordance with all regulatory bodies and the "Manual of Accident Prevention in Construction" of the Associated General Contractors of America, Inc.
- 4. The Contractor shall be solely responsible for any damage resulting from the use of explosives.
- 5. The Contractor is responsible for securing all permits required in performing this work.
- E. Unauthorized excavation:
 - 1. Excavation of material to depths below the grades indicated unless so directed by the Engineer will be deemed unauthorized excavation.
 - 2. Unauthorized overexcavation shall be backfilled and compacted without any additional expense to the Owner.
- F. Authorized overexcavation:
 - 1. In the event that it is necessary to remove unsuitable material to a depth greater than that shown on the drawings or otherwise specified, the Contractor, upon receiving direction from the Engineer, shall remove, replace and compact such material as directed by the Engineer at the unit prices indicated in the Bid Form.

3.6 Filling and Backfilling

- A. Use fills formed of suitable material placed in layers of not more than 8" in depth measured loose and rolled and/or vibrated with suitable equipment until compacted.
- B. Do not place rock that will not pass through a 6" diameter ring within the top 12" of the surface of the completed fill or rock that will not pass through a 3" diameter ring within the top 6" of the completed fill.
- C. Do not use broken concrete or asphaltic pavement in fills.
- D. Selection of borrow material:
 - 1. Material in excess of that available on the site shall be suitable material furnished by the Contractor from private sources selected by the Contractor. The material shall be approved by the Engineer before use. All expenses involved in securing, developing, transporting and placing the material shall be borne by the Contractor.
- E. Placing and compacting:
 - 1. Place backfill and fill materials in layers not more than 8" in loose depth.
 - 2. Before compacting, moisten or aerate each layer as necessary to provide the optimum moisture content.
 - 3. Compact each layer to required percentage of maximum density for the area.
 - 4. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
 - 5. Place backfill and fill materials evenly adjacent to structures, to required elevations.
 - 6. Take care to prevent wedging action of backfill against structures by carrying the material uniformly around the structures to approximately the same elevation in each lift.
- F. Moisture control:
 - 1. Do not use soil material that is either too dry or too wet to achieve proper compaction.
 - 2. Where subgrade or layer of soil material is too dry to achieve proper compaction, uniformly apply water to surface of soil material such that free water does not appear on the surface during or subsequent to compacting operations.

- 3. Remove and replace, or scarify and air dry, soil material that is too wet to permit compacting to the specified density.
- 4. Soil material that has been removed because it is too wet to permit compacting may be stockpiled or spread and allowed to dry. Assist drying by discing, harrowing, or pulverizing until moisture content is reduced to a satisfactory value as determined by moisture-density relation tests approved by the Engineer.
- G. Compaction requirements:
 - 1. Compact soils to not less than the following percentages of maximum dry density as determined in accordance with ASTM D698, Method A (Standard Proctor).
 - 2. Fill beneath structures and beneath an area extending 10' beyond the limits of the foundation:

	Top 12" of subgrade	100%
	All other fill material	98%
3.	Fill beneath roadway:	
	Top 12" of subgrade	100%
	All other fill material	95%
4.	Embankments:	
	Top 12" of subgrade	98%
	All other fill material	95%
5.	Fill beneath walkways:	
	Top 12" of subgrade	95%
	All other fill material	90%
6.	Lawn and unpaved open areas:	
	All other fill material	90%

3.7 Finish Grading

A. General:

- 1. Uniformly grade the areas within limits of grading under this Section, including adjacent transition areas.
- 2. Smooth the finished surfaces within specified tolerance.
- 3. Grade with uniform levels or slopes between points where elevations are shown on the drawings, or between such points and existing grades.
- Where a change of slope is indicated on the drawings, construct a rolled transition section having a minimum radius of approximately 8'0", unless adjacent construction will not permit such a transition, or if such a transition defeats positive control of drainage.
- B. Grading adjacent to structures: Grade areas adjacent to buildings to achieve drainage away from the structures and to prevent ponding.

3.8 Field Quality Control

A. Secure the Engineer's construction review and observation and approval of subgrades and fill layers before subsequent construction is permitted thereon.

3.9 Placing Topsoil

- A. Upon completion of site grading and other related site work, topsoil shall be uniformly spread over the graded or improved areas. Topsoil shall be evenly distributed to conform to final grade elevations shown on the plans. Only areas outside the playing field and bullpens will have top soil placed in them.
- B. Place, level and lightly compact topsoil to a depth of not less than 3".

- C. Maintain topsoil free of roots, rocks, debris, clods of soil and any other objectionable material which might hinder subsequent grassing or mowing operations.
- D. Any surplus materials shall be disposed of in approved areas on the site.

3.10 Maintenance

- A. Protection of newly graded areas:
 - Protect newly graded areas from traffic and erosion, and keep free from trash and weeds.
 Repair and re-establish grades in settled, eroded and rutted areas to the specified tolerances.
- B. Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify the surface, reshape, and compact to the required density prior to further construction.

3.12 Measurement and Payment

A. The work under this Section and all costs for same shall be included in the lump sum price bid for the item to which it pertains with additional or deductive payments allowed for the specified items based on the unit prices given in the Bid Form.

END OF SECTION 312200

Section 312200.1 - PLAYING FIELD EARTHWORK

PART 1 - GENERAL

1.1 Summary

- A. Section includes:
 - 1. Stripping of subsurface materials for removal, replacement, and grading of the warning track and areas that may be incidentally disturbed on the softball field perimeter in support of the Softball Stadium Construction.
 - 2. Preparation of subgrade for removal and replacement of the subdrainage system including quick drains within the warning track in support of the Softball Stadium Construction
- B. Related Sections
 - 1. Playing Field Materials and Mixtures: Section 329231

1.2 Playing Field Contractor Qualifications

- A. Contractor Qualifications shall apply to all work contained within all Division One specification sections.
- B. Those submitting bids shall be a licensed South Carolina contractor and shall perform at least 80% of the construction with its own "in-house" forces. Bidding contractors must have been actively, and directly engaged in constructing similar types of sand based athletic fields, and renovations for a minimum period of three (3) or more years. At the time of bid, bidder must provide proof of five (5) or more regulation NCAA and/or professional sports field installations or renovations which required sand based construction techniques, and have been in use successfully for three (3) or more years. The bidder further understands that specialized laser grading equipment is mandatory for this project.
- C. The bidder will be a Certified Field Builder by the American Sports Builders Association and will have a Certified Sports Field Manager (SFM) on staff.
- D. In addition to the above, provide a resume of experience, at the time of bidding, for the project superintendent who will be on the site and actively directing the project on a day to day basis. Project superintendent must possess, on a minimal basis, the same qualifications as listed above for the company. The submission of this information is a material requirement of all playing field specifications. Bidders who cannot meet these minimum criteria will be considered non-responsive for the purposes of this project and their Bid will not be considered. The Bidder must provide a minimum of five (5) names and telephone numbers of Architects and/or Owners who can be contacted to verify the completion of previous Work.

1.3 Project Conditions

- A. The project scope includes removal and replacement of limited areas of the perimeter and warning track of the existing softball field for the installation of additional perimeter infrastructure. Establishing the finished subgrade and final finished grades of the playing field, and field perimeters shall be accomplished as a part of this section.
- B. The subgrade field elevations of the sand based areas of the field are approximately 14 inches lower than the proposed finished grade of the field. Playing Field Contractor shall verify the proper subgrade elevations with a grade certification prior to the installation of the subdrainage piping. (Subgrade certification shall be provided by a registered State of South Carolina professional engineer. This grade certification shall be approved, in writing, by the Engineer, prior to the commencement of the installation of the subdrainage piping system. Notify the Engineer immediately, in writing, of any discrepancies.
- C. Locate known existing underground utilities in the areas of work. Refer to the plans and specifications regarding utilities that are to remain in place and provide adequate means of protection during earthwork operations. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, consult with the Engineer and utility owner for directions. Cooperate with the Engineer and utility companies in keeping utilities in operation. Repair damaged utilities to the satisfaction of the Owner. Do not interrupt existing utilities serving occupied or used facilities except when permitted in writing by the Engineer, and then only after acceptable temporary utility services have been provided, and a schedule for outages has been approved by the Owner. Demolish and completely remove from the site existing underground utilities indicated to be removed. Coordinate with utility companies for shut-off and capping of services if these lines are active.
- D. Protection of Persons and Property: Barricade open excavations occurring as a part of this work and post warning lights. Operate warning lights as recommended by authorities having jurisdiction. Protect structures, utilities, sidewalks, pavements and other facilities from damage caused by settlement, lateral movement, undermining, washout and other hazards created by earthwork operations. Provide a temporary site fence as shown on the construction drawings.
- E. Cleaning: Contractor shall maintain adjacent streets to meet requirements of authorities having jurisdiction.

PART TWO-PRODUCTS

2.1 Materials Soil

A. Soil materials to be utilized to finish the laser graded subgrade, whether from sources on or offsite must be approved by the Engineer as suitable for intended use and specifically for required location or purpose.

PART THREE-EXECUTION

3.1 Examination

A. Site visit: Visit and inspect site and take into consideration known or reasonably inferable conditions affecting work, prior to bidding. Failure to visit the site will not relieve the Contractor of furnishing materials or performing work required.

3.2 Preparation

- A. Field engineering for bench marks, monuments, reference points and layout of the work shall be verified prior to commencing work. A bench mark has been provided by URS|BP Barber Surveyors. A copy of this plan is included within the construction plans prepared by URS|BP Barber. Reference Sheet C-2 "Existing and Demolition Plan."
- B. Protection:
 - 1. Maintain soil under foundations and pavements at natural moisture content.
 - 2 Provide and maintain slopes, crowns and ditches in excavation to insure satisfactory surface drainage at all times. Provide temporary drainage facilities to prevent water from draining into excavations. When work is completed, restore temporary ditches or cuts to original grade or finish grade as indicated.
 - 3. Bailing or Pumping: Keep excavations free from water at all times. Take measures and furnish equipment and labor necessary to control water flow, drainage and accumulation of water as required to permit completion of work under this Section to avoid damage to work. Discharge water into the existing storm drainage system and or subdrainage piping system as approved by the Engineer.

3.3 Excavation

- A. Area excavations: Excavate site as required to accommodate aggregate layers as indicated on the drawings.
 - 1. Subdrainage pipe trenches: Bottoms of full width required. If through error, trenches are carried deeper than required, fill excess depth with compacted fill as directed at Contractor's expense.
 - 2. Subgrades: If debris, soft spots or loose or excessively moist areas are found at the bottom of any excavation, immediately report condition to Engineer who will determine the corrective work if necessary.
 - 3. Unsuitable Subgrade Material: If unsuitable bearing materials are encountered at the required subgrade elevations, carry excavations deeper and replace the excavated material as directed by the Engineer's representative with suitable ma terial from an offsite stockpile.

- 4. Subgrade laser grading, survey certification and blue topping: When subgrade elevations established by the site work contractor has reached the required elevations, playing field contractor to laser grade and certify the subgrade of the playing field. Finished subgrade elevation grades shall be brought to within $\pm 1/2"$ of designed subgrade elevations with a registered South Carolina survey engineer's 25' X 25' grid report. Notify the Engineer's representative who will make an inspection of the grid survey, and will in writing, approve or reject the subgrade conditions. Playing field contractor may not commence the installation of the subdrainage piping system until the certified subgrade of the field is approved in writing by the Engineer's representative.
- B. Stability of excavations:
 - 1. Sides of excavation basin to comply with all codes and ordinances having jurisdiction. Shore and brace side walls for stability of material excavated.
 - 2. Maintain sides and slopes of excavations in a safe condition until completion of backfilling.
- C. Dewatering:
 - 1. Prevent surface water from flowing into excavations and from flooding project site and surrounding areas.
 - 2. Do not use footing or foundation or utility trench excavations as temporary drainage ditches.
- D. Cold weather protection:
 - 1. If necessary, protect excavation bottoms against freezing when atmospheric temperature is less that 35 F if work must continue to meet schedule.
- E. Excavated Materials:
 - 1. Playing Field Contractor will completely remove the existing playing field sod, subsurface soils to subgrade elevations, irrigation piping, heads and valves, (salvage as directed by the Owner).
 - 2. All excavated materials shall be removed to an offsite location at the expense of the contractor. No area is available immediately adjacent to the site for storage of excess excavated materials.

3.4 Compaction

- A. Compaction requirements: Compact each layer to minimum of the following Standard Proctor Densities by ASTM D698.
 - 1.Subdrainage trench backfill95%2.Subgrade95%
Owner shall be responsible for compaction testing of the subgrade soils beneath the renovated portions of the field. Notify Owner 48 hours in advance of anticipated compaction testing. Approval, in writing, shall occur prior to the installation of the subdrainage piping system for the field. Compaction tests shall occur for every 10,000 s.f. of surface area of the field (approximately 5) and shall be provided immediately to the Engineer for review and comment.

3.5 Finish Grading

- A. General: Cut and fill all areas to elevations and tolerances specified. Leave graded surface clean, free from rubbish and large clods and laser graded.
- B. Subgrade under playing field: Finish grade to subgrade elevations indicated on the Drawings. Tolerance: $(\pm) 0.04' (1/2'') (25' X 25' grid survey required for certification).$
- C. Finish grade at top of sand rootzone for Bermuda Grass sod areas, infield clays and warning track:

Finished grade elevations of the field shall be accomplished utilizing low ground pressure, laser grading equipment. Finished grades shall be brought to within plus 0.00 or minus 0.75 inch with no variations of more than .25 inch in 25 feet of the designed elevations. **Provide certified as-built drawings (25' X 25' grid survey required for certification) of final finished grade elevations for Engineer's representative approval <u>prior</u> to sodding.**

3.6 Maintenance

- A. Protection of graded areas: Protect newly graded areas from traffic and erosion. Keep free of trash and debris. Repair and re-establish grades in settled, eroded and rutted areas to specified tolerances.
- B. Reconditioning compacted areas: Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify the surface, re-shape and compact to required density prior to further construction.
- C. Settling: Where settling is measurable or observable at backfilled or filled areas during general project warranty period, remove surface (pavement, lawn or other finish), add appropriate backfill material, compact and replace surface treatment. Restore appearance, quality and condition of surface to match adjacent work and eliminate evidence of restoration to greatest extent possible.

END OF SECTION 312200.1

SECTION 312316.16 - EXCAVATING, BACKFILLING FOR STRUCTURES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Work included: Excavating, backfilling, compacting and grading to build the structures as shown on the Drawings, as specified herein, and as needed to meet the requirements of the construction shown in the Contract Documents.
- B. Related work:
 - 1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.
 - 2. Section 312200 Site Grading.
- C. Classification: All excavation is unclassified and excavation of every description, regardless of material encountered within the excavation limits of the structure, shall be performed to the lines and grades indicated.
- D. Definitions:
 - 1. Open areas: Open areas shall be those areas that do not include building sites, paved areas, street right-of-way and parking areas.
 - 2. Maximum density: Maximum weight in pounds per cubic foot of a specific material.
 - 3. Optimum moisture: Percentage of water in a specific material at maximum density.
 - 4. Rock excavation: Excavation of any hard natural substance which requires the use of explosives and/or special impact tools such as jack hammers, sledges, chisels or similar devices specifically designed for use in cutting or breaking rock, but exclusive of trench excavating machinery. To be considered as rock excavation, the material shall be continuous; individual boulders or rocks in soil will not be considered rock excavation.
 - 5. Muck: Materials unsuitable for foundation because of organic content, saturation to the extent that it is somewhat fluid and must be moved by dragline, dredge, or other special equipment, are designated as muck. No extra payment will be made for muck removal.
 - 6. Unsuitable material: Unsuitable material is defined as earth material unsatisfactory for its intended use and as classified by the soils technicians. In addition to organic matter, sod, muck, roots, and rubbish, highly plastic clay soils of the CH and MH descriptions, and organic soils of the OL and OH descriptions, as defined in the Unified Soil Classification System shall be considered as unsuitable material.
 - 7. Suitable material: Where the term suitable material is used in specification sections pertaining to earthwork, it means earth or materials designated as being

suitable for their intended use by soils technicians or the Engineer. Suitable material shall be designated as meeting the requirements of the Unified Soil Classification System types SW, GW, GC, SC, SM, ML, Cl or as designated in these specifications.

- 8. Select material: Select material is defined as granular material to be used where indicated on the drawings or where specified herein consisting of soils conforming to the Unified Soil Classification types SW, SM, GW, or GM or as otherwise approved by the Engineer as select fill. Select material shall contain no stones or rubble larger than 1-1/2" in diameter.
- 9. Crushed stone (gravel): Crushed stone shall be No. 57 aggregate or equal conforming to ASTM C 33.
- 10. Excavation: Excavation is defined as unclassified excavation of every description regardless of materials encountered.

1.2 Quality Assurance

- A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- B. Comply with requirements of governmental agencies having jurisdiction.
- C. Testing: A testing laboratory retained by the Owner will make such tests as are deemed advisable.
 - 1. Schedule fill and backfill operations so as to permit a reasonable time for inspection and testing before placing succeeding lifts and keep the laboratory and Engineer informed of progress.
 - 2. Notify the Engineer and allow sufficient time for observation and/or testing of foundation subgrades prior to commencing any work on the exposed excavation.

1.3 JOB CONDITIONS

- A. If conditions encountered during construction warrant additional removal of unsuitable material below foundation subgrades, then remove unsuitable material and replace it as specified at no additional expense to the Owner.
- B. Restoration of disturbed areas:
 - 1. Restore all areas disturbed by, during or as a result of construction activities to their existing or better condition.
 - a. For existing areas with sod type grasses, replace with new sod. Existing sod may be reused where properly removed and stored.
 - 2. Do not interpret this as requiring replacement of trees and undergrowth in undeveloped sections of the rights-of-way.

1.4 PRODUCT HANDLING

A. Comply with pertinent provisions of Section 016000.

PART 2 - PRODUCTS

2.1 Soil Materials

- A. Soil material used as fill, backfill or subgrade for structures shall consist of suitable material.
 - 1. Provide suitable material free from organic matter and deleterious substances, containing no rocks or lumps over 6" in greatest dimension, and with not more than 15% of the rocks or lumps larger than 2-1/2" in their greatest dimension.
 - 2. Do not permit rocks having a dimension greater than 1" in the upper 6" of fill or subgrade.
- B. Where select material is indicated on the drawings or specified, use select granular material as defined herein and approved by the Engineer.
- C. Where indicated on the drawings or specified, use gravel or crushed stone as defined herein.
- D. Where indicated on the drawings, provide a lean concrete "mud slab" beneath foundations.
 - 1. Use 2000 psi concrete and a minimum thickness of 2-1/2".
 - 2. With prior approval of the Engineer, a "mud slab" may be substituted for gravel base material except where the gravel base is required for drainage or for use with pressure relief valves.

PART 3 - EXECUTION

3.1 Excavation

- A. Protection of persons and property:
 - 1. Protect structures, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, washout and other hazards created by operations under this Section.
 - 2. Unless shown to be removed, locate and protect active utility lines shown on the drawings or otherwise made known to the Contractor prior to excavating. If damaged, repair or replace at no additional cost to the Owner.
 - 3. If active utility lines are encountered and are not shown on the drawings or otherwise made known to the Contractor, promptly notify the Engineer and take necessary steps to assure that service is not interrupted.

- 4. Barricade open holes and depressions occurring as part of this work, and post warning lights on property adjacent to or with public access. Operating warning lights during hours from dusk to dawn each day and as otherwise required.
- 5. Side slopes: Slope, bench and/or shore sides of excavations and trench walls to maintain stability of the wall or sides. Pile materials obtained from the excavation a minimum of four feet from the edge of the excavation.
- 6. Shoring and sheeting: Where necessary, shore and sheet excavations with members of sizes and arrangement sufficient to prevent injury to persons, damage to structures or injurious caving or erosion.
 - a. Furnish, put in place, and maintain such sheeting and bracing as may be required to support the sides of excavations, to prevent any movement which could in any way diminish the width of the excavation below that necessary for proper construction, and to protect adjacent structures from undermining or other damage. Any movement or bulging that may occur shall be corrected immediately by the Contractor. Care shall be taken to prevent voids outside of the sheeting, but if voids are formed, they shall be immediately filled and compacted.
 - b. Take all precautions to prevent distress of existing structures because of sheeting installation or removal. Where the removal of sheeting may cause damage to existing or newly constructed structures, such sheeting shall be left in place at no expense to the Owner.
 - c. All sheeting and shoring operations and maintenance thereof shall be the responsibility of the Contractor.
- B. Excavating: Perform excavating of every type of material encountered to the lines, grades and elevations indicated or as necessary for construction of the structures shown.
 - 1. Conform to elevations and dimensions shown within a tolerance of 0.10', and extending a sufficient distance from footings and foundations to permit placing and removing concrete formwork, installation of services, other construction required and for construction observation.
 - 2. Where earth will stand, shallow footing excavations may be cut to the exact size of the footing.
 - 3. Separate suitable materials and stockpile for future use.
 - 4. Dispose of unsuitable material and excess suitable material.
- C. Foundation subgrades: Excavate foundations and footings to a level bottom in firm, solid, suitable material.
 - 1. Take care not to disturb the bottom of the excavation unless further compaction of the subgrade is required.
 - 2. Notify the Engineer in due time to permit observation of the completed excavation prior to performing work on the foundation subgrade.
 - 3. Should unsuitable or soft material be encountered at subgrade elevation, remove such material and replace with compacted suitable material or crushed stone from firm earth up to the indicated elevation.

- a. In wet excavations or where groundwater is normally present, replace unsuitable material with crushed stone or lean concrete.
- b. In dry excavations above the normal groundwater level, replace unsuitable material with compacted suitable material.
- c. Removal and replacement of unsuitable material shall be paid for at the unit prices for such work as stated in the Bid Form.
- 4. Where rock is encountered at foundation level:
 - a. Use drilling, picking, wedging or similar methods leaving the foundation rock in an entirely solid and unshattered condition.
 - b. Roughen approximately level surfaces to provide satisfactory bond with concrete.
 - c. Cut steps or benches in sloped surfaces to provide satisfactory bond.
- D. Drainage: Provide drainage and control grading in the vicinity of the work to prevent drainage into the excavation.
- E. Rock excavation:
 - 1. Notify the Engineer upon encountering rock or similar material that cannot be removed or excavated by conventional earth moving or ripping equipment.
 - 2. Do not use explosives without written permission from the Engineer.
 - 3. When explosives are permitted, use only experienced powdermen or persons who are licensed or otherwise authorized to use explosives. Store, handle and use explosives in strict accordance with all regulatory bodies and the "Manual of Accident Prevention in Construction" of the Associated General Contractors of America, Inc.
 - 4. The Contractor shall be solely responsible for any damage resulting from the use of explosives.
 - 5. The Contractor is responsible for securing all permits required in performing this work.
 - 6. Do not use blasting adjacent to existing buildings or structures.
 - a. Remove rock at such locations using jack hammers and bull points.
- F. Unauthorized excavation:
 - 1. Excavation of material to depths below the grades indicated unless so directed by the Engineer will be deemed unauthorized excavation.
 - 2. Backfill and compact unauthorized over excavation at no expense to the Owner.
 - a. In wet excavations or excavations below normal groundwater elevations: Use crushed stone or lean concrete as directed by the Engineer.
 - b. In dry excavations above normal groundwater elevations: Use compacted suitable material.

3.2 Dewatering

A. Remove all surface and subsurface waters from excavations and maintain the excavation in a dry condition during construction operations.

- B. Maintain the water level below the excavation subgrade during excavation and construction.
 - 1. Material disturbed below the foundation subgrade due to improper dewatering shall be removed and replaced with crushed stone or lean concrete at no expense to the Owner.
 - 2. Use sumps, pumps, drains, trenching or well point system as necessary to maintain a dry excavation.
 - 3. Dewatering by trench pumping will not be permitted if migration of fine grained natural material (running sand) from bottom, side walls or bedding material will occur.
- C. Dispose of water pumped from excavations in storm drains having capacity, canals, trenches or other approved locations.
 - 1. Contractor is responsible for acquiring all permits required to discharge the water and shall protect waterways from turbidity during the operation.
 - 2. Prevent flooding of streets, roadways, or private property.
 - 3. Provide engines driving dewatering pumps with residential type mufflers.

3.3 Backfilling, Filling, and Compaction

- A. Use suitable material for all filling and backfilling operations.
- B. Fill under structures: Deposit suitable material in layers not exceeding 8" in depth and compact each layer using proper equipment.
 - 1. Do not place rock that will not pass through a 6" diameter ring within the top 12" of the surface of the completed fill or rock that will not pass through a 3" diameter ring within the top 6" of the completed fill.
 - 2. Do not place broken concrete, bricks, or asphaltic pavement in fills.
 - 3. Where indicated on the drawings, provide select granular material.
- C. Backfill excavations as promptly as progress of the Work permits, but not until completion of the following:
 - 1. Inspection and acceptance of construction below finish grade including, where applicable, damp proofing and waterproofing.
 - 2. Inspecting, testing, approving and recording locations of underground utilities.
 - 3. Removing concrete formwork.
 - 4. Removing shoring and bracing, and backfilling of voids with satisfactory materials.
 - 5. Removing trash and debris.
 - 6. Foundation walls have been in place seven days.
- D. Placing and compacting:

- 1. Place backfill and fill materials in layers not more than 8" in loose depth.
- 2. Before compacting, moisten or aerate each layer as necessary to provide the optimum moisture content within $\pm 2\%$.
- 3. Compact each layer to required percentage of maximum density for area.
- 4. Do not place backfill or fill material on surfaces that are muddy, frozen, or containing frost or ice.
- 5. Place backfill and fill materials evenly adjacent to structures, to required elevations.
- 6. Take care to prevent wedging action of backfill against structures by carrying the material uniformly around the structure to approximately the same elevation in each lift.
- 7. Do not operate heavy equipment closer to foundation or retaining walls than a distance equal to height of backfill above the footing.
 - a. Compact remaining area using power driven hand tampers.
- 8. Where the construction includes basement or other underground walls having structural floors over them, do not backfill such walls until the structural floors are in place and have attained sufficient strength to support the walls.
- E. Compaction requirements:
 - 1. Compact soils to not less than the following percentages of maximum dry density as determined in accordance with ASTM D698, Method A (Standard Proctor).
 - 2. Existing in place subgrade below structures where subgrade has been disturbed by water, improper dewatering, or construction traffic.

Top 12" of subgrade:	100%
Below top 12" of subgrade:	98%

3. Fill beneath structures and beneath an area extending 10 feet beyond the limits of the foundation:

Top 12" of subgrade:	100%
Below top 12" of subgrade:	98%

4. Compaction of suitable material used to replace unsuitable material below foundation subgrades:

Top 12" of subgrade:	100%
Below top 12" of subgrade:	98%

3.4 Field Quality Control

- A. Secure the Engineer's construction observation and approval of subgrades and fill layers before subsequent construction is permitted thereon.
- B. Field density determinations will be made, at no cost to the Contractor, to ensure that the specified densities are being obtained. Field density tests will be performed as determined by the Engineer, considering the following:
 - 1. At areas to receive paving, at least one field density test for every 5000 sq.ft. of subgrade area, but not less than three tests.

- 2. In each compacted fill layer, one field density test for every 5000 sq.ft. of overlaying paved area, but not less than three tests.
- 3. In fill beneath structures, one field density test for every 2500 sq.ft. in each layer.
- 4. Other tests as deemed necessary by the Engineer.
- C. If, the Engineer's opinion based on reports of the testing laboratory, subgrade or fills that have been placed are below specified density, provide additional compacting and testing until specified requirements are met.
 - 1. Additional testing will be provided by the Owner's selected testing laboratory and all costs for the additional testing will be borne by the Contractor.
- D. Proofrolling:
 - 1. Upon request by the Engineer, proofroll the subgrade of structure foundations.
 - a. Make not less than three passes of a 25 to 50 ton rubber tired roller over the full area.
 - b. Unstable, soft or otherwise unsuitable materials revealed by the proofrolling shall be removed and replaced with satisfactory material and compacted as specified herein.

3.5 Measurement and Payment

A. The work under this section and all costs for same shall be included in the lump sum price bid for the item to which it pertains, with additional or deductive payments allowed for the specified items based on the unit prices given in the Bid Form.

END OF SECTION 312316.16

SECTION 312333 - TRENCHING, BACKFILLING FOR UTILITIES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Work included: Trench, backfill, and compact as specified herein and as needed for installation of underground utilities associated with the Work.
- B. Related work:
 - 1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions and Sections in Division 1 of these Specifications.
 - 2. Section 331100 Water Distribution System.
 - 3. Section 334100 Sewers: Storm Drainage.
 - 4. Section 330100 Sewers: Sanitary, Gravity.

1.2 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- B. Use equipment adequate in size, capacity, and numbers to accomplish the work in a timely manner.

1.3 JOB CONDITIONS

- A. Existing utilities:
 - 1. There now exists in the construction areas, waterworks, storm drainage, sanitary sewers, street paving, gas mains and other utilities.
 - 2. Approximate location of certain underground lines and structures are shown on the plans for information only, other underground lines or structures are not shown.
 - 3. Locate these and other possible unknown utility lines using electronic pipe finder, or other approved means.
 - 4. Locate, excavate and expose all existing underground lines in advance of trenching operations.
 - 5. The Contractor will be held responsible for the workmanlike repair of any damage done to any of these utilities in the execution of his work under this Section.
 - 6. The Contractor shall familiarize himself with the existing conditions and be prepared to adequately care for and safeguard himself and the Owner from damage.

- B. Notification of intent to excavate:
 - South Carolina Underground Utility Damage Prevention Act (S.C. Code Ann, 58-35-10, CT-SEQ, Supp. 1978) requires persons to ascertain the location of underground public utility property prior to excavation or demolition in certain situations. The Act also requires such persons to give timely notice of intent to excavate or demolish prior to commencing such operations. Failure to comply could subject the violator to a civil penalty of up to one thousand dollars (\$1,000) for each violation of the Act.
 - 2. Notification of intent to excavate may be given by calling this toll free number: 1-888-721-7877.
- C. Protecting trees, shrubbery and lawns:
 - 1. Trees and shrubbery in developed areas and along the trench line shall not be disturbed unless absolutely necessary, and subject to the approval of the Engineer.
 - a. Any such trees and shrubbery necessary to be removed shall be heeled in and replanted.
 - 2. Where trenches cross private property through established lawns, sod shall be cut, removed, stacked and maintained in suitable condition until replacement is approved by the Engineer.
 - a. Topsoil underlying lawn areas shall be removed and kept separate from general excavated materials.
- D. Clearing:
 - 1. Perform all clearing necessary for installation of the complete work.
 - 2. Clearing shall consist of removing all trees, stumps, roots, brush and debris in the rights-of-way obtained for the Work.
 - 3. All timber of merchantable size shall remain the property of the Owner and shall be trimmed and cut in such lengths as directed and stacked along the edge of the right-of-way.
 - 4. All other material, including trimmings from above, shall be completely disposed of in a satisfactory manner.
- E. Restoration of disturbed areas:
 - 1. Restore all areas disturbed by, during or as a result of construction activities to their existing or better condition.
 - a. For existing areas with sod type grasses, replace with new sod. Existing sod may be reused where properly removed and stored.
 - 2. Do not interpret this as requiring replacement of trees and undergrowth in undeveloped sections of the rights-of-way.
- F. Minimizing silting and bank erosion during construction:

- 1. During construction, protective measures shall be taken and maintained to minimize silting and bank erosion of creeks and rivers adjacent to the work being performed during construction.
- 2. Sack breakers are to be used on steep slopes along creek banks and fill slopes to prevent washing of ditch. Sack breakers are to be placed at the direction of the Engineer.

PART 2 - PRODUCTS

2.1 EXCAVATED MATERIALS

- A. Perform all excavation of every description and of whatever substances encountered to depths indicated or specified.
- B. Pile material suitable for backfilling in an orderly manner at safe distance from banks or trenches to avoid overloading and to prevent slides or cave-ins.
- C. Remove and deposit unsuitable or excess materials as directed by the Engineer.

2.2 BACKFILL MATERIALS

- A. Provide from materials excavated for installation of utility.
 - 1. Select soil material free from organic matter and deleterious substances, containing no rocks or lumps over 2" in greatest dimension for backfill up to 12" above top of utility being covered.
 - 2. Do not permit rocks larger than 2" in greatest dimension in top 6" of backfill.

2.3 OTHER MATERIALS

- A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Engineer.
- B. Should the quantity of suitable on-site material be insufficient to complete the work, provide suitable borrow material as approved by the Engineer at no additional expense to the Owner.
- C. Provide select materials from on-site if acceptable material as approved by the Engineer is available on-site. Otherwise, provide approved select material from an off-site source.

PART 3 - EXECUTION

3.1 PROCEDURES

- A. Existing utilities:
 - 1. Unless shown to be removed, protect active utility lines shown on the drawings or otherwise made known to the Contractor prior to trenching. If damaged, repair or replace at no additional cost to the Owner.
 - 2. If active utility lines are encountered and are not shown on the Drawings or otherwise made known to the Contractor, promptly take necessary steps to assure that service is not interrupted.
 - 3. If service is interrupted as a result of work under this Section, immediately restore service by repairing the damaged utility at no additional cost to the Owner.
 - 4. If existing utilities are found to interfere with the permanent facilities being constructed under this Section, immediately notify the Engineer and secure his instructions.
 - 5. Do not proceed with permanent relocation of utilities until written instructions are received from the Engineer.
- B. Locations within streets or highways:
 - 1. Comply with South Carolina Department of Transportation's (SCDOT) "Encroachment Permit" issued for the Work, and the South Carolina Department of Transportation's (SCDOT) "A Policy for Accommodating Utilities on Highway Rights-of-Way".
 - 2. Take all precautions and comply with all requirements as may be necessary to protect the improvements, including barricades for protection of traffic.
 - 3. Keep minimum of one lane open to traffic at all times where utility crosses street or highway.
- C. Protection of persons and property:
 - 1. Barricade open holes and depressions occurring as part of the Work, and post warning lights on property adjacent to or with public access.
 - 2. Operate warning lights during hours from dusk to dawn each day and as otherwise required.
 - 3. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, washout and other hazards created by operations under this Section.
- D. Dewatering:
 - 1. Remove all surface and subsurface waters from excavations and maintain the excavation in a dry condition during construction operations.

- 2. Maintain the ground water level a minimum of 3-feet below the trench bottom during excavation, installation and backfilling.
 - a. Material disturbed below the invert elevation due to improper dewatering shall be removed and replaced with crushed stone or lean concrete at no expense to the Owner.
 - b. Use sumps, pumps, drains, trenching, wells, vacuum or well point system as necessary to maintain the ground water level a minimum of 3-feet below the trench bottom and maintain a dry excavation.
 - c. Dewatering by trench pumping will not be permitted if migration of fine grained natural material (running sand) from bottom, side walls or bedding material will occur.
 - d. Provide monitoring wells sufficient in size, location, number and depth to monitor the ground water level in the construction area during excavation and backfill operations.
 - e. Maintain dewatering operations until backfilling and compaction operations are complete.
- 3. Dispose of water pumped from excavations in storm drains having capacity, canals, trenches or other approved locations.
 - a. Contractor is responsible for acquiring all permits required to discharge the water and shall protect waterways from turbidity during the operation.
 - b. Prevent flooding of streets, roadways, or private property.
 - c. Provide engines driving dewatering pumps with residential type mufflers.
- E. Use means necessary to prevent dust becoming a nuisance to the public, to neighbors, and to other work being performed on or near the site.
- F. Maintain access to adjacent areas at all times.

3.2 TRENCH EXCAVATION (Un-Classified)

- A. Remove all materials of whatever substance encountered
- B. Where trenching occurs in existing lawns, remove turf in sections and keep damp. Replace turf upon completion of the backfilling.
- C. Open cut:
 - 1. Excavate for utilities by open cut.
 - 2. If conditions at the site prevent such open cut, and if approved by the Engineer, tunneling may be used.
 - 3. Short sections of a trench may be tunneled if, in the opinion of the Engineer, the conductor can be installed safely and backfill can be compacted properly into such tunnel.
 - 4. Remove boulders and other interfering objects, and backfill voids left by such removals, at no additional cost to the Owner.

- 5. Remove wet or otherwise unstable soil incapable of properly supporting the utility, as determined by the Engineer, to depth required and backfill to proper grade with stone bedding material, at no additional cost to the Owner.
- 6. Excavating for appurtenances:
 - a. Excavate for manholes and similar structures to a distance sufficient to leave at least 12" clear between outer surfaces and the embankment or shoring that may be used to hold and protect the banks.
 - b. Overdepth excavation beyond such appurtenances that has not been directed will be considered unauthorized. Fill with sand, gravel, or lean concrete as directed by the Engineer, and at no additional cost to the Owner.
- D. Trench to the minimum width necessary for proper installation of the utility, with sides as nearly vertical as possible. Accurately grade the bottom to provide uniform bearing for the utility.
- E. Provide sheeting and shoring necessary for protection of the Work and for the safety of personnel.
 - 1. Remove in units when level of backfilling has reached the elevation necessary to protect the utility work and adjacent property.
 - 2. Sheeting at the bottom of trenches over 10' deep for sewers 15" and larger in size, shall remain in place and be cut off no less than 2" above top of pipe, at no additional cost to the Owner.
- F. Depressions:
 - 1. Dig bell holes and depressions for joints after the trench has been graded. Provide uniform bearing for the pipe on prepared bottom of the trench.
 - 2. Except where rock is encountered, do not excavate below the depth indicated or specified.
 - 3. Where rock is encountered, excavate rock to a minimum overdepth of 4" below the trench depth indicated or specified, and to provide 6" clearance in any horizontal direction from all parts of the utility and appurtenances.
- G. Special requirements relating to excavation for specific types of utilities shall comply with the following:
 - 1. Water distribution lines:
 - a. Provide depth of cover shown or minimum cover of 36", whichever is greater.
 - b. Where minimum cover only is required, carry excavations to depths necessary to properly grade the pipe on tangents and vertical curves as directed by the Engineer.
 - c. Provide minimum clearance of 6" between pipe walls and trench walls or sheeting and bracing lines.

- d. If minimum cover of 36" cannot be provided, then thermoplastic piping may not be used. Use ductile iron piping or other Engineer-approved material.
- 2. Sanitary or storm sewer lines:
 - a. Comply with requirements of Section 330100 and Section 334100.
 - b. Do not excavate trench more than 200' ahead of pipe laying, unless permitted by Engineer.
 - c. Maintain trench sides vertical to point not less than 2' above top of pipe.
 - d. Upper portion of trench may be sloped to any width which will not cause damage to adjoining structures, utilities, pavements or private property.
- H. Comply with pertinent OSHA regulations in regards to the excavation of utilities.

3.3 BACKFILLING

- A. General:
 - 1. Backfill trenches and excavations immediately after the pipes are laid, unless other protection is directed or indicated.
 - 2. Select and deposit backfill materials with special reference to the future safety of the pipes.
 - 3. Reopen trenches which have been improperly backfilled, to a depth as required for proper compaction. Refill and compact as specified, or otherwise correct to the approval of the Engineer.
 - 4. Surplus material shall be disposed of as directed by the Engineer.
 - 5. Original surface shall be restored to the approval of the Engineer.
 - 6. Maintain proper dewatering during backfill and compaction operations.
- B. Lower portion of trench:
 - 1. Deposit approved backfill and bedding material in layers of 6" maximum thickness, and compact with suitable tampers to the density of the adjacent soil until there is a cover of not less than 24" over sewers and 12" over other utility lines.
 - 2. Take special care in backfilling and bedding operations not to damage pipe and pipe coatings.
- C. Remainder of trench:
 - 1. Except for special materials for pavements, backfill the remainder of the trench with material free from stones larger than 6" or 1/2 the layered thickness, whichever is smaller, in any dimension.
 - 2. Deposit backfill material in layers not exceeding the thickness specified, and compact each layer to the minimum density directed by the soil engineer.
- D. Adjacent to buildings: Mechanically compact backfill in 6" layers within ten (10') feet of buildings.

- E. Under roads, streets and other paved areas:
 - 1. Mechanically tamp in 6" layers using heavy duty pneumatic tampers or equal.
 - 2. Tamp each layer to a density equivalent of not less than 100% of an ASTM D 698 Proctor Curve.
 - 3. Provide additional compaction by leaving the backfilled trench open to traffic while maintaining the surface with crushed stone.
 - 4. Refill any settlement with crushed stone and continue such maintenance until replacement of pavement is authorized by the Engineer.
- F. Undeveloped areas:
 - 1. Backfill in wooded, swampy or undeveloped areas shall be as specified hereinbefore, except that tamping of the backfill above a level 2' over the top of the pipe will not be required.
 - 2. Mound excavated material neatly over the ditch to provide for future settlements.

3.4 MEASUREMENT AND PAYMENT

- A. Unclassified excavation:
 - 1. No measurement or direct payment will be made for the Work under this Section and all costs for same shall be included in the price bid for the utility line to which it pertains.

END OF SECTION 312333

Section 312513 - EROSION AND SEDIMENT CONTROL

PART ONE - GENERAL

1.1 Description

A. Work included: Provide protection of the environment during the construction of this project to reduce soil erosion and siltation to the lowest reasonably achievable level.

1.2 General

A. Exercise every reasonable precaution, throughout the life of the project, to prevent the eroding of soil and the silting of rivers, streams, lakes, reservoirs, other water impoundments, ground or roadway surfaces, or other property. Erosion control practices to be used for this project are shown on the drawings and are to conform to South Carolina Department of Health and Environmental Control regulations. All products to be accepted "as equal" will be listed on the SDCOT approved products list.

PART TWO - PRODUCTS

2.1 Crushed Stone

- A. Provide #57 crushed stone for project entrance and exit.
- B. Provide #57 crushed stone for temporary sediment barriers around inlets and for temporary stone check dams as needed.

2.2 Silt Fence

- A. All posts to be self-fastener angle steel, 5' in length.
 - 1. Wooden posts are not acceptable.
- B. Woven wire shall conform to the requirements of ASTM A 116, Class I zinc coating for wire. Each woven square shall measure 5.33" X 12". The top and bottom wires shall be 10 gauge. All other wires shall be 12-1/2 gauge.
 - 1. Securely attach woven wire to posts with wire ties.
- C. Filter fabric shall be Mirafi 600X synthetic fabric as manufactured by Celanese Fibers Co., Bidim C34 as manufactured by DuPont or approved equal.
 - 1. Limit splices in filter fabric using continuous rolls whenever possible.
 - 2. Whenever splices are necessary a minimum overlap of 6" is required and all splices must occur at a post so that the integrity of the fence is not compromised.
 - 3. Securely attach filter fabric to top of woven wire and at posts with wire ties.
- D. Silt fences should be continuous and transverse to the flow. The silt fence should follow the contours of the site as closely as possible. Place the fence such that the water cannot runoff around the end of the fence.

2.3 Erosion Control Blanket

- A. Use erosion control blanket S150, from North American Green or approved equal.
 - 1. Use Biostakes where staples are required or indicated on the drawings for stabilization.
 - a. Staple in pattern recommended by blanket manufacturer.

2. Staple locations must be clearly marked on the blanket when stakes are used.

PART THREE - EXECUTION

3.1 General

A. Construct and maintain all erosion control measures until the substantial completion of the project.

3.2 Temporary Construction Entrance/Exit

- A. Construct a gravel area or pad at points where vehicles enter and leave a construction site.
- B. Clear the entrance and exit area of all vegetation, roots, and other objectionable material and properly grade and place gravel to the grade and dimensions shown on the plans.
- C. Construct drainage channels to carry water to a sediment trap or other suitable outlet.
- D. Use geotextile fabrics to improve stability of the foundation in locations subject to seepage or high water table.
- E. Maintain the gravel pad in a condition to prevent mud or sediment from leaving the construction site by periodic top dressing with two inches of stone.
- F. After each rainfall, inspect any structure used to trap sediment and clean it out as necessary.
- G. Immediately remove objectionable materials spilled, washed, or tracked onto public roadways.

3.3 Temporary Grassing

- A. Provide a temporary cover for erosion control on disturbed areas that will remain unstabilized for a period of more than 14 days in accordance with SCDHEC Standards.
- B. This practice applies to cleared areas, diversions, dams, temporary sediment basins, temporary road banks, and topsoil stockpiles where vegetation is needed for less than 1 year.
- C. Provide grassing on slope 5% or greater within 14 days of disturbance. Comply with Section 329213.

3.4 Silt Fence

- A. Provide silt fence barrier where shown on the plans and on utility construction parallel to the disturbed trench where perpendicular sheet flow runoff occurs on disturbed areas with slopes greater than 4%.
- B. Place at the extreme limits of the area to be disturbed as shown.
- C. Construct temporary sediment barriers of filter fabric, buried at the bottom, stretched and supported by posts and install below small disturbed areas as indicated on the drawings to retain sediment by reducing the flow velocity to allow sediment deposition.
- D. Space posts 10'-0" on center, maximum or as indicated on the drawings.
- E. Remove sediment deposits prior to reaching one-third height of the fence.
- F. Monitor site frequently and place additional silt fencing should evidence indicate that erosion is about to occur at locations other than those shown on plan.

3.5 Inlet Protection

EROSION AND SEDIMENT CONTROL

- A. Construct temporary sediment barriers around storm drain curb inlets using block and gravel as indicated on the drawings.
- B. Construct metal frame barriers around grate and frame of drop inlets as indicated on the drawings.
- C. Inspect structure after each rainfall and repair as required.
- D. Remove sediment when trap reaches one-half capacity.
- E. Remove structure when protected areas have been stabilized.

3.6 Maintenance

- A. Place all erosion control devices or measures prior to any land disturbing activity within the drainage area they are located.
- B. Inspect erosion control devices and clean or otherwise remove silt buildup as necessary once a week or 24-hours following a rain event of ≥ 0.1 ".

3.7 Removal

A. Remove temporary structures after protected areas have been stabilized.

3.8 Measurement and Payment

A. No separate measurement or direct payment will be made for the items under this Section and all costs for same shall be included in the lump sum price bid for the project.

END OF SECTION 312513

SECTION 313116 - TERMITE CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Soil treatment with termiticide.
- B. Related Sections:
 - 1. Section 061000 "Rough Carpentry" for wood preservative treatment by pressure process.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of termite control product.
 - 1. Include the EPA-Registered Label for termiticide products.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Product Certificates: For termite control products, from manufacturer.
- C. Soil Treatment Application Report: After application of termiticide is completed, submit report for Owner's records and include the following:
 - 1. Date and time of application.
 - 2. Moisture content of soil before application.
 - 3. Termiticide brand name and manufacturer.
 - 4. Quantity of undiluted termiticide used.
 - 5. Dilutions, methods, volumes used, and rates of application.
 - 6. Areas of application.
 - 7. Water source for application.
- D. Warranties: Sample of special warranties.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A specialist who is licensed according to regulations of authorities having jurisdiction to apply termite control treatment and products in jurisdiction where Project is located.
- B. Regulatory Requirements: Formulate and apply termiticides and termiticide devices according to the EPA-Registered Label.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: To ensure penetration, do not treat soil that is water saturated or frozen. Do not treat soil while precipitation is occurring. Comply with requirements of the EPA-Registered Label and requirements of authorities having jurisdiction.
- B. Coordinate soil treatment application with excavating, filling, grading, and concreting operations. Treat soil under footings, grade beams, and ground-supported slabs before construction.

1.7 WARRANTY

- A. Soil Treatment Special Warranty: Manufacturer's standard form, signed by Applicator and Contractor, certifying that termite control work, consisting of applied soil termiticide treatment, will prevent infestation of subterranean termites. If subterranean termite activity or damage is discovered during warranty period, re-treat soil and repair or replace damage caused by termite infestation.
 - 1. Warranty Period: Five years from date of Substantial Completion.

1.8 MAINTENANCE SERVICE

A. Continuing Service: Beginning at Substantial Completion, provide 12 months' continuing service including monitoring, inspection, and re-treatment for occurrences of termite activity. Provide a standard continuing service agreement. State services, obligations, conditions, terms for agreement period, and terms for future renewal options.

PART 2 - PRODUCTS

2.1 SOIL TREATMENT

A. Termiticide: Provide an EPA-Registered termiticide, complying with requirements of authorities having jurisdiction, in an aqueous solution formulated to prevent termite infestation. Provide quantity required for application at the label volume and rate for the maximum termiticide concentration allowed for each specific use, according to product's EPA-Registered Label.

- 1. <u>Products</u>: Subject to compliance with requirements, provide one of the following:
 - a. <u>BASF Corporation</u>, Agricultural Products; Termidor.
 - b. <u>Bayer Environmental Science</u>; Premise 75.
 - c. <u>FMC Corporation</u>, Agricultural Products Group; Dragnet FT, Talstar, Prevail.
 - d. <u>Syngenta</u>; Demon TC, Prelude, Probuild TC.
- 2. Service Life of Treatment: Soil treatment termiticide that is effective for not less than five years against infestation of subterranean termites.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for moisture content of soil per termiticide label requirements, interfaces with earthwork, slab and foundation work, landscaping, utility installation, and other conditions affecting performance of termite control.
- B. Proceed with application only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. General: Comply with the most stringent requirements of authorities having jurisdiction and with manufacturer's written instructions for preparation before beginning application of termite control treatment. Remove all extraneous sources of wood cellulose and other edible materials such as wood debris, tree stumps and roots, stakes, formwork, and construction waste wood from soil within and around foundations.
- B. Soil Treatment Preparation: Remove foreign matter and impermeable soil materials that could decrease treatment effectiveness on areas to be treated. Loosen, rake, and level soil to be treated except previously compacted areas under slabs and footings. Termiticides may be applied before placing compacted fill under slabs if recommended in writing by termiticide manufacturer.
 - 1. Fit filling hose connected to water source at the site with a backflow preventer, complying with requirements of authorities having jurisdiction.

3.3 APPLICATION, GENERAL

A. General: Comply with the most stringent requirements of authorities having jurisdiction and with manufacturer's EPA-Registered Label for products.

3.4 APPLYING SOIL TREATMENT

- A. Application: Mix soil treatment termiticide solution to a uniform consistency. Provide quantity required for application at the label volume and rate for the maximum specified concentration of termiticide, according to manufacturer's EPA-Registered Label, to the following so that a continuous horizontal and vertical termiticidal barrier or treated zone is established around and under building construction. Distribute treatment evenly.
 - 1. Slabs-on-Grade and Basement Slabs: Under ground-supported slab construction, including footings, building slabs, and attached slabs as an overall treatment. Treat soil materials before concrete footings and slabs are placed.
 - 2. Foundations: Adjacent soil, including soil along the entire inside perimeter of foundation walls; along both sides of interior partition walls; around plumbing pipes and electric conduit penetrating the slab; around interior column footers, piers, and chimney bases; and along the entire outside perimeter, from grade to bottom of footing. Avoid soil washout around footings.
 - 3. Masonry: Treat voids.
 - 4. Penetrations: At expansion joints, control joints, and areas where slabs will be penetrated.
- B. Avoid disturbance of treated soil after application. Keep off treated areas until completely dry.
- C. Protect termiticide solution, dispersed in treated soils and fills, from being diluted until groundsupported slabs are installed. Use waterproof barrier according to EPA-Registered Label instructions.
- D. Post warning signs in areas of application.
- E. Reapply soil treatment solution to areas disturbed by subsequent excavation, grading, landscaping, or other construction activities following application.

END OF SECTION 313116

SECTION 321123 - STONE BASE COURSE

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Work included: Provide crushed stone base (with prime) constructed on the compacted subgrade where shown on the Drawings, as specified herein, and as needed for a complete and proper installation.
- B. Related work:
 - 1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.
 - 2. Section 312200 Site Grading.

1.2 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

1.3 SUBMITTALS

- A. Comply with pertinent provisions of Section 013300.
- B. Certificates, signed by materials producer, stating that materials meet the specified requirements.

1.4 PRODUCT HANDLING

A. Comply with pertinent provisions of Section 016000.

PART 2 - PRODUCTS

2.1 COARSE AGGREGATE

- A. Furnish a coarse aggregate (retained on No. 4 sieve) consisting of hard, durable particles of stone, reasonably free from soft, thin, elongated or laminated pieces and deleterious substances.
- B. Furnish aggregate with an abrasion loss of less than 65% as measured by the Los Angeles Abrasion Test.

2.2 FINE AGGREGATE

- A. Furnish a fine aggregate consisting of material produced by stone crushing operations.
- B. Liquid limit shall not exceed 25 and the plasticity index shall not exceed 6 when tested in accordance with AASH TO T-89 and T-90, respectively.

2.3 COMPOSITE MIXTURE

- A. Produce in one crushing operation or by blending the fine and coarse aggregate in proper proportions.
- B. After the materials have been mixed, laid down, and initial compaction operations begun, the composite mixture shall conform to the following:

Sieve Designation	Percent by Weight Passing
2"	100
1-1/2"	95-100
1"	70-100
1/2"	48-75
No. 4	30-50
No. 30	11-30
No. 200	0-12
Liquid Limit	25 max.
Plasticity Index	6 max.

2.4 PRIME ASPHALT

A. Use either MC-30, RC-30, RC-70, or EA-P complying with requirements of Sections 406, 407, and 408 of the South Carolina Department of Transportation specifications.

PART 3 - EXECUTION

3.1 **PREPARATION OF SUBGRADE**

- A. Proofroll all areas to receive crushed stone paving.
 - 1. Make not less than three passes over the full area, using a 35 to 50 ton rubber tired roller.
- B. Remove all soft, unstable, or unsuitable material that will not compact readily.
 - 1. Remove to full depth of unsuitable material, or to a depth of 30", whichever is less.
 - 2. Replace with satisfactory materials.
- C. Fill all holes, ruts or depressions which develop in the subgrade with approved on-site material, bringing subgrade to indicated line and grades.

- D. Compact subgrade using suitable construction procedures to provide not less than 95% Standard Proctor Maximum Dry Density.
- E. Seal roll the subgrade surface with a steel wheel roller, sealing the surface against excessive water infiltration.

3.2 PLACING AND MIXING OF PAVING MATERIAL

- A. Place aggregates using spreader boxes or other approved spreaders uniformly on one operation.
- B. Take care to avoid segregation of the fine from the coarse aggregate during handling, spreading or shaping operations.
- C. Mix, while at proper moisture, with motor grader or other equipment and maintain to required section and grade until thoroughly compacted.

3.3 ROLLING AND COMPACTING

- A. Perform using 3-wheel steel wheel roller weighing not less than 10 tons, tandem roller weighing at least 8 tons, or other rollers approved by the Engineer.
- B. Start rolling at edges and proceed toward the center, continue rolling until aggregates are firmly keyed or set.
- C. When initial compaction is completed, should voids remain, place fine aggregates on the surface in an amount only sufficient to fill the voids.
- D. Broom, wet and roll until coarse aggregate is set, bonded and thoroughly compacted for full width and depth.

3.4 ALLOWABLE TOLERANCES

- A. Thickness tolerance: Provide the compacted thicknesses shown on the Drawings within a tolerance of minus 1/2".
 - 1. Depth measurements will be made by digging through the base at intervals no closer than 250', nor greater than 500' apart.
 - 2. Where thickness is less than depth specified minus 1/2", it shall be corrected as directed by the Engineer.
- B. Smoothness tolerance: Provide the lines and grades shown on the Drawings within a tolerance of 3/8" in 10', parallel to the center line of the roadway nor more than 1/2" from a template conforming to the cross sections shown on the plans.
- C. Deviations: Correct by removing materials, replacing with new materials, and reworking or recompacting as required.

3.5 PLACING PRIME COAT

- A. Allow base course to season sufficiently to permit uniform penetration.
- B. Do not apply to wet surfaces or when the temperature is below 60°F in the shade and falling, or below 55°F in the shade and rising.
- C. Clean surfaces of all dust, dirt, clay, etc. using mechanical brooms, etc.
- D. Apply prime material, using pneumatic mounted distributors, at a rate of 0.25 to 0.30 gallon per square yard.
- E. Permit no traffic on primed surfaces until bituminous material has penetrated and dried sufficiently that it does not pick up under traffic.

3.6 MEASUREMENT AND PAYMENT

A. No separate measurement or direct payment will be made for this work and all costs for same shall be included in the price bid for the work to which it pertains.

END OF SECTION 321123

Section 321125 - SYNTHETIC TURF BASE COURSE

PART 1 – GENERAL

1.1 Scope of Work:

- A. All labor, materials, equipment and tools necessary for the complete installation of a new infill artificial turf base system. The artificial turf base shall consist of, but not necessarily be limited to, the following:
 - 1. A vertically-draining, porous Dynamic Stone Base
 - 2. Installation of the Perimeter Edge Anchoring Systems

1.2 Related Work

- A. Review Contract Documents for requirements that affect work of this section. Specification Sections that directly relate to work of this section include, but are not limited to:
 - 1. Section 312200.1 Playing Field Earthwork

1.3 References

- A. Comply with applicable requirements of the following standards. Should the standards conflict with other specified requirements, the most restrictive requirement shall govern.
 - 1. American Association of State Highway and Transportation Officials (AASHTO).
 - a. T 89 Determining the Liquid Limit of Soils
 - b. T 90 Determining the Plastic Limit and Plasticity Index of Soils
 - 2. American Society for Testing and materials (ASTM):
 - C88 Sulfate Soundness Test for Aggregates
 - C 131 LA Abrasion Test for Aggregates
 - D 422 Standard Test Method for Particle Size Analysis of Soils
 - D 2922 Standard Test Methods for Density of Soil and Soil-Aggregate in
 - Place by Nuclear Methods (Shallow Depth)
 - F 1632 Standard Test Method for Particle Size Analysis and Sand
 - Shape Grading of Golf Course Putting Green and Sports Field Rootzone Mixes
 - 3. Occupational Safety and Health Administration (OSHA)
 - 4. SCDOT Specifications, Current Edition

1.4 Submittals

- A. Manufacturer's Product Data
 - 1. Provide certifications stating that the material used to comprise the system comply with the system requirements.

1.5 Job Conditions

- A. The Contractor shall be responsible for maintaining finish grades in all areas to receive the Dynamic Stone Base and for executing any fine grading, as may be necessary or incidental to placement of the artificial turf.
- B. The Dynamic Stone Base material shall not be contaminated with other soil. Any material contaminated by other soil will be rejected and replaced at no additional cost to the Owner.

1.6 Coordination

A. The Contractor shall be responsible for coordinating all work in these specifications with the Artificial Turf Installer, who must accept the Dynamic Stone Base prior to installing the artificial turf.

1.7 Tolerances

A. The finished grade of the Dynamic Stone Base shall not vary more than ¹/₄" from the planned grades and not vary more than 3/16" in 10' in any direction.

1.8 Quality Assurance

- A. The sports field contractor is responsible for the subgrade fine grading, installation of fabric, replacement of field drainage system if necessary, installation of the perimeter nailing system, installation of the dynamic stone base.
- B. The synthetic field surfacing manufacturer shall provide evidence indicating that the specified materials have been successfully utilized on work of similar scope to that shown and specified for this Project.

PART 2 – PRODUCTS

2.1 Crushed Stone

- A. The artificial turf system requires a permeable base for outdoor use. The permeable base for the Synthetic Turf Surface shall be an angular crushed stone, that meets the following gradation criteria:
 - 1. The dynamic stone base shall conform to the turf vendor's standard specifications subject to the engineer's approval and meet the following gradation: Sieve Size Percent Passing by Weight

1 1/2" (37.5mm)	100
1" (19mm)	95-100
1/2" (12.5mm)	25-60
No. 4 (4.75mm)	15-45
No. 8 (2.36mm)	0-10

2. The topping stone must conform to the turf vendor's standard specs, is subject to the Engineer's approval, and meets the following gradation:

Sieve Size	Percent Passing by Weight
	100
1/2"	100
3/8"	90-100
1/4"	75-100
No. 8	35-75
No. 16	10-55
No. 60	0-15
No. 200 (.074mm)	0-4

B. Soft limestones and shale materials are not suitable. Questionable materials should be evaluated using a sulfate soundness test (ASTM C-88) and LA Abrasion Test (ASTM C-131).

Test Method	Criteria
Sulfate Soundness (C-88)	Not to exceed 12% Loss
LA Abrasion (ASTM C-131)	Not to exceed 40

C. Restrictions:

- 1. To ensure structural stability of the Dynamic base stone:
 - $D_{60}/D_{10} > 5$ and $1 < D_{30}^2/D_{10}*D_{60} < 3$ Fragmentation must be 100%
- 2. Permeability of the dynamic base stone shall be > 14 in/hr Permeability of the topping stone shall be > 14 in/hr

2.2 Testing Protocol

- A. The testing agent must be accredited by the American Association for Laboratory Accreditation (A2LA) and must have at least five years experience in similar projects and test protocols. The testing agent must be A2LA accredited to perform all of the following testing protocols:
 - 1. ASTM C136: Sieve Analysis of Fine and Coarse Aggregates
 - 2. ASTM D854: Specific Gravity of Soils
 - 3. ASTM D2216: Laboratory Determination of Water (Moisture) Content of Soil and Rock
 - 4. ASTM D4972: pH of Soils
 - 5. ASTM F1632: Standard Test Method for Particle Size Analysis and Sports Field Root Zone Mixes
 - 6. Water Release Characterization
 - 7. Infiltration Rate (Saturated Hydraulic Conductivity (KSAT)
- B. The dynamic base stone and topping stone samples shall initially be submitted to the Engineer for testing and approval 15 calendar days prior to scheduled placement on the playing fields.

The Contractor shall include the following items:

- 1. Identification of proposed source and supplier.
- 2. Current lab mechanical analysis of the proposed crushed stone or topping stone using standards for sieve analysis.
- 3. Sample sizes as determined by the Engineer.
- 4. Certification that the supplier can deliver the total quantity of material needed to complete the project in a timely manner.
- C. All dynamic base stone must come from one supplier only. All topping stone must come from one supplier only.

2.3 Field Curb Nailer

A. The field curb nailer shall be as shown on plans. Where a 2x4 attachment piece is required, the material shall be Trex, or approved equal.

PART 3 – EXECUTION

3.1 Preparing The Subgrade

A. Prior to the placement of the Dynamic Stone Base, the Contractor shall verify that all compaction and stability criteria have been met.

3.2 Nailer And Miscellaneous Adjustments

A. The Contractor shall install the Trex nailer in strict conformance to details shown on the plans. The final elevation of the top of the nailer shall not vary by more than 1/8" from planned grade.

3.4 Placing The Crushed Stone

- A. The dynamic base stone must be laid without damaging the subgrade. It is very important to not create any depressions with heavy equipment. The specified stone or aggregate supplied must conform to the specifications, and must be stable and free draining.
- B. In performing this work, the Contractor shall avoid damage to any existing structures or features of the playing field or features under construction, such as drainage and irrigation systems. Any such damage shall be repaired by the Contractor at his own expense.
- C. As part of this work, the Contractor shall check all graded areas and assure that all features of the subgrade area at the proper finished grade, with no changes or damage to grades, as specified herein and on the grading plan.
- D. Crushed stone trucked into the site must be done in such a manner as not to alter the subgrade and/or damage drainage and irrigation systems.

- E. The crushed stone shall be carefully and evenly spread. Excess water should not be applied when dumping and rough grading as it could create a soft sub-base which could alter constructed grades and damage the drainage system.
- F. The crushed stone shall then be carefully placed and uniformly compacted to the finished grade through the use of LGP Dozers equipped with fully functioning, machine control (laser grading) systems, and rolling. All surfaces shall then be checked for irregularities due to settling and brought back to a uniform grade.
- G. The crushed stone layer shall be constructed in one layer of uniform thickness. The crushed stone shall be compacted in both directions and watersettled to attain uniform 95% compaction, per ASTM D 698. Maintain 8-10% moisture content during installation.
- H. The finished surface of the crushed stone shall not vary from the specified grades by more than 3/16", and not very more than 1/4" in 10' when measured in any direction.
- I. The topping stone shall be installed to a maximum thickness of $\frac{1}{2}$ ". The topping stone shall not vary from the specified grades by more than $\frac{1}{4}$ ", and not vary more than $\frac{3}{16}$ " in 10" when measured in any direction.
- J. The finished surface shall be smooth uniform in appearance and shall not exhibit any segregation or pockets of coarse stone.

END OF SECTION 321125
Section 323113.25 - COLOR CHAIN LINK FENCE SYSTEM

PART 1 - GENERAL

1.1 Description

- A. Work included: Provide color chain link fence system where shown on the Drawings, as specified herein, and as needed for a complete and proper installation.
- B. Related work:
 - 1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplemental General Conditions, and Sections in Division 1 of these Specifications.
- C. All chain link fence and gates shall be thermally-bonded polyvinyl chloride (PVC), plastic resin finish over galvanized steel wire. Comply with ASTM F668, Class 2, not less than 10 mils (.010") thick. Color: Dark Black.

1.2 Quality Assurance

- A. Comply with standards of the Chain Link Fence Manufacturer's Institute.
- B. Comply with ASTM A-120 for requirements of Schedule 40 piping.
- C. Height of fence shall be measured from the top of concrete footing to the top of post.
- D. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- E. Obtain fabric, gates, fittings, fasteners, accessories, and framework from a single supplier.

1.3 Submittals

- A. Comply with pertinent provisions of Section 013300.
- B. Product data: Within 30 calendar days after the Contractor has received the Owner's Notice to Proceed, submit:
 - 1. Materials list of items proposed to be provided under this Section.
 - 2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.
 - 3. Shop drawings in sufficient detail to show fabrication, installation, anchorage, and sizes of all components.
 - 4. Color charts.

1.4 Product Handling

A. Comply with pertinent provisions of Section 016000.

1.5 Warranty

- A. Comply with pertinent provisions of Section 016000.
- B. The manufacturer shall warrant the system being provided for a period of 15 years against defects from workmanship and materials, and under normal and proper usage will be free from corrosion, rot, breakage or coating failure.

2.1 General

- A. Provide thermally-bonded polyvinyl chloride (PVC), plastic resin finish over galvanized steel pipe/wire. Comply with ASTM F668, Class 2, not less than 10 mils (0.010") thick.
- B. Color: Dark Black.

2.2 Chain Link Fence Fabric

- A. Thermally-bonded polyvinyl chloride (PVC), plastic resin finish over galvanized steel wire. Comply with ASTM F668, Class 2 not less than 10 mils (.010") thick. Color: Black.
- B. Size: Provide fabric in one piece widths.
 - 1. Provide helically wound and woven fabric with 2" diamond mesh.
 - 2. Provide 9 gauge fabric, with a core wire diameter of 0.148" and a minimum breaking strength of 1290 lbf.
- C. Selvage of fabric knuckled at top and bottom.
- D. Provide single wrapped 9 gauge wire ties at 18" intervals.

2.3 Steel Fence Framing

- A. Provide domestically produced SS40 steel round sections complying with ASTM F 1043 external coating type B and internal coating type D.
- B. Nominal Framework sizes shall be the following:

						Concrete Foundation Dia.		
		End,				Diameters	Corner/End	
Fence	Line	Corner &	Rails &	Gate	*Gate		Pull &	
Height	Posts	Pull Posts	Braces	Frames	Posts	Line Posts	Gate Posts	Depth
3'	1-1/2"	2"	1-1/4"	1-1/2"	2-1/2"	12"	12"	4'
3'-6"	1-1/2"	2"	1-1/4"	1-1/2"	2-1/2"	12"	12"	4'
4'	2"	3"	1-5/8"	1-1/2"	3"	12"	12"	4'
4'-6"	2"	3"	1-5/8"	1-1/2"	3"	12"	12"	4'
5'	2"	3"	1-5/8"	1-1/2"	3"	12"	12"	4'
6'	2"	3"	1-5/8"	1-1/2"	3"	12"	18"	4'
8'	3"	4"	1-5/8"	1-1/2"	3-1/2"	18"	18"	5'
10'	3"	4"	1-5/8"	1-1/2"	3-1/2"	18"	18"	5'
12'	3"	4"	1-5/8"	1-1/2"	3-1/2"	18"	18"	5'
16'	3-1/2"	4"	1-5/8"	1-1/2"	3-1/2"	18"	18"	5'-0"

Note: Gate post for 4' high, 24' wide gate shall be 4" diameter with 48" deep by 16" diameter concrete footing.

- Thermally bonded polyvinyl chloride (PVC), resin finish over galvanized steel pipe. Comply C. with ASTM F668, Class 2, not less than 10 mils (.010") thick. Color: Dark Black.
- D. Provide truss bars on between Line Post and Bottom Rail.
- E. Bottom tension wire shall be 7 ga. class 4.

2.4 **PVC Coated Accessories**

- Chain link fence accessories: Α.
 - Provide items required to complete fence system complying with ASTM F 626. 1.
 - 2. Galvanize each ferrous metal item and finish to match framing.
- B. Post caps:
 - Provide formed steel, cast malleable iron, or aluminum allow weather tight closure cap for 1. tubular posts.
 - 2. 3. Provide one cap for each post.
 - Where top rail is used, provide tops to permit passage of top rail.
- C. Top rail and brace rail ends:
 - Provide pressed steel per ASTM F626, for connection of rail and brace to terminal posts. 1
 - 2. Provide means for attaching top rail securely to each gate, corner, pull, slope and end post.
- D. Top rail sleeves: Provide 7" expansion sleeve with spring, allowing for expansion and contraction of top rail.
- E. Wire ties:
 - Provide 9 gauge, 0.148" galvanized steel wire for attachment of fabric to line posts. Double wrap 13 gauge, 0.092" for rails and braces. Hog ring ties of 12-1/2 gauge, 0.0985" for attachment of fabric to tension wire. 1.
 - 2. 3.
- F. Brace and tension (stretcher bar) bands:
 - Provide pressed steel. 1.
 - 2. Provide tension bar clips at square posts.
- G. Tension (stretcher) bars:
 - Provide one piece lengths equal to 2 inches less than full height of fabric with a minimum cross-section of 3/16" x 3/4" or equivalent fiber glass rod. 1.
 - 2. Provide tension (stretcher) bars where chain link fabric meets terminal posts.
- H. Truss rods and tightener: Steel rods with minimum diameter of 5/16" capable of withstanding a tension of minimum 2,000 lbs.
- I. Provide flanges with round base for interior installation.
 - Each flange to have four (4) 1/2" dia. holes for mounting. 1.
 - Mount flanges to concrete using four (4) 3/8" dia. epoxy anchors. 2.
- J. Provide stainless steel nuts and bolts painted to match fence color.

2.5 **Swing Gates**

- A. Gate frames:
 - Fabricate chain link swing gates in accordance with ASTM F 900 using galvanized steel 1 tubular members, 2" square, weighing 2.60 lb/ft.

03/16/12

- 2. Fusion or stainless steel welded connections forming rigid one-piece unit (no substitution).
- 3. PVC coated frames thermally fused with minimum 10 mils per ASTM F668, Class 2 (after fabrication).
 - a. Coating before fabrication will not be allowed.
- 4. Provide swing gate size as shown on the Drawings.
- B Chain link fabric filler:
 - 1. PVC coating, thermally fused to metallic coated steel wire, ASTM F 668, Class 2b, mesh, and gauge to match fence.
 - 2. Install fabric with hook bolts and tension bars at all 4 sides (no substitution). 3. Attach to gate frame at not more than 15" on center.
- C. Hardware materials:
 - 1. Hot dipped galvanized steel or malleable iron shapes to suit gate size.
 - 2. Field coat moveable parts (e.g. hinges, latch, keeper, and drop bar) with PVC touch up paint, provided by manufacturer, to match adjacent finishes.
- D. Hinges:
 - 1. Structurally capable of supporting gate leaf and allow opening and closing without binding.
 - 2. Non-lift-off type hinge design to permit gate to swing 180° outward.
- E. Jamb Posts:
 - 1. 2-1/2" round steel square sections (ASTM A500, Grade B) having a minimum yield strength of 40,000 psi size as indicated.
 - 2. Hot-dipped galvanize with a minimum 1.8 oz/ft^2 of zinc.
 - 3. Weld posts and transom bar into ridged one piece outer frame, held together at bottom with 1.5" x 1.5" angle tie bar.
 - 4. Bottom tie bar may be removed during installation and top bar must remain.
- F. Fabrication:
 - 1. Assemble gate frames by welding, with special malleable or pressed steel fittings and rivets for rigid connections.
 - 2. Use same fabric as used in the fence.
 - 3. Install fabric with stretcher bars at vertical edges as a minimum.
 - 4. Attach stretchers to gate frame at not more than 15" on centers.
 - 5. Attach hardware with rivets or by other means that will provide security against removal and breakage.
 - 6. Provide diagonal cross bracing consisting of 3/8" diameter adjustable length truss rods on gates where required to provide frame rigidity without sag or twist.
- G. Latches:
 - 1. Provide forked type or plunger bar type to permit operation from either side of the gate.
 - 2. Provide padlock eye as integral part of latch.
- H. Keeper: Provide keeper for vehicle gates, which automatically engages the gate leaf and holds it in the open position until manually released.
- I. Double gates:
 - 1. Provide gate stops for double gates consisting of mushroom or flush plate, with anchors.
 - 2. Set in concrete to engage the center drop rod or plunger bar.
 - 3. Provide locking device and padlock eyes as an integral part of the latch, requiring one padlock for locking both gate leaves.

PART 3 - EXECUTION

COLOR CHAIN LINK FENCE SYSTEM

3.1 **Chain Link Fence Framing Installation**

- Install chain link fence in accordance with ASTM F 567 and manufacturer's instructions. A.
- B. Locate terminal post at each fence termination and change in horizontal or vertical direction of 30° or more.
- C. Space line posts uniformly at spacing as shown on plans.
- D. **Excavating:**
 - Drill holes for post footings in firm, undisturbed or compacted soil, strictly adhering to 1. the dimensions and spacing shown.
 - 2. Spread soil from excavations uniformly adjacent to the fence line, or on adjacent areas of the site if so directed.
 - 3. When solid rock is encountered near the surface, drill into rock at least 12" for line posts and at least 18" for end, pull, gate and corner posts. Drill hole at least 1" greater diameter than the largest dimension of the post to be placed. If solid rock is below soil overburden, drill to full depth required, except penetration into
 - 4. rock need not exceed minimum depths specified above.
- E. Setting posts:
 - Remove loose and foreign materials from sides and bottoms of holes, and moisten soil 1 prior to placing concrete.
 - 2. Center and align posts in holes.
 - *3*. Place concrete around posts in a continuous pour, and vibrate or tamp for consolidation.
 - 4. Check each post for vertical and top alignment, and hold in position during placement and finishing operations.
 - 5. Trowel tops of footings, and slope or dome to direct water away from posts.
 - Extend footings for gateposts to the underside of bottom hinge. 6.
 - 7. Set keeps, stops, sleeves and other accessories into concrete as required.
 - 8. Keep exposed concrete surfaces moist for at least 7 days after placement, or cure with membrane curing material or other curing method approved by the Engineer.
 - 9. Grout in those posts that are set into sleeved holes, concrete constructions, or rock excavations, using non-shrink portland cement grout or other grouting material approved by the Engineer.
- Bracing: Install horizontal pipe brace at mid-height for fences 6' and over, on each side of terminal posts. Firmly attach with fittings. Install diagonal truss rods at these points. Adjust F. truss rod, ensuring posts remain plumb.
- Top and bottom rails: G.
 - 1.
 - Install lengths up to 21'-0" to minimize joints. Connect joints with sleeves for rigid connections for expansion/contraction. Mount bottom rail no more than 1" above finish grade.
 - 2. 3.
 - Provide expansion couplings as recommended by the fencing manufacturer. 4.
 - Provide bracing to the mid point of the nearest line post or posts at all end, corner, slope, 5. pull and gate posts.
- H. Center Rails for fabric height 6'-0" and higher. Install mid rails between posts with fittings and accessories.
- I. Concrete strength:
 - Allow concrete to attain at least 75% of its minimum 28-day strength before rails, tension 1. wires, and/or fabric is installed.
 - 2. Do not, in any case, install such items in less than 7 days after placement of concrete.
 - 3. Do not stretch and tension fabric and wire, and do not hang gates until concrete has attained its full design strength.

Comply with provisions of Section 030000 for 2500 psi concrete. 4.

3.2 **Chain Link Fabric Installation**

- A. Fabric:
 - Install fabric on playing field side and attach so that fabric remains in tension after 1. pulling force is released.
 - 2. 3.
 - Leave maximum 1" gap from bottom salvage to finish grade. Attach fabric with wire ties to line posts at 15" on center and top rails, and braces at 24" on center.
- Β. Tension (stretcher) bars: Pull fabric taut; thread tension bar through fabric and attach to terminal posts with bands or clips spaced maximum of 15" on center.

3.3 **Chain Link Swing Gate Post Installation**

- Install gate posts in accordance with manufacturer's instructions. A.
- Gate posts and hardware: Check each post for vertical and top alignment, and maintain in B. position during placement and finishing operations.

3.4 **Gate Installation**

- Install gates plumb, level, and secure for full opening without interference. A.
- B. Attach hardware by means which will prevent unauthorized removal.
- С. Lubricate and adjust hardware for smooth operation.
- D. Adjust rollers and guides of sliding gates so that gates are level.

3.5 Miscellaneous

- Tie wires: Use U-shaped tie wires, conforming to diameter of pipe to which attached, clasping A. pipe and fabric firmly with ends twisted at least two full turns and bend ends of wire to minimize hazard to persons and clothing.
- B. Fasteners:
 - Install stainless steel bolts with nuts on side of fence opposite fabric side for added 1. security.
 - 2. Peen the ends of bolts to prevent removal of nuts.
- C. Repair coatings damaged in the shop or field erection in accordance with the manufacturer's recommendations as approved by the Engineer.

3.6 **Measurement and Payment**

No separate measurement or direct payment will be made for the work in this Section and all A. payment for same shall be included in the price bid for the item to which it pertains.

END OF SECTION 323113.25

SECTION 323119 - DECORATIVE METAL FENCES AND GATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:1. Swing gates.
- B. Related Requirements:
 - 1. Section 033000 "Cast-in-Place Concrete" for concrete and post concrete fill.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For gates. Include plans, elevations, sections, details, and attachments to other work.
- C. Initial Sample: 4"x4" minimum for initial color approval / selection (on metal).
- D. Samples: For each fence material and for each color specified.
 - 1. Provide Samples 12 inches (300 mm) in length for linear materials and 12 inches (300 mm) square for sheet or plate materials.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For gate operators to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

DECORATIVE METAL FENCES AND GATES

PART 2 - PRODUCTS

2.1 SWING GATES

- A. Gate Configuration: Double leaf.
- B. Gate Frame Height: As indicated.
- C. Gate Opening Width: As indicated.
- D. Aluminum Frames and Bracing: Fabricate members from square extruded-aluminum tubes as indicated with 0.140-inch (3.56-mm) wall thickness. Gate fabricator responsible for size and thickness of members to accommodate gate size and weight.
- E. Frame Corner Construction: Welded.
- F. Additional Rails: See Drawings
- G. Infill: See Drawings
- H. Hardware: Latches permitting operation from both sides of gate, hinges, and keepers for each gate leaf more than 5 feet (1.52 m) wide. Provide center gate stops and cane bolts for pairs of gates. Fabricate latches for rim lock.
- I. Hinges: Heavy duty Suitable for exterior use.
 - 1. Function: 39 Full surface, triple weight, antifriction bearing.
 - 2. Material: Aluminum or material compatible with aluminum gate system.
 - 3. Elite Power Hinge 3 Aluminum Gate Hinge with double ball bearings
- J. Rim Locks: BHMA A156.5, Grade 1, suitable for exterior use.
 - 1. Function: 626 Interlocking deadbolt operated by key from either side.
 - 2. Material: Cast, forged, or extruded brass or bronze.
 - 3. Mounting Plate: Configuration necessary for mounting locks. Fabricate from 1/8-inch-(3.2-mm-) thick, aluminum plate.
- K. Cane Bolts: Provide for inactive leaf of pairs of gates. Fabricated from 3/4-inch- (19-mm-) diameter, round steel bars, hot-dip galvanized after fabrication. Finish to match gates. Provide galvanized-steel pipe strikes to receive cane bolts in both open and closed positions.
- L. Finish exposed welds to comply with NOMMA Guideline 1, Finish #2 completely sanded joint, some undercutting and pinholes okay.
- M. Aluminum Finish: powder coating.

2.2 ALUMINUM

- A. Aluminum, General: Provide alloys and tempers with not less than the strength and durability properties of alloy and temper designated in paragraphs below for each aluminum form required.
- B. Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T5.
- C. Tubing: ASTM B 429/B 429M, Alloy 6063-T6.
- D. Plate and Sheet: ASTM B 209 (ASTM B 209M), Alloy 6061-T6.
- E. Die and Hand Forgings: ASTM B 247 (ASTM B 247M), Alloy 6061-T6.
- F. Castings: ASTM B 26/B 26M, Alloy A356.0-T6.

2.3 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
 - 1. For aluminum, provide type and alloy as recommended by producer of metal to be welded and as required for strength and compatibility in fabricated items.

2.4 ALUMINUM FINISHES

- Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 2 mils (0.05 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 - 1. Minimum hardness measured in accordance with ASTM D3363: 2H.
 - 2. Direct impact resistance tested in accordance with ASTM D2794: Withstand 160 inchpounds.
 - 3. Salt spray resistance tested in accordance with ASTM B117: No undercutting, rusting, or blistering after 500 hours in 5 percent salt spray at 95 degrees F and 95 percent relative humidity and after 1000 hours less than 3/16 inch (5 mm) undercutting.
 - 4. Weatherability tested in accordance with ASTM D822: No film failure and 88 percent gloss retention after 1 year exposure in South Florida with test panels tilted at 45 degrees.
 - 5. Color and Gloss: As selected by Architect from manufacturer's full range. Semi-gloss.
 - 6. Prior to powder-coat finish application, prepare surfaces as required for smooth finish. Remove all rough areas and runs in welding. Apply primer at all weld joints to fill in all pits and voids.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for site clearing, earthwork, pavement work, construction layout, and other conditions affecting performance of the Work.
- B. Do not begin installation before final grading is completed unless otherwise permitted by Architect.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 500 feet (152.5 m) or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.
 - 1. Construction layout and field engineering are specified in Section 017300 "Execution."

3.3 GATE INSTALLATION

- A. Post Setting: Set posts with mechanical anchors designed for size of gate and loads by gate fabricator.
 - 1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with mechanical devices.
 - 2. Connection plate shall be coordinated to avoid tripping hazard and cover plate shall be installed to conceal fasteners.
- B. Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary.

3.4 ADJUSTING

- A. Gates: Adjust gates to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.
- B. Lubricate hardware and other moving parts.

END OF SECTION 323119

SECTION 329213 - GRASSING

PART 1 - GENERAL

1.1 Description

- Work included: Provide temporary grassing of the areas as indicated, for a complete and proper A. installation. Permanent grassing of areas outside the playing field will consist of the same variety of turf grasses as the playing field.
- B. Related work: Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.

1.2 **Quality Assurance**

- Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the A. necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- B. Seed: Conform to all City and State laws and to all requirements and regulations of the South Carolina Department of Agriculture.
 - Deliver to site each variety of seed individually packaged and tagged to show name, net 1. weight, origin and lot number.
- C. Fertilizer: Conform to State fertilizer law.

1.3 **Submittals**

- Comply with pertinent provisions of Section 013300. A.
- B. Product data: Within 14 calendar days after the Contractor has received the Owner's Notice to Proceed, submit: 1.
 - Complete materials list of items proposed to be provided under this Section.

1.4 **Product Handling**

- Comply with pertinent provisions of Section 016000. A.
- B. At time of delivery, furnish the Engineer invoices of all materials received in order that application rates may be determined.
- C. Immediately remove from the site materials that do not comply with the specified requirements, and promptly replace with materials meeting the specified requirements.

PART 2 - PRODUCTS

2.1 Fertilizer

Provide commercial balanced 16-4-12 or 12-4-8 fertilizer delivered to the site in bags labeled A. with the manufacturer's guaranteed analysis.

University of South Carolina Softball Stadium Construction BID SET

2.2 Grass Seed

A. Provide grass seed that is:

- Free from noxious weed seeds, and recleaned. 1.
- 2. 3. Grade A recent crop seed.
- Treated with appropriate fungicide at time of mixing.
- 4. Delivered to the site in sealed containers with dealer's guaranteed analysis.

2.3 Lime

- A. Provide agricultural grade, standard ground limestone conforming to current "Rules, Regulations and Standards of the Fertilizer Board of Control" issued at Clemson University.
- Bag tags or delivery slip for bulk loads shall indicate brand or trade name, calcium carbonate Β. equivalent, and other pertinent data to identify the lime.

2.4 Wood Cellulose Fiber

- Provide wood chip particles manufactured particularly for discharging uniformly on the ground A. surface when dispersed by a hydraulic water sprayer.
- B. Material to be heat processed so as to contain no germination or growth inhibiting factors.
- C. It shall be dyed (non-toxic) an appropriate color to facilitate metering.

2.5 **Straw Mulch**

- A. Provide straw or hay material.
 - Straw to be stalks of wheat, rye, barley or oats. 1.
 - 2. Hay to be timothy, peavine, alfalfa, or coastal bermuda.
- Material to be reasonably dry and reasonably free from mature seed bearing stalks, roots, or B. bulblets or Johnson Grass, Nutgrass, Wild Onion and other noxious weeds.

2.6 **Excelsior Fiber Mulch**

- To consist of 4" to 6", average length, wood fibers cut from sound, green timber. A.
- B. Make cut in such a manner as to provide maximum strength of fiber, but at a slight angle to natural grain of the wood.

PART 3 - EXECUTION

3.1 General

- A. Temporary seed areas outside the playing field immediately upon completion of grading or construction and clean-up operations.
- B. Areas ready for planting between May 1 and August 15 shall be planted with a temporary cover of Schedule No. 1. Prior to permanent seeding, the turf shall be destroyed by reworking the soil and turf grasses identical to the playing field will be planted.
- Use Rate A lbs. per 1000 sq. ft. on slopes over 5' horizontal to 1' vertical in height and use Rate B C. lbs. per 1000 sq. ft. on slopes less than 5' horizontal to 1' vertical.

Seeding Schedules 3.2

- Mixtures of different types of seed for the various schedules shall be weighed and mixed in A. proper proportions in the presence of the Engineer.
- B. Schedule No. 1 - Planting dates May 1 to August 15:

Common Name of Seed

German Millet Mulch Straw Agricultural Limestone Fertilizer 10-10-10

40 LBS/ACRE 4000 LBS/ACRE 2000 LBS/ACRE 500 LBS/ACRE

3.3 **Ground Preparation**

- A. Bring all areas to proper line, grade and cross section indicated on the plans.
- B. Repair erosion damage prior to commencing seeding operations.
- C. Loosen seed bed to minimum depth of 3".
- D. Provide and prepare topsoil in accordance with Section 02210.
- Conduct soil test to determine pH factor. E. If pH is not in the range of 6.0 to 6.5, adjust. 1.

3.4 **Application of Fertilizer**

- Spread uniformly over areas to be seeded at: A.
 - Rate of 18 lbs per square foot when using 16-4-12. (Contractor to verify with Owner) 1.
 - 2. Rate of 25 lbs per 1000 square feet when using 12-4-8. (Contractor to verify with Owner)
 - 3. Use approved mechanical spreaders.
- B. Mix with soil to depth of approximately 3".

3.5 **Sowing Methods**

- A. General:
 - Perform seeding during the periods and at the rates specified in the seeding schedules. 1.
 - Do not conduct seeding work when ground is frozen or excessively wet.
 - 2. 3. Produce satisfactory stand of grass regardless of period of the year the Work is performed.
- Seeding, slopes less than four horizontal to one vertical: Β.
 - Shall conform to Methods EA, WF or WCF as specified hereinafter. 1. 2.
- Method EA (Emulsified Asphalt):
 a. Sow seed not more than 24 hours after application of fertilizer.
 b. Use mechanical seed drills on accessible areas, rotary hand seeders, power sprayers, etc. may be used on steep slopes or areas not accessible to seed drills. Cover seed and lightly compact with cultipacker if seed drill does not.
 - c. d. Within 24 hours following compaction of seeded areas, uniformly apply 0.2
 - gallons per square yard of emulsified asphalt over the seeded area.
 - Method WF: 3.
 - Sow seed as specified for Method EA. a.
 - Within 24 hours following covering of seeds, uniformly apply excelsior fiber at b. the rate of 100 lbs. per 1000 sq. ft.
 - Apply material hydraulically. c.
 - Seeded areas to be lightly rolled to form a tight mat of the excelsior fibers. d.

- 4. Method WCF:
 - Apply seed, fertilizer and wood fiber mulch using hydraulic equipment. a.
 - Equipment to have built-in agitation system with capacity to agitate, suspend and b. homogeneously mix a slurry of the specified amount of fiber, fertilizer, seed and water.
 - Minimum capacity of slurry tank: 1000 gallons. c.
 - Apply fiber mulch at rate of 35 lbs. per 1000 sq. ft. d.
 - Regulate slurry mixture so that amounts and rates of application will result in e. uniform application of all materials at not less than the specified amounts.
 - f. Apply slurry in a sweeping motion, in an arched stream, so as to fall like rain, allowing the wood fibers to build upon each other.
 - Use color of wood pulp as guide, spraying the prepared seed bed until a uniform g. visible coat is obtained.
- C. Seeding, slopes greater than four horizontal to one vertical:
 - Sow seed as specified for Method EA, unmulched. 1. 2
 - Cover seeded area with erosion control blanket.

Second Application of Fertilizer 3.6

- When plants are established and showing satisfactory growth, apply nitrogen at the rate of 1.0 lb. A. per 1000 sq. ft.
- Apply in dry form unless otherwise directed by the Engineer. B.
- C. Do not apply to stands of temporary grasses.

3.7 Maintenance

- Maintain all seeded areas in satisfactory condition until final acceptance of the Work. A.
- Areas not showing satisfactory evidence of germination within six weeks of the seeding date B. shall be immediately reseeded, fertilized and/or mulched.
- C. Repair any eroded areas.
- D. Mow as necessary to maintain healthy growth rate until final acceptance of the Work.

3.8 Acceptance

- A. Permanently seeded areas will be accepted when the grass attains a height of 2".
- B. No acceptance will be made of temporary seeded areas. Rework and seed with permanent turf grasses.

3.9 **Measurement and Payment**

No measurement and payment will be made for the work under this Section and all costs for A. same shall be included in the price bid for the item to which it pertains.

END OF SECTION 329213

Section 329230 - SYNTHETIC TURF

PART 1 - GENERAL

1.1 Summary

- A. Furnish all labor, materials, tools and equipment necessary to repair or replace artificial grass Field Turf as specified herein; including components and accessories required for a complete installation, including but not limited to
 - 1. Acceptance of prepared sub-base.
 - 2. Coordination with related trades to ensure a complete, integrated, and timely installation: Aggregate base course, sub-base material, grading and compacting, piping and drain components (when required); as provided under its respective trade section.

1.2 Related Sections

- A. Section 312200 Site Grading
- B. Section 321125 Synthetic Turf Base Course

1.3 Reference Standards

- A. ASTM American Society for Testing and Materials.
 - 1. D1577 Standard Test Method for Linear Density of Textile Fiber
 - 2. D1907-Yarn Denier Skein Method
 - 3. D2256 Yarn Tensile & Elongation
 - 4. D3218 Yarn Thickness, Microns
 - 5. D5823-Pile Height
 - 6. D5848 Standard Test Method for Mass Per Unit Area of Pile Yarn Floor Covering
 - 7. D5793 Stitch Gauge
 - 8. D1335 Standard Test Method for Tuft Bind of Pile Yarn Floor Covering
 - 9. D5034 Standard Test Method of Breaking Strength and Elongation of Textile Fabrics (Grab Test)
 - 10. F1015 Standard Test Method for Relative Abrasiveness of Synthetic Turf Playing Surfaces
 - 11. DIN 18-035 Water Permeability
 - 12. D2859 Standard Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials
 - 13. D7138-Melting Point
 - 14. F355 Standard Test Method for Shock-Absorbing Properties of Playing Surfaces.
 - 15. F1936 Standard Test Method for Shock-Absorbing Properties of North American Football Field Playing Systems as Measured in the Field
 - 16. F1951-ADA Compliance
 - 17. 2117-01 -Ball Rebound

SYNTHETIC TURF

- 18. D792 Specific Gravity
- 19. EN 14808 Force Reduction
- 20. EN 14809 Vertical Deformation
- 21. EN 15301-1- Rotational Resistance

1.4 Submittals

- A. Substitutions: Other products are acceptable if in compliance with all requirements of these specifications. Submit alternate products to Engineer for approval in accordance Section 013300 Shop Drawings.
 - 1. Provide substantiation that proposed system does not violate any other manufacturer's patents, patents allowed or patents pending.
 - 2. Provide a sample copy of insured, non-prorated warranty and insurance policy information.
- B. Comply with Section 013300, Submittals Procedures. Submit for approval prior to fabrication.
- C. Shop Drawings:
 - 1. Indicate bullpen layout; home plate marking plan and details for the specified sports; i.e., NCAA Softball; roll/seaming layout; methods of attachment, field openings and perimeter conditions.
 - 2. Show installation methods and construction indicating field verified conditions, clearances, measurements, terminations, drainage.
- D. Product Data:
 - 1. Submit manufacturer's catalog cuts, material safety data sheets (MSDS), brochures, specifications; preparation and installation instructions and recommendations; storage, handling requirements and recommendations.
 - 2. Submit fiber manufacturer's name, type of fiber and composition of fiber.
 - 3. Submit data in sufficient detail to indicate compliance with the contract documents.
 - 4. Submit manufacturer's instructions for installation.
 - 5. Submit manufacturer's instructions for maintenance for the proper care and preventative maintenance of the synthetic turf system, including painting and markings.
- E. Samples: Submit samples, 6x6 inches, illustrating details of finished product in amounts as required by General Requirements, or as requested by Engineer.
- F. Product Certification:
 - 1. Submit manufacturer's certification that products and materials comply with requirements of the specifications.
 - 2. Submit test results indicating compliance with Reference Standards.

- G. Warranties: Submit warranty and ensure that forms have been completed in Owner's name and registered with approved manufacturer.
- H. Testing data to the Owner to substantiate that the finished field meets the required shock attenuation, as per ASTM F1936.
- I. Testing Certification: Submit certified copies of independent (third-party) laboratory reports on ASTM testing:
 - 1. D1577 Standard Test Method for Linear Density of Textile Fiber
 - 2. D1907 Yarn Denier Skein Method
 - 3. D2256 Yarn Tensile & Elongation
 - 4. D3218 Yarn Thickness, Microns
 - 5. D5823 Pile Height
 - 6. D5848 Standard Test Method for Mass Per Unit Area of Pile Yarn Floor Covering
 - 7. D5793 Stitch Gauge
 - 8. D1335 Standard Test Method for Tuft Bind of Pile Yarn Floor Covering
 - 9. D5034 Standard Test Method of Breaking Strength and Elongation of Textile Fabrics (Grab Test)
 - 10. F1015- Standard Test Method for Relative Abrasiveness of Synthetic Turf Playing Surfaces
 - 11. DIN 18-035 Water Permeability
 - 12. D2859 Standard Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials
 - 13. D7138 Melting Point
 - 14. F355 Standard Test Method for Shock-Absorbing Properties of Playing Surfaces.
 - 15. F1936 Standard Test Method for Shock-Absorbing Properties of North American Football Field Playing Systems as Measured in the Field
 - 16. F1951 ADA Compliance
 - 17. F2117-01 Ball Rebound
 - 18. D792 Specific Gravity
 - 19. EN 14808 Force Reduction
 - 20. EN 14809 Vertical Deformation
 - 21. EN 15301-1 Rotational Resistance

1.5 Quality Assurance

- A. Installer: Company shall specialize in performing the work of this section. The Contractor shall provide competent workmen skilled in this specific type of synthetic grass installation.
- B. The Contractor shall verify special conditions required for the installation of the system.
- C. The Contractor shall notify the Engineer of any discrepancies.

1.6 Delivery, Storage, and Handling

- A. Comply with Section 016000, Handling.
- B. Prevent contact with materials that may cause dysfunction.
- C. Deliver and store components with labels intact and legible.
- D. Store materials/components in a safe place, under cover, and elevated above grade.
- E. Protect from damage during delivery, storage, handling and installation. Protect from damage by other trades.
- F. Inspect all delivered materials and products to ensure they are undamaged and in good condition.
- G. Comply with manufacturer's recommendations.

1.7 Sequencing and Scheduling

- A. Coordinate the Work with installation of work of related trades as the Work proceeds.
- B. Sequence the Work in order to prevent deterioration of installed system.

1.8 Warranty and Guarantee

A. The Contractor shall provide a warranty to the Owner that covers defects in materials and workmanship of the turf for a period of two (2) years from the date of substantial completion. The turf manufacturer must verify that their representative has inspected the installation and that the work conforms to the manufacturer's requirements. The manufacturer's warranty shall include general wear and damage caused from UV degradation. The warranty shall specifically exclude vandalism, and acts of God beyond the control of the Owner or the manufacturer. The warranty shall be fully third party insured; pre paid for the entire 8 year term and be non-prorated. The Contractor shall provide a warranty to the Owner that covers defects in the installation workmanship, and further warrant that the installation was done in accordance with both the manufacturer's recommendations and any written directives of the manufacturer's representative. Prior to final payment for the synthetic turf, the Contractor shall submit to owner notification in writing that the field is officially added to the annual policy coverage, guaranteeing the warranty to the Owner.

1.9 Maintenance Service

- A. Contractor shall train the Owner's facility maintenance staff in the use of the turf manufacturer's recommended maintenance equipment.
- B. Manufacturer must provide maintenance guidelines to the facility maintenance staff.

PART 2 - PRODUCTS

2.1 Acceptable Manufacturer

- A. Approved manufacturers are as follows (or approved equals):
 - FieldTurf USA Inc. 175 N. Industrial Blvd Calhoun, GA 30701 Phone: 800/724-2969 Model: Field Turf Classic (or approved equals)

2.3 Materials and Products

- A. Artificial grass Field Turf baseball system materials shall consist of the following:
 - 1. Carpet made of slit-film polyethylene fibers tufted into a fibrous, non-perforated, porous backing for the bullpen area.
 - 2. Infill: Controlled mixture of graded sand, rubber crumb, and non-marking rubber that partially covers the carpet.
 - 3. Glue, thread, seaming fabric and other materials used to install and mark the artificial grass monofilament FieldTurf. All markings will be sewn in.
- B. The installed artificial grass monofllament FieldTurf shall have the following properties:

Property	Value	Units	ASTM
Pile Yarn Type	UV-resistant polyethylene		n/a
Yarn Structure	Parallel Fibrillated		n/a
Yarn Denier	10000	Denier	D1577
Yarn Breaking Strength	45 nominal	Ibs	D2256
Yarn Maximum Elongation	>40 nominal	%	D2256
Pile Height	2	inches	D5823
Pile Weight	30	Oz/yd2	D5848
Primary Backing Weight	>7	Oz/yd2	D5848
Secondary Backing Weight	16-18	Oz/yd2	D5848
Total Weight	53	Oz/yd2	D5848
Stitch Gauge	% inch centers		D5793
Tuft Bind	9	Ibs/force	D1335
Grab Tear Length	>200	Ibs/force	D5034
Grab Tear Width	>200	Ibs/force	D5034
Pill Burn Test	Pass		D2859

Property	Value	Units	ASTM
Yarn Melting Point	250	degreesF	D7138
Impact Attenuation (Gmax)	<200	gmax	F1936
Water Permeability	>40	inch/hou r	DIN 18-035
Total Depth of Infill Material	1.25	inches	n/a
SBR Rubber (including non-marking rubber)	2.6	Ibs/ft2	n/a
Silica Sand	3.65	Ibs/ft2	n/a
Product Weight	953	Oz/yd2	

- C. Bullpen shall consist of the slit-film fibers tufted into a primary backing with a secondary backing.
- D. Carpet Rolls shall be 15' wide rolls.
 - 1. Rolls shall be long enough to go from each end of the bullpen.
- E. Backing:
 - 1. Primary backing shall be a double-layered polypropylene fabric treated with UV inhibitors.
 - 2. Secondary backing shall consist of an application of porous, heat-activated urethane to permanently lock the fiber tufts in place.
 - 3. Perforated (with punched holes), backed carpet are unacceptable.
- F. Fibers shall be 10,000 denier, low friction, and UV-resistant fiber measuring not less than 2 inches high.
 - 1. Systems with less than 2 inch fibers are unacceptable.
- G. Infill materials shall be approved by the manufacturer.
 - 1. Infill shall consist of a resilient layered granular system, comprising selected and graded dust-free silica sand and cryogenically hammer-milled rubber crumb.
 - 2. Artificial Grass products without cryogenically processed rubber or a finish application of straight rubber cryogenically processed will not be acceptable.
 - 3. The sand component of the infill must represent a minimum of 51% or more of the total infill, by weight.
- H. Non-tufted or inlaid lines and markings shall be sewn in using materials and methods approved by the synthetic turf manufacturer. Painted marks will not be acceptable.
- I Thread for sewing seams of turf shall be as recommended by the synthetic turf manufacturer.
- J. Glue and seaming fabric for inlaying lines and markings shall be as recommended by the synthetic turf manufacturer.

2.4 Quality Control in Manufacturing

- A. The manufacturer shall own and operate its own manufacturing plant in North America. Both tufting of the field fibers into the backing materials and coating of the turf system must be done in-house by the turf manufacturer. Outsourcing of either is unacceptable.
- B. The manufacturer shall have full-time certified in-house inspectors at their manufacturing plant that are experts with industry standards.
- C. The manufacturer's full-time in-house certified inspectors shall perform pre-tufting fiber testing on tensile strength, elongation, tenacity, denier, shrinkage, and twist i.e., turns per inch, upon receipt of fiber spools from fiber manufacturer.
- D. Primary backing shall be inspected by the manufacturer's full-time certified in-house inspectors before tufting begins.
- E. The manufacturer's full-time in-house certified inspectors shall verify "pick count", yarn density in relation to the backing, to ensure the accurate amount of face yarn per square inch.
- F. The manufacturer's full-time, in-house, certified inspectors shall perform turf inspections at all levels of production including during the tufting process and at the final stages before the turf is loaded onto the truck for delivery.
- G. The manufacturer shall have its own, in-house laboratory where samples of turf are retained and analyzed, based on standard industry tests, performed by full-time, in-house, certified inspectors.
- H. The manufacturer must have ISO 9001, ISO 14001 and OHSAS 18001 certifications demonstrating its manufacturing efficiency with regards to quality, environment and safety management systems.

PART 3 - EXECUTION

3.1 Examination

- A. Verify that all sub-base leveling is complete prior to installation.
- B. Installer shall examine the surface to receive the synthetic turf and accept the sub-base planarity in writing prior to the beginning of installation.
 - 1. Acceptance is dependent upon the Owner's test results indicating compaction and planarity are in compliance with manufacturer's specifications.
 - 2. The surface shall be accepted by Installer as "clean" as installation commences and shall be maintained in that condition throughout the process.

- C. Compaction of the aggregate base shall be 95%, in accordance with ASTM D1557 (Modified Proctor procedure); and the surface tolerance shall not exceed 0-1/4 inch over 10 feet and 0-1/2" from design grade.
- D. Correct conditions detrimental to timely and proper completion of Work.
- D. Do not proceed until unsatisfactory conditions are corrected.
- F. Beginning of installation means acceptance of existing conditions.

3.2 Preparation

- A. Prior to the beginning of installation, inspect the sub-base for tolerance to grade.
- B. Sub-base acceptance shall be subject to receipt of test results (by others) for compaction and planarity that sub-base is in compliance with manufacturer's specifications and recommendations.

3.3 Installation - General

- A. The installation shall be performed in full compliance with approved Shop Drawings.
- B. Only trained technicians, skilled in the installation of athletic caliber synthetic turf systems working under the direct supervision of the approved installer supervisors, shall undertake any cutting, sewing, gluing, shearing, topdressing or brushing operations.
- C. The designated Supervisory personnel on the project must be certified, in writing by the turf manufacturer, as competent in the installation of this material, including sewing seams and proper installation of the Infill mixture.
- D. Designs, markings, layouts, and materials shall conform to all currently applicable National Collegiate Athletic Association rules, NFHS rules, and/or other rules or standards that may apply to this type of synthetic grass installation. Designs, markings and layouts shall first be approved by the Engineer or Owner in the form of final shop drawings. All markings will be in full compliance with final shop drawings.

3.4 Installation

- A. Install at location(s) indicated, to comply with final shop drawings, manufacturers'/ installer's instructions.
- B. The Contractor shall strictly adhere to specified procedures. Any variance from these requirements shall be provided in writing, by the manufacturer's on-site representative, and submitted to the Engineer and/or Owner, verifying that the changes do not in any way affect the Warranty. Infill materials shall be approved by the manufacturer and installed in accordance with the manufacturer's standard procedures.

- C. Carpet rolls shall be installed directly over the properly prepared aggregate base. Extreme care shall be taken to avoid disturbing the aggregate base, both in regard to compaction and planarity.
 - 1. Repair and properly compact any disturbed areas of the aggregate base as recommended by manufacturer 2.
- D. Full width rolls shall be laid out across the bullpen.
 - 1. Turf shall be of sufficient length to permit full cross-field installation from end to end.
 - 2. No cross seams will be allowed in the main bullpen area between the sidelines.
 - 3. Each roll shall be attached to the next roll utilizing standard state-of-the- art sewing procedures.
- E. Artificial turf panel seams shall be sewn along the selvedge edging flap of the turf roll. Seams secured by other means including gluing are unacceptable. Installation shall be 99% sewn.
 - 1. Minimum gluing will only be permitted to repair problem areas, .corner completions, and to cut in any logos or inlaid lines as required by the specifications.
 - 2. Seams shall be flat, tight, and permanent with no separation or fraying.
 - 3. In the case of all lines and logos, turf carpet must be sheared to the backing (do not cut the backing) and adhered using hot melt adhesives.
- F. Infill Materials:
 - 1. Infill materials shall be applied in numerous thin lifts. The turf shall be brushed as the mixture is applied. The infill material shall be installed to a depth determined by the manufacturer.
 - 2. Layered infill shall be installed in a systematic order.
 - 3. Infill materials shall be installed to fill the voids between the fibers and allow the fibers to remain vertical and non-directional. The Infill installation consists of a base layer of sand followed by a homogenous mixture of the sand and the cryogenically processed rubber. A final application of specifically sized non-marking rubber completes the system. The Infill shall be installed to the depth of 1 1/4". Infill density shall consist of no more than 3.65 pounds of sand and at least 2.6 pounds of rubber per square foot. The Infill shall be placed so that there is a void of %" to the top of the fibers.
- G. Non-tufted or inlaid lines and markings shall be sewn in accordance with turf manufacturers' recommendations. Number of applications will be dependent upon installation and field conditions.
- H. Synthetic turf shall be attached to the perimeter edge detail in accordance with the manufacturer's standard procedures.

I. Upon completion of installation, the finished area shall be inspected by the installation crew and an installation supervisor.

3.5 Field Markings

- A. Field markings shall be installed in accordance with approved shop drawing.
- B. All of sports markings will be inlaid in accordance with approved shop drawings.

3.6 Adjustment and Cleaning

- A. Do not permit traffic over unprotected surface.
- B. Contractor shall provide the labor, supplies, and equipment as necessary for final cleaning of surfaces and installed items.
- C. All usable remnants of new material shall become the property of the Owner. The Contractor will provide a 20' roll of turf for future repairs.
- D. The Contractor shall keep the area clean throughout the project and clear of debris.
- E. Surfaces, recesses, enclosures, and related spaces shall be cleaned as necessary to leave the work area in a clean, immaculate condition ready for immediate occupancy and use by the Owner.

3.7. Protection

A. Protect installation throughout construction process until date of final completion.

END OF SECTION 329230

SECTION 329231 - PLAYING FIELD MATERIALS AND MIXTURES

PART 1 - GENERAL

1.1 Description of Work

Scope of work includes the removal and replacement of under drains, quick drains, and the warning track of the softball playing field. Work described in this section shall include all labor, materials, and equipment necessary to remove and replace the warning track and any other areas of the playing field root zone system and miscellaneous baseball mixtures of the softball playing field that may be damaged.

A. Related Work - Playing Field Earthwork, Section 312200.1

PART 2 - PRODUCTS 2.1

1.2 Materials

A. NATURAL TURF ROOTZONE SAND - The sand shall preferably be a silica sand, **non-calcareous**, clean and processed and meet the following particle size criteria. Calcareous sand meeting the following criteria will be acceptable only if proven that a local source within a 150 mile radius of the project cannot be found to supply non-calcareous material.

	Sieve	Diameter	Allowable range
	Mesh	(mm)	% retained
Gravel	10	>2.00	Less than, equal to 5%
Very Coarse	18	1.00-2.00	0 to 20% w/gravel
Coarse	35	0.50-1.00	at least 60%
Medium	60	0.25-0.50	particles in this range
Fine	100	0.15-0.25	20% maximum
Very Fine	270	0.05-0.15	5% maximum
Silt		0.002	5% maximum
Clay		less than	
-		0.002	3% maximum

In addition, there should be 100% passing the No. 5 screen (4mm), and no more than 10% combined very fine sand, silt, and clay, and the sand should have a uniformity of coefficient (Cu) of 2.5 to 3.5.

Submit samples to testing agent for analysis to assure conformance with 1993 USGA protocol and this specification.

B. NATURAL TURF ROOTZONE DAKOTA REED SEDGE PEAT- Must be at least 85% organic material well decomposed and uniform in texture. Organic materials shall be low enough in silt and clay content to hold the final rootzone mixture to less than 5% silt and less than 3% clay. Ph of organic materials shall be 6.0 to 7.0 and material shall be free from extraneous materials such as sticks, roots, rocks, etc.

C. NATURAL TURF ROOTZONE MIXTURE- Organic range of 0.4 to 0.6 organic matter on a dry weight basis. Approximately a 90% sand/10% peat ratio. The sand peat mix shall be mixed off-site to a uniform consistency using a mechanical blender designed for producing high performance sand based rootzones. Final percentage of peat in the sand rootzone blend will be determined through laboratory testing. Using 1993 USGA protocol (ASTM F1815), the final rootzone mixture shall comply with the following criteria:

Water retention shall be based upon a 25 cm depth:

Infiltration Rate, inches per hour:	15 to 25
Bulk Density, grams/cc:	1.2 to 1.6
Total Porosity, percent:	35 to 55%
Saturation percentage @ 25 cm tension:	35 to 65%
Uniformity of Coefficient	2.5 to 3.5

Peat content will be verified using the loss on ignition (ASTM F1647, Method 1) determination process. Suggested (but not limited to) Rootzone sand and peat supplier:

Golf Agronomics Supply and Handling

D. NATURAL TURF SOIL AMENDMENTS AND FERTILIZERS - Soil Amendments and fertilizers shall be as recommended by final lab analysis of the rootzone sand, submitted to the agronomic testing lab, by the Playing field contractor, with review and final written specifications prepared by the Engineer's representative. An allowance of \$7,500 (materials cost only) shall be included in the base bid for testing and purchase of soil amendments and fertilizers incorporated into the sand rootzone prior to sodding. Testing and installation/tilling of these materials in to the top 2"-3" of the sand rootzone shall be included by the playing field contractor. Approved agronomic testing lab:

Servi-Tech Laboratories, 1816 East Wyatt Earp, Dodge City, KS 67801, (316)227-7123.

- E. INFIELD SKINNED AREA MIX Infield skinned area and baselines shall be installed and laser graded to a compacted depth of 4". Infield Mix shall be pre-mixed and processed to approximate percentages of 50-60% sand, 20-25% silt and 20-25% clay mixture and red in color. Submit samples and testing analysis to Engineer's representative prior to work commencement (see details). Skinned Infield shall be conditioned by the playing field contractor, at the direction of the Owner's turf manager, with 1/4" of Pro League Select Turface Infield Conditioner (or equivalent).
- F. INFIELD SKINNED AREA BASE. The infield skinned area mix shall be place on a 6" thick layer of natural turf rootzone sand. A filter fabric shall be placed on top of the sand layer prior to installation of final in field skinned area mix.
- G. WARNING TRACK MATERIAL The warning track shall be installed to a minimum compacted depth of 4" over a 6" depth of grade #8 or #67 stone material. Warning track materials shall be 3/8" minus brick dust, lava rock or equivalent and **red** in color. Submit sample and testing analysis to Engineer's representative prior to work commencement. (See details).

University of South Carolina Softball Stadium Construction BID SET

H. BASES AND PITCHING RUBBER - Provide Jack Corbett original "Hollywood" 15" X 15" bases for 1st, 2nd and 3rd bases, Bury-All Homeplates, and Professional pitchers box 4-way pitching rubbers, as noted on plans for playing field and bull pens. Other than the bases and pitching rubbers needed to construct the main playing field diamond and bullpens, provide for three (3) additional and complete sets of bases and rubbers to be utilized for future use.

PART 3 – EXECUTION

3.1 Installation

A. ROOTZONE BLENDING - Based upon the final lab analysis of the sand, the specified amendments shall be blended at an **offsite** location with the selected organic materials. Final rootzone blend shall be tested by a USGA approved soil's testing laboratory and final blend shall be approved by the Engineer's representative **prior** to bulk blending of entire rootzone. Upon approval (by the Owner's representative) of the final rootzone blend, the sand/peat rootzone shall be tested in 1000 ton lots by a soil's testing laboratory for conformance with this specification. Suggested soil's testing laboratories:

A. McNitt Company 240 Dogtown Road, RRI Center Hall, PA 16828 (814) 364-2792 voice/fax Hummel & Co, Inc 35 King Street Trumansburg, NY 14886 (607) 387-5694

- B. PLACEMENT Sand rootzone mixture shall be delivered to the playing field by truck and carefully placed over the 90% compacted subgrade, 4" depth of drainage rock, subdrainage piping system and the irrigation system using low ground pressure, wide track equipment (see section 02710). Final depth of rootzone mixture shall be a water settled, and compacted depth often inches (10").
- C. VERIFICATION Verify finished grade elevation and depth of skinned infield materials, and rootzone mixture, utilizing a laser operated survey instruments. Final finish grading of the skinned infield clays and sand rootzone, prior to sodding, shall be accomplished utilizing conical automatic laser operated equipment capable of the following tolerances:

Finished grade elevations of the field shall be within plus 0.00 or minus .75 inch with no variations of more than .25 inch in 25 feet of the designed elevations. Provide certified as-built drawings of final finished grade elevations to owner's representative upon completion and <u>prior</u> to the installation of the sod.

- D. FERTILIZERS- Broadcast approved specified starter fertilizer blend by truck or power operated machinery. Fertilizer shall be mechanically disced, ripped, or harrowed to a 3" depth taking care to maintain proper finished grades and protecting irrigation system and all existing features. Bulk fertilizer program will be provided to the playing field contractor by the Owner.
- E. FIELD LAYOUT Layout, install forms and install the skinned infield area, pitching mound, home plate area, coaches boxes, bullpens and warning track as indicated on the drawings and coordinate work with owner's turf manager. This work shall include the adequate compaction of all materials to the depths specified on the plans and details.

University of South Carolina Softball Stadium Construction BID SET

3.2 Protection

A. GENERAL - Provide protection of the sand rootzone playing surface, skinned infield, mound/homeplate area, warning track and bull pens until such time as the sod installation can be performed. This protection shall include tarping of the skinned infield and homeplate areas of the diamond and bullpens until substantial completion and acceptance of the field by the Owner.

PART 4 – GUARANTEE

4.1 Guarantee

A. NATURAL TURF GUARANTEE - Materials shall be guaranteed to conformance with this specification. Final rootzone mixture shall be guaranteed to an initial **minimum** infiltration rate of 15-25 inches/per hour. It is intended that the field will percolate at a minimum infiltration rate of 3" per hour <u>after establishment</u> of the turf. Final field percolation rates shall be subject to the proper sod installed and maintenance of the system provided by Owner, his heirs or assigns.

END OF SECTION 329231

SECTION 330100 - SEWERS: SANITARY, GRAVITY

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Work included: Provide gravity sanitary sewer as shown on the drawings, specified herein, and needed for a complete and proper installation.
- Related work: B.
 - Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these 1. specifications. Section 312333 - Trenching, Backfilling for Utilities.
 - 2.

1.2 **OUALITY ASSURANCE**

Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the A. necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

1.3 **SUBMITTALS**

- A. Comply with pertinent provisions of Section 013300.
- B. Product data: Within fifteen (15) calendar days after the Contractor has received the Owner's Notice to Proceed, submit:
 - Materials list of items proposed to be provided under this Section. 1.
 - 2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.

1.4 **PRODUCT HANDLING**

- Comply with pertinent provisions of Section 016000. A.
- B. Storage of PVC pipe:
 - Store in unit packages as received from manufacturer until just prior to use. 1.
 - Stack units in such a manner as to prevent deformation to pipe barrel and bells.
 - 2. 3. Protect from direct sunlight by covering with opaque material if storage period will exceed six weeks.
- C. Avoid severe impact blows, gouging or cutting by metal surfaces or rocks.

1.5 **ORDER AND ACCEPTANCE OF WORK**

- A. Engineer shall direct on what line or street the Contractor shall work and the order thereof.
 - 1. Generally, Work shall commence with outfalls, to mains, thence to laterals.
- B. Owner reserves right to accept and use any portion of Work whenever it is considered to be in the public interests to do so.

PROTECTION OF OTHER UTILITIES 1.6

- A. Location:
 - Approximate location of certain known underground lines is shown. 1.
 - 2. 3. Existing small lines not shown.
 - Locate small and other possible utility lines using electronic pipe finder, or other approved method.
 - Excavate and expose existing underground utilities ahead of trenching operations. 4.
- B. Repair or replace any damaged utility line or structure at no additional cost to Owner.

1.7 **CONFLICTING UTILITIES**

- Remove and/or relay conflicting utilities, when so directed by the Engineer, at the expense of the A. Owner.
- Where alterations to existing utilities are shown to avoid conflicts, make alterations at no cost to B. Owner.

1.8 **JOB CONDITIONS**

- Work under this Section may require construction or work in a confined space, defined as any A. space having one or more of the following characteristics:
 - 1. Limited openings for entry and exit.
 - 2.3. Unfavorable natural ventilation.
 - Not designed for continuous worker occupancy.
- Β. The Contractor shall have on the job site at all times the following minimum safety equipment:
 - 1. Gas monitor capable of testing and detecting for combustible gas, oxygen deficiency and hydrogen sulfide.
 - 2. Confined space access and retrieval winch system.
 - 3. Ventilating fan with large diameter ventilating hose.
 - 4. Supplied air respirator, MISHA/NIOSH approved type.
 - 5. Safety harness and lifelines.

This equipment to be available for use by the Contractor, Engineer and Owner for the duration of the project.

C. All entries into or work within confined spaces to be conducted in accordance with the U.S. Department of Health and Human Services/National Institute for Occupational Safety and Health [DHHS (NIOSH)] Publication No. 87-113, A Guide to Safety in Confined Spaces

PART 2 - PRODUCTS

2.1 GENERAL

- A. Pipe shall be subject to Engineer's observation, at plant, trench or other point of delivery, for culling and rejecting pipe, independent of laboratory tests, not conforming to specifications.
- B. Rejected pipe will be marked by the Engineer and Contractor shall remove it from project site.
- C. All sanitary sewer service lines, cleanouts and all appurtenances shall comply with City of Columbia Regulations.

PART 3 - EXECUTION

3.1 LAYING OUT WORK

- A. Provide all materials, labor, instruments, etc. required to lay out Work.
- B. Prepare "cut sheets" under direct supervision of the Engineer.
- C. Exercise proper precaution to verify figures on the drawings prior to laying out Work. Contractor will be held responsible for any errors therein that otherwise might have been avoided.
- D. Promptly inform Engineer of errors or discrepancies found, in order that proper corrections may be made.

3.2 LOCATION

- A. Sewer lines in relation to water lines must conform to South Carolina Standards for Wastewater Facility Construction R.61-67 section 67-300 paragraph A.14.
- B. Where the sewer location is not located clearly by dimensions on the drawings, locate the sewer:
 - 1. Not closer than 10' horizontally from a water supply main or service line. The distance shall be measured edge to edge.
 - 2. Where it is not practical to maintain a 10' horizontal separation, the sewer pipe may be installed closer to a water main, provided that the water main is in a separate trench or on an undisturbed earth shelf located on one side of the sewer and at an elevation so the bottom of the water main is at least 18" above the top of the sewer.
 - 3. Where sewers are crossing a water main, either above or below, provide a minimum vertical distance of 18" between the outside of the water main and the outside of the sewer.
 - 4. The crossing shall be arranged so that the sewer joints will be equidistant and as far as possible from the water main joints.
 - 5. Where a water main crosses under a sewer, fully encase the sewer pipe for a distance of 10' on each side of the crossing; or
 - 6. Use acceptable pressure pipe with no joint closer horizontally than 3' feet from the crossing. This pipe will be pressure tested to assure watertightness prior to backfilling.
 - 7. Where concrete encasement is used, provide not less than 4" thickness including that on pipe joints.

3.3 INSTALLATION

- A. Trench, backfill and compact for the work of this Section in strict accordance with pertinent provisions of Section 312333 and Section 320117 of these specifications, and the following requirements:
 - 1. Maximum trench widths, depths and bedding methods.
 - a. Install all sewers complying with tables for depths of cut and class of bedding included hereinafter.
 - b. Where trenches are excavated beyond specified widths, or trench walls collapse, lay sewer complying with requirements of the next better class of bedding at no additional cost to the Owner.
 - c. Include cost of special bedding and tamping in unit prices bid for sewer.

			CLASS OF BEDDING		
		D	С	В	Α
PIPE SIZE	MAX. TRENC H WIDTH	FLAT BOTTO M TRENCH	TYPE 1 OR TYPE 2	TYPE 2* ONLY	SPECIAL CONCRETE BEDDING
4"	2'0"	**	**	30	30
8"	2'2"	**	**	30	30
10"	2'4"	**	**	30	30
12"	2'6"	**	**	30	30
15"	2'10"	**	**	30	30
18"	3'2"	**	**	30	30
21"	3'6"	**	**	30	30

2. Polyvinyl chloride pipe (SDR35):

- 3. Bedding and tamping requirements for the various classes of bedding shall comply with the following specifications:
 - a. Class A Bedding Excavate trench to one-fourth of nominal pipe diameter below pipe grade; lay pipe to grade on concrete blocking; place 2500 psi concrete around pipe for full width of trench up to one-fourth nominal pipe diameter above the invert.
 - b. Class B (Type 1) Bedding Shape bottom of trench to a level 2" below bottom of pipe; bring bed to proper level by spreading and thoroughly tamping fine granulated moist earth and sand to conform accurately to one-fourth circumference of pipe barrel; provide suitable material if not available from trench excavation; lay pipe, backfill and hand tamp in thin layers to height three-fourths of pipe diameter, using material same as bedding material; complete trench backfill complying with Section 312333.
 - 1) Trenches excavated to excess depths shall be brought to grade with stone or gravel bedding at the Contractor's expense.
 - 2) Exercise care to avoid disturbing pipe grade, alignment or joints at all times.
 - 3) In lieu of this class bedding, Contractor may elect to use Class B (Type 2) bedding.
 - c. Class B (Type 2) Bedding Undercut 4" below pipe barrel, full width of trench; bring to grade with approved backfill and compacted crushed stone complying with SCDOT Aggregate No. 5; except for PVC sewers, use SCDOT Aggregate No. 57, then:

- 1) For pipe other than PVC, place stone in six-inch layers to mid-point of pipe, compacting by slicing with shovel. For PVC pipe, place stone (Aggregate No. 57) in six-inch layers to the
- 2)
- 2) For two pipe, piace stone (Aggregate No. 57) in six-inch layers to the top of the pipe, compacting by slicing with shovel.
 3) Complete trench backfill complying with Section 312333.
 Class C (Type 1) bedding Shape trench bottom by hand to conform accurately to bottom one-quarter of pipe barrel circumference.
 1) Use Class C (Type 2) bedding 11 d.

 - Use Class C (Type 2) bedding if unable to properly shape trench bottom. If shaping is not performed accurately, the Contractor will be required to 1) 2)
- use Class C (Type 2) bedding. Class C (Type 2) Bedding Undercut 4" below bottom of pipe barrel; full width e. of trench; bring to grade with approved backfill and compacted crushed stone complying with SCDOT Aggregate No. 5; lay pipe; place stone in 6" layers to quarter-point of pipe, compacting by slicing with shovel; complete backfill complying with Section 312333.
- Class D Bedding Excavate bell holes in flat-bottomed trench; lay pipe; backfill complying with Section 312333. f.
- B. Pipe laying:
 - 1. General:
 - Protect pipe during handling against shocks and free fall. Remove extraneous a. material from the pipe interior.
 - b. Lay pipe by proceeding upgrade with the spigot ends of bell-and-spigot pipe pointing in direction of flow.
 - c. Lay each pipe accurately to the indicated line and grade, aligning so the sewer has a uniform invert.
 - Continually clear interior of the pipe free from foreign material. d.
 - Before making pipe joints, clean and dry all surfaces of the pipe to be joined. e.
 - Use gasket lubricants as recommended by the pipe manufacturer. f.
 - Place, fit, join and adjust the joints to obtain the degree of water tightness g. required.
 - 2. Polyvinyl chloride pipe:
 - Select proper bedding class from preceding table as determined by pipe size and depth of cut.
 - Class B (Type 2) or better bedding shall be used for all PVC sewers.
 - Comply with ASTM D2321, except as otherwise specified herein. b.
 - 3. Remove defective pipe and replace with sound pipe, at no cost to the Owner.

3.4 **INSTALLATION OF MANHOLES**

a.

- A. Set bases level so that walls will be plumb.
- B. Clean bells and spigots.
- C. Apply joint sealer, or ring gasket to wall section(s), set firmly in place to assure watertight joints.
- D. Set risers and cones so steps align.
- E. Tightly connect pipe boot to piping with dual stainless steel straps.
- F. Grout lift holes from the outside using non-shrink grout.

3.5 SERVICE LINES

- Connect to street sewers using wye branches and ells as indicated on the plans. A.
- B. Do not stack service lines vertically over the sewer main.

Architect's Project No. 11.122.00
State Project No. H27-6088-MJ
03/16/12

- C. Provide sufficient fittings to route piping without bending the pipe sections.
- The Contractor is responsible for coordinating with the property owner and the utility owner's D. representative to determine the depth and location of both the sewer line connection and clean out to best provide a sewer service connection point for the property being served.
- The Contractor is responsible for locating service lines to avoid conflicts with existing utilities E. and exposure of line in ditches.

3.6 **CLEANOUTS**

- A. Secure the Engineer's approval of locations for cleanouts in finished areas prior to installation.
- B. Pour 4" concrete protection pad around cleanout.

3.7 **INSPECTIONS AND TESTING**

- A. General:
 - All sewers will be visually inspected, tested and gauged for infiltration and/or 1. exfiltration.
 - All visible leaks shall be repaired even if infiltration is within allowable limits. 2.
 - 3. Broken or cracked pipe, mislaid pipe and other defects shall be corrected.
 - All repairs, relaying of sewers, etc., required to bring the sewers to specified status shall 4. be made at no additional cost to the Owner.
 - 5. Expense of all testing will be borne by the Contractor.
- B. Construction observation:
 - Clean and prepare for observation each block or section of sewer upon completion, or at 1. such other time as the Engineer may direct.
 - Each section between manholes shall show a full circle of light when viewed from either 2. end.
- C. Deflection tests:
 - Perform deflection tests on all PVC pipe in the presence of the Engineer. 1.
 - 2. No pipe to exceed a deflection of 5%.
 - 3. Conduct deflection testing after the final backfill, and compaction thereof, has been in place at least thirty (30) days and prior to placing the sewer lines into operation.
 - 4. Conduct the deflection tests using a rigid ball or mandrel having a diameter equal to 95% of the inside diameter of the pipe.
 - 5. Do not use mechanical pulling devices for the deflection tests.
- D. Infiltration tests:
 - Conduct tests using V-notch weir, or by direct measurement prior to allowing sewage 1. flows in the line.
 - 2. Close the end of the sewer at upstream structure sufficiently to prevent the entrance of water.
 - 3. Discontinue use of well points or other groundwater pumping operations at least three days prior to testing.

- 4. Infiltration into the entire system of new sewers or any one trunk, interceptor or outfall sewer, including connecting laterals, or any stretch of sewer shall not exceed:
- a. 200 gallons per inch of diameter per mile per day.
 5. Make tests in presence of the Engineer, giving the Engineer at least three days advance notice.

E. Air testing:

1. Where sewers are installed above the groundwater table, conduct air tests complying with ASTM C 828 for ductile iron and concrete pipe and ASTM F 1417 for PVC pipe.

3.11 MEASUREMENT AND PAYMENT

A. No separate measurement or direct payment will be made for this work and all costs for same shall be included in the price bid for the project.

END OF SECTION 330100
SECTION 331100 WATER DISTRIBUTION SYSTEM

PART 1 - General

1.1 DESCRIPTION

- A. Work included: Provide water distribution system as shown on the Drawings, specified herein, and needed for a complete and proper installation.
- B. Related work:
 - 1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these specifications.
 - 2. Section 312333 Trenching, Backfilling for Utilities.

1.2 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- B. All materials in this Section are to be manufactured in the United States.

1.3 SUBMITTALS

- A. Comply with pertinent provisions of Section 013300.
- B. Product data: Within fifteen (15) calendar days after the Contractor has received the Owner's Notice to Proceed, submit:
 - 1. Materials list of items proposed to be provided under this Section.
 - 2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.

1.4 PRODUCT HANDLING

- A. Comply with pertinent provisions of Section 016000.
- B. Shipment of pipe:
 - 1. Protect pipe with tarp or other means during shipment to prevent truck exhaust from damaging pipe.
- C. Avoid severe impact blows, gouging or cutting by metal surfaces or rocks.

PART 2 - PRODUCTS

2.1 GENERAL

A. Use any pipe material and associated fittings as specified herein, except where use of a particular material is indicated on the plans, or specified herein.

2.2 PIPE AND FITTINGS

A. General:

- Pipe sizes 3" and larger: Use ductile iron. 1.
- Any pipe, solder, or flux used shall be lead free (lead free is defined as less than 0.2% 2. lead in solder or flux and less than 8.0% lead in pipes and fittings).
- 3. Gaskets are to be factory-installed and integral with the pipe.
- All pipe 4" and larger shall be National Sanitary Foundation (NSF) approved and shall 4. be third party certified as meeting the specifications of ANSI/NSF Standard 61.
- 5.
- All materials and products that contact potable water shall be third party certified as meeting the specifications of ANSI/NSF Standard 61. All chemical or products added to the public water supply must be third party certified as meeting the specifications of ANSI/NSF Standard 60. 6.
- 7. For valves cast all markings integral on the valve body with the size of valve, year of manufacture and the class working pressure.
 - Certifications to rate a 150B valve body to a Class 250 valve will not be a. acceptable.
- For valves spray coat all interior wetted ferrous surfaces with two-component epoxy 8. applied to a nominal thickness of 3 to 4 mils. a. Coating material to be AWWA and U.S. Food and Drug Administration
 - approved for use with potable water.
- 9. Exterior Coatings: For ductile iron pipe
 - For buried service provide bituminous coating. a.
- Β. Pipe:
 - 1. Ductile iron pipe (DIP):
 - Comply with ANSI/AWWA C150/A21.50 or AWWA C151/A21.51, latest a. revision.
 - b. The class or nominal thickness, net weight without lining, and casting period shall be clearly marked on each length of pipe. Additionally, the manufacturer's mark, country where cast, year in which the pipe was produced, and the letters "DI" or "Ductile" shall be cast or stamped on the pipe.
 - Wall thickness in accordance with Table 51.1 of ANSI/AWWA C151/A21.51 c. with working pressure of 150 psi, depth of cover indicated and Type 3 bedding conditions, minimum Class 50.
 - Use cement mortar lining complying with ANSI/AWWA C104/A21.4, standard d. thickness.
- C. Joints:
 - Ductile iron pipe: 1.
 - a. Use mechanical or push-on joints complying with ANSI/AWWA C111/A21.11 as modified by ANSI/AWWA C151/Â21.51.
 - Use gaskets and lubricant complying with ANSI/AWWA C111/A21.11. Natural b. rubber gaskets are not acceptable.
 - Lubricants shall be compatible with pipe and gasket materials, shall not support c. bacteria growth and shall not adversely affect potable quality of line contents. Vegetable shortening shall not be used to lubricate joints.
 - NSF approved. 1)
 - Exposed pipe: d.
 - Class 53 minimum. 1)
 - 2) Use flanged joints complying with ANSI/AWWA C115/A21.11, latest revision; and
 - Flanges to be solid type. i)
 - Use full face, red rubber, factory cut, 1/16" thick for pipe up to ii) 10" diameter and 1/8" thick for larger sizes.
 - Bolts and nuts shall be standard carbon steel machine bolts, hex iii) head complying with ANSI A21.11/AWWA C111.

- D. Fittings and specials:
 - 1. Ductile iron pipe:
 - Use 250 psi pressure rated ductile iron fittings or specials unless otherwise a. indicated, complying with ANSI/AWWA C110/A21.10.
 - Compact fittings for piping 3" 16" may be provided in accordance with ANSI/AWWA C153/A21.53.88.b. b.
 - Fittings for use with push-on joint pipe, comply with ANSI/AWWA c. C111/A21.11.
 - Use cement mortar lining complying with ANSI/AWWA C104/A21.4, standard d. thickness.
 - The maximum phosphorous level in the casting will be 0.08%. e.
 - The fitting surface finish will conform to MSS SP-112 Quality Standard for f. Evaluation of Cast Surface Finishes.
 - The manufacturer shall be ISO 9000 certified.
 - g. h. Markings
 - Each fitting shall have the following markings cast integrally to the fitting:
 - 1. Manufacturer's Name or Logo
 - "MJ"
 - 2. 3. Country of origin
 - 4. Manufacturer's Foundry Mark
 - 5. AWWA C-153 or C110
 - 6. **Pressure Rating**
 - Nominal Diameter (each leg) 7.
 - "DI" or "Ductile" 8.
 - 9. No. of Degrees (bends)
- Couplings: E.
 - Provide couplings where needed to make piping connections and where located on the 1. plans.
 - 2. Provide mechanical joint ductile iron sleeve, full length, minimum 12".
 - 3. Provide cutting-in sleeve where installing fittings in an existing line.
 - Provide ductile iron with mechanical joint.
 - Provide restrained joint couplings where restrained joints are indicated on the plans. 4.
- F. Restrained joint pipe and fittings:

a.

- Provide restrained joint pipe and fittings where indicated on the plans. 1.
 - Ductile iron pipe:
 - Provide retainer glands for use with mechanical joint pipe and fittings. 1)
 - 2) Provide wedge type.
 - Provide ductile iron gland conforming to ASTM A 536-80. Provide split 3) gland where standard gland cannot be installed.
 - 4) Provide ductile iron set screws, heat-treated to a minimum hardness of 370 BHN with twist-off nuts and permanent standard hex head remaining.
 - Provide for the following rated pressure with minimum 2 to 1 safety 5) factor; 3" - 16" 350 psi, 18" - 48" 250 psi. Provide tee-head bolts conforming to ANSI/AWWA C111/A21.11 latest
 - 6) revision.
 - 7) Provide "MEGALUG" series 1100 or series 1200 as manufactured by EBAA Iron, Inc. of Eastland, Texas, or approved equal.
- G. Tee head bolts: Provide Cor-Ten steel tee head bolts for use on mechanical joints complying with ASTM A242.

- H. Plugs or caps:
 - 1.
 - Provide at all pipe ends and unused branches of fittings. All plugs and caps shall be tapped 2" and provided with 2" plug. 2. 3.
 - Plugs and caps to be restrained joint.

2.3 **COPPER TRACER WIRE**

- Provide a continuous 12 gauge blue insulated copper tracer wire when PVC or polyethylene pipe A. is used.
- B. Approved for direct burial by the manufacturer.
- C. Locate tracer wire a minimum of 6" above top of water main.
- D. Terminate tracer wire at each valve and meter and make provisions to allow for connection of testing apparatus without interfering with the proper operation of valves and meters.
- E. Connect to the water line with duct tape at every bell connection or every 20' to ensure that the wire is directly over the top of the pipe.
- F. Place in the trench with all service lines.
- G. Splice at each service lateral and tee connection with an approved copper

2.4 VALVES

- General: A.
 - 2" through 12": Use gate valves. 1.
 - 2. 3. Open by turning counterclockwise.
 - End connections as required for the piping in which they are installed.
 - 4. Two-inch metal operating nut with arrow indicating direction of opening.
 - Use valves designed for a working pressure of not less than 150 psi. 5.
 - Provide stem extensions on all valves where the top of the operator nut is located greater 6. than 36" below the top of the valve box.
 - Fully coat all internal ferrous metal surfaces with two part thermosetting epoxy. 7.
 - Design for external stem failure when excessive closing torque is applied with no failure 8. of the pressure retaining parts.
 - 9. Provide double disc gate valves with bevel gears, grease case, and other necessary appurtenances for horizontal installation.
 - Provide valved bypass on valves 14" and larger. 10.
 - 11. Provide stainless steel bolting.
 - Valves to be manufactured in the United States. 12.
 - 13. Provide all wetted rubber compounds of synthetic rubber.
- B. Gate valves 2" through 12":
 - Use double disc valves complying with ANSI/AWWA C500 or resilient seated wedge 1. valves complying with ANSI/AWWA C509.
 - 2. Provide integrally cast bronze stem nut on resilient seated wedge valves.
 - 3. Suitable for working pressure of not less than 250 psi.
 - 4 Design for external stem failure outside of the valve body or bonnet when excessive closing torque is applied with no failure of the pressure retaining parts per AWWA Section 3.2.
 - Factory test with no leakage from either side of the disc. a
 - Test shell to 500 psig. h
 - 5. Provide certified to NSF 61.

- 6. Resilient wedge valves:
 - Completely encapsulate resilient iron wedge by an elastomer, without thin spots a. or voids. b.
 - Provide polymer wedge guide bearing caps bearing surface between the encapsulated wedge and the interior epoxy coating, lowering operation torque and extending service life of the valve.
 - The manufacturing plant to have ISO9001 certification. с.
- C. Valve operator:
 - Provide one T-handle operator for each ten buried valves with nut operator. 1.
 - 2. Provide one stainless steel T-handle operator for each four buried valves with "T" head.
- D. Provide valve boxes and position indicators for all buried service valves and operators.
 - Hermetically sealed for installation in a C.I. valve box. 1.
 - 2. Show valve disc position, direction of rotation and number of turns from full open to full close.
 - 3. Shaft extension and pins to be stainless steel.
 - Base plate and housing to be aluminum. Provide all bronze gearing. Provide 2" AWWA square nut. 4.
 - 5.
 - 6.
 - Locate top of indicator no more than 6" below grade. 7.
 - Approved manufacturer: Valcom or approved equal. 8

2.5**HYDRANTS**

- Fire hydrants: A.
 - Comply with ANSI/AWWA C502. 1.
 - 2. Waterway valve opening, 5-1/2".
 - 3. Six inch hub connection, two 2-1/2" hose connections, one 4-1/2" steamer connection.
 - 4. National Standard screw threads on outlet nozzles.
 - 5. Hydrants shall open in clockwise direction with arrow cast on top indicating direction of opening.
 - Hydrants shall be no less than 3', or more than 6' from the curb, or 4-1/2' to 6' from edge 6. of pavement.
 - Minimum cover 2'6". 7.
 - Finish painting not required. 8.
 - Minimum distance between valve and hydrant shall be 3'. 9.
 - 10. Hydrant valves open right.
 - Provide one hydrant wrench for each ten hydrants. 11.
 - Hydrant shall be Mueller Company "Super Centurion" Model 250, American Valve and Hydrant Company Model B-62-B, U.S. Pipe and Foundry Company, Model 12. "Metropolitan 250", or approved equal.

2.6 VALVE BOXES

- A. Provide at each buried valve.
- B. Cast iron extension type, suitable for minimum cover of 3'6" over the pipe.
- C. Minimum inside diameter at the top of 5", minimum riser wall thickness 1/4" and thickness at the top of 11/16".
- Have the word "WATER"; "SEWER"; "SLUDGE", etc., as applicable, cast into the cover. D.
- E. Provide Tyler Series 6850.

WATER DISTRIBUTION SYSTEM

- F. Where depth requires more than a two piece box use adjustable cast iron extensions.
- G. Coat box and cover with two (2) shop coats of bitumastic paint.

2.7 VALVE BOX PROTECTION RING

- Provide at each valve box a precast concrete protection ring. A.
- B. Provide two rings of No. 3 reinforcing steel, one 14" in diameter, and one 23" in diameter.
- C. Inside dimensions to be 9-1/4".
- D. Outside diameter to be 27".
- Provide 5" thickness at interior with a continuous slope to 2" thickness at the outside. E.
- F. Minimum weight of 110 lbs.

2.8 SERVICE SADDLE

Provide of the following materials: A.

Body	Type 304 Stainless Steel
Bales and Strips	Type 304 Stainless Steel
Studs	Type 304 Stainless Steel
Hardware	Type 304 Stainless Steel

- B. Provide double-strap for sizes 5" and larger.
- C. Provide Romac 304 and 305 or approved equal.
- D. Connect to pipeline using a 6" stainless steel nipple.
 - Do not use a threaded PVC connection. 1.

2.9 MISCELLANEOUS PARTS AND ACCESSORIES

Use standard commercial grade suitable for the type of installation or system involved, and A. conforming to the applicable standards and specifications of the AWWA.

PART 3 - EXECUTION

3.1 HANDLING

- Handle pipe accessories so as to ensure delivery to the trench in sound, undamaged condition: A.
 - Carry pipe into position do not drag. 1.
 - 2. 3. Use pinch bars or tongs for aligning or turning the pipe only on the bare end of the pipe.

 - Use care not to injure pipe linings. Do not damage pipe with chokers or lifting equipment. 4.
- Thoroughly clean interior of pipe and accessories before lowering pipe into trench. Keep clean Β. during laying operations by plugging or other method approved by the Engineer.
- C. Before installation, inspect each piece of pipe and each fitting for defects.

- 1. Material found to be defective before or after laying: Replace with sound material meeting the specified requirements, and without additional cost to the Owner.
- D. Gaskets: Store in a cool dark place until just prior to time of installation.

3.2 PIPE CUTTING

- A. Cut pipe neatly and without damage to the pipe.
- B. Unless otherwise recommended by the pipe manufacturer, and authorized by the Engineer, cut pipe with mechanical cutter only.
 - 1. Use wheel cutters when practicable.
 - 2. Cut plastic pipe square, remove all burrs, and grind bevel on end.

3.3 LOCATING

- A. Water mains shall be laid at least 10' edge-to-edge horizontally distanced from any existing or proposed sewer pipes.
- B. Should a 10' separation not be practical, then the water main may be located closer with South Carolina Department of Health and Environmental Control (SCDHEC) approval provided:
 - 1. It is laid in a separate trench.
 - 2. It is laid in the same trench with the water main located at one side on a bench of undisturbed earth.
 - 3. In either of the above cases, crown elevation of the sewer shall be at least 18" below invert elevation of water line.
- C. Where water lines cross over sewers, maintain 18" vertical separation between the outside of the sewer and the outside of the water line.
- D. Where water lines cross under sewers, each line shall be cast iron or ductile iron.
 - 1. A full length of water line shall be located over an existing sewer so that joints of each line will be as far from each other as possible.
 - 2. Where a new water main crosses a new sewer line, a full length of pipe shall be used for both the water main and sewer line and the crossing shall be arranged so that the joints of each line will be as far as possible from the point of crossing and each other.
- E. No water pipe shall pass through or come in contact with any part of a sewer manhole.
- F. Water lines shall not be laid within 25' horizontally from any portion of a wastewater tile or spray field.
- G. Water lines shall be located outside all contaminated areas, unless using pipe materials that will protect the water supply.
- H. No flushing device or drain directly connected to any type of sewer is allowed.
- I. No cross connections between water lines and any pipes, valves, tanks or pumps that are not part of the potable water system are allowed.
- J. Water lines may come in contact with storm sewers or catch basins if there are no other practical alternatives provided that ductile iron is used and no joints of the water line are within the storm sewer or catch basin, and, provided that the joints are located as far as possible from the storm sewer or catch basin.

K. Structures containing valves, blowoffs, meters, air release valves, etc., shall not be connected directly to any storm drainage or sewer system.

3.4 EXCAVATION AND BACKFILLING

- Comply with pertinent provisions of Section 312333 and Section 320117 of these Specifications. A.
- B. For P.E. Pipe, comply with manufacturer's recommendations.

3.5 ALIGNMENT OF PIPE

- Pipe lines intended to be straight shall be so laid. A.
- B. Where vertical or horizontal alignment requires deflection from straight line or grade, such deflection shall not exceed maximum deflection recommended by the pipe manufacturer.
- C. If alignment requires deflection exceeding recommended limits, furnish special bends or a sufficient number of shorter lengths of pipe to provide angular deflections within the allowable limits.

PLACING AND LAYING 3.6

- Α. General:
 - Lower pipe and accessories into trench by means of derrick, ropes, belt slings, or other 1. equipment approved by the Engineer.
 - 2. Do not dump or drop any of the materials of this Section into the trench.
 - Except where necessary in making connections to other lines, lay pipe with the bells 3. facing in the direction of laying.
 - Rest the full length of each section of pipe solidly on the pipe bed, with recesses 4. excavated to accommodate bells, couplings, and joints.
 - Take up and relay pipe that has the grade or joint disturbed after laving. 5.
 - Do not lay pipe in water, or when trench conditions are unsuitable for the work; keep 6. water out of the trench until jointing is completed.
 - 7. Securely close open ends of pipe, fittings, and valves when work is not in progress.
 - Where any part of coating or lining is damaged, repair to the approval of the Engineer 8. and at no additional cost to the Owner.
 - 9. Structures containing valves, blowoffs, meters, air release valves, etc., shall not be connected to any storm drain or sewer system.
- Β. Ductile iron pipe:
 - Mechanical, push on and flanged joints, install in accordance with ANSI/AWWA C600. 1.
 - 2. Gaskets: Handle, lubricate where necessary and install in strict accordance with manufacturer's recommendations.
- C. Flanged joints:
 - Provide true face flanges, field clean and fit with one full face gasket and make bolts up 1. finger tight.
 - 2. Use torque wrench to alternately tighten bolts 180° apart until full gasket flow and seal are secured.
 - 3. Bias cut or unusual refacing of any flange will not be acceptable.
- D. **Restrained** joints:
 - 1. 2. Install in accordance with manufacturer's instructions.
 - Tighten set screws to the manufacturer's rated torque using a torque wrench. If twist-off nuts are provided, tighten screws until nut breaks loose.

3.7 SETTING VALVES AND VALVE BOXES

- A. General:
 - 1. Center valve boxes on the valves, setting plumb.
 - 2. Tamp earth fill around each valve box to a distance of 4' on all sides, or to the undisturbed trench face if less than 4'.
 - 3. Install shaft extensions plumb without any binding.
 - 4. Fully open and close each valve to assure that all parts are in working condition.
 - 5. Place valve box protection ring around top of valve box as indicated on the plans.
 - a. Install ring level with top 1" above finished grade.
 - b. Top of ring to be level with or no more than 1" above the top of the valve box.

3.8 INSTALLATION OF HYDRANTS

A. General:

- 1. Inspect carefully, ensuring that all foreign material is removed from the barrel.
- 2. Set plumb and at such elevation that connecting pipe and distribution main have same depth of cover.
- 3. Install stone drainage bed and thrust blocking as indicated.
- 4. No connection or location of hydrant drains within 10' of sewer systems is allowed.
- 5. Hydrant leads to be a minimum of 6" in diameter and to include an auxiliary gate valve.
- 6. Fully open and close each hydrant to assure that all parts are in working condition.
- 7. Install blue hydrant reflector on centerline of paved roadway marking the perpendicular location of hydrant with reference to the road centerline.

3.9 HYDROSTATIC TESTING

A. General:

- 1. Pressure and leakage testing must be conducted in accordance with AWWA Standards C600.
- 2. Clean and flush line of air, dirt and foreign material.
- 3. Do not perform hydrostatic tests until at least five days after installation of concrete thrust blocking.
- 4. Test pump, pipe connection, pressure gauges, measuring devices and all other necessary appurtenances to conduct tests are to be provided by the Contractor.
- 5. Install brass corporation cocks at all high points that do not have permanent air vents. Corporation cocks are to be left in place and all costs for providing such cocks are to be borne by the Contractor.
- 6. Conduct tests on each line or valved section of line.
- 7. Test pressures to be 150 psi, or 1.5 times the maximum working pressure, whichever is greater, based on the elevation of the lowest point of the section under test and corrected to the elevation of the test gauge.
- 8. Do not test pipe at pressures exceeding manufacturer's recommendations.
- 9. The Contractor must provide documentation of the pressure and leakage tests. Documentation must include length of lines, diameter of pipe(s), amount of water required to fill line after test was performed, and amount of allowable leakage.
- 10. The witness to the hydrostatic testing is to be someone other than the Contractor or the utility installing the lines.
- B. Pressure tests:
 - 1. After the pipe is laid, the joints completed, and the trench backfilled, subject the newly laid piping and valved sections of the piping to the test pressure specified in Part A above.
 - 2. Open and close each valve within the section being tested several times during the test period.

- 3. Replace or remake joints showing leakage.
 - Remove cracked pipe, defective pipe, and cracked or defective joints, fittings a. and valves. Replace with sound material and repeat the test until results are satisfactory.
 - Make repair and replacement without additional cost to the Owner. b.
- C. Leakage test:
 - Conduct leakage test after the pressure test has been completed satisfactorily.
 - 1. 2. 3. Duration of each leakage test: At least two hours.
 - During the test, subject water lines to the test pressure specified in Part A above.
 - Leakage is defined as the quantity of water to be supplied into the newly laid pipe, or any valved or approved section thereof, necessary to maintain the specified leakage test pressure after the pipe has been filled with water and the air expelled. 4.
 - No piping installation will be accepted until the leakage is less than the number of gallons per hour as determined by the formula(s):
 - 1) Ductile iron piping:

 $L = S \times D \times \sqrt{P}$ /133,200; where

L = allowable leakage in gallons per hour;

- S =length of pipe tested in feet; D = nominal diameter of pipe in inches; and
- P = average test pressure psi gauge.
- 2) PVC piping:

 $L = N \times D \times \sqrt{P}$ /7400; where

- L = allowable leakage in gallons per hour;
- N = number of joints in pipeline being tested;
- D = nominal diameter of pipe in inches; and
- P = average test pressure psi gauge.
- b. When testing against closed metal-seated valves, an additional leakage per closed valve of 0.0078 gallons per hour per inch of nominal valve size will be allowed.
 - Should any test of pipe disclose leakage greater than that specified 1) above, locate and repair the defective joint or joints until the leakage is within the specified allowance, and at no additional cost to the Owner.
 - 2) Repair all visible leaks regardless of test results.

3.10 **STERILIZATION**

A. General:

- Upon completion of testing, sterilize all water lines to meet requirements of the South 1. Carolina Department of Health and Environmental Control.
- 2. Newly laid valves or other appurtenances shall be operated several times while line is filled with chlorinating agent.
- 3. Should initial treatment fail to meet results specified, repeat procedures until satisfactory results are obtained, at no additional cost to the Owner.
- All pipe taps, feeders, chemicals, etc., for sterilization shall be provided by the 4. Contractor.
- Β. Procedure:

1. Flush line to extent possible with available pressure and outlets, prior to sterilization. Hydrant openings required to produce proper flushing velocity at 40 psi are: a.

Pipe Size (Inches)	Hydrant Openings		
4 through 12	one 2-1/2"		
14 through 18	two 2-1/2"		
20	one 4-1/2"		

- 2. Comply with the latest revision of AWWA C651 and the following:
 - Apply chlorine as liquid chlorine or chlorine compound such as calcium a. hypochlorite with known chlorine content.
 - b. Apply through corporation cock in top of main located no greater than ten (10) sections from the beginning of section being sterilized.
 - Control water flow to a slow flow into the line. c.
 - Use proper feeder and flow regulator to introduce chlorinating agent. d.
 - Application rate shall be not less than 25 ppm and no greater than 50 ppm. e.
 - f. Retain chlorinated water in main not less than 24 hours.
 - At end of retention period, at least 10 ppm of chlorine shall remain in the water g. at the extreme end of section.
 - Dechlorinate and flush line thoroughly. h.
- C. Acceptance:
 - 1. Provide two separate samples for each sample location, taken at 24-hour intervals, free of coliform bacteria.
 - Contractor to take 1st and 2nd samples, deliver to South Carolina Department of Health and Environmental Control (SCDHEC) approved laboratory for testing. a.
 - The first and second sample results shall include the free chlorine residual at the b.
 - time the samples were collected.
 c. Notify SCDHEC to take a 3rd sample.
 At a minimum, sample locations shall be as required by SCDHEC and the following: 2.
 - The tie-in location of new and existing water lines. a.
 - The end of all dead end lines. b.
 - At intervals of no more than 1,200' for all new lines longer than 1,200' in length. c. All sample locations are to be given an identifying label and a corresponding 3. identification label is to be included on the record drawings indicating each sample

3.11 DECHLORINATION OF CHLORINATED STERILIZATION WATER

- A. Dechlorinate the chlorinated water used for sterilizing water lines.
- B. Apply dechlorinating agent as liquid sulfur dioxide or sulfite salts.
- C. Prepare a mixing chamber using a 55-gallon tank. Feed the discharge and dechlorinating agent at the bottom of the tank with overflow at the top.
- D. Discharge total chlorine residual to be less than 0.5 milligrams per liter.

3.12 **MEASUREMENT AND PAYMENT**

location.

No separate measurement or direct payment will be made for the items under this Section and all A. costs shall be included in the Lump Sum price bid for the project.

END OF SECTION 331100

SECTION 334100 - SEWERS: STORM DRAINAGE

PART 1 - GENERAL

1.1 Description

- Work included: Provide storm drainage sewer as shown on the drawings, specified herein, and A. needed for a complete and proper installation.
- B. Related work:
 - Documents affecting work of this Section include, but are not necessarily limited to, 1 General Conditions, Supplementary Conditions, and Sections in Division 1 of these specifications.
 - 2. 3.
 - Section 017123 Field Engineering. Section 312333 Trenching, Backfilling for Utilities Section 320117 Removing and Replacing Pavements
 - 4.

1.2 **Quality Assurance**

- Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the A. necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- All materials in this Section are to be manufactured in the United States. B.
- C. Contractor to be certified by the manufacturer for installation of HDPE pipe.

1.3 **Submittals**

- Comply with pertinent provisions of Section 013300. A.
- B. Product data: Within 35 calendar days after the Contractor has received the Owner's Notice to Proceed, submit:
 - Materials list of items proposed to be provided under this Section. 1.
 - Manufacturer's specifications and other data needed to prove compliance with the 2. specified requirements.

1.4 **Product Handling**

Comply with pertinent provisions of Section 016000. Α.

1.5 **Order And Acceptance Of Work**

Engineer shall direct on what line or street the Contractor shall work and the order thereof. A. Generally, work shall commence at the lower end of a system and proceed upgrade.

1.6 **Protection of Other Utilities**

- Location: A.
 - Approximate location of certain known underground lines is shown. 1.
 - 2. 3. Existing small lines not shown.
 - Locate small and other possible utility lines using electronic pipe finder, or other approved method.
 - 4. Excavate and expose existing underground utilities ahead of trenching operations.
- B. Repair or replace any damaged utility line or structure at no additional cost to Owner.

C. The Contractor will take all reasourceable care to avoid disturbing and or damaging the existing fiber optic cable shown on the construction plans. The Contractor will bear the cost of any repairs to the cable or any damages suffered by its users from its damage.

1.7 **Conflicting Utilities**

- A. Remove and/or relay conflicting utilities, when so directed by the Engineer, at the expense of the Owner.
- B. Where alterations to existing utilities are shown to avoid conflicts, make alterations at no cost to Owner.

PART 2 - PRODUCTS

2.1 General

- Pipe shall be subject to Engineer's observation, at plant, trench or other point of delivery, for Α. culling and rejecting pipe, independent of laboratory tests, not conforming to specifications.
- B. Rejected pipe will be marked by the Engineer and Contractor shall remove it from project site.

2.2 **Pipe and Materials**

- High density polyethylene pipe (HDPE): A.
 - Manufacture from High Density Polyethylene (HDPE) virgin compounds conforming to 1 cell classifications as listed in ÅASHTO M-252 and M-294, Type S, MP7-97 (Type D and DP).
 - Form with annular corrugation, conforming to AASHTO M-294. 2.
 - Furnish a Certificate of Compliance to the Engineer for each type of plastic pipe a. furnished.
 - Provide integrated bell and spigot joints with ASTM F-477 rubber gasket on b. spigot end.
- B. Reinforced concrete pipe (RCP)
 - 1. 2. Pipe to comply with ASTM C-76 for Class III, Wall B.
 - Furnish pipe with joints designed for flexible watertight gaskets.
 - Provide integral bell and spigot joints. 3.
 - Provide gaskets on all pipe: 4.
 - Ŏ-ring rubber complying with ASTM C-443; or a.
 - Preformed plastic gaskets complying with AASHTO Designation M-198 or Type B, Flexible Plastic Gasket. b.

2.3 **Drainage Structures**

- A. Use precast concrete or built-in-place masonry units, except for yard inlets which are described in Section 2.8.
- Precast drop inlets, catch basins, curb inlets, etc. shall be as manufactured by Tindall B. Concrete Products, Inc. or equal units by others.
- C. Inlet Castings.
 - Provide gray iron castings, complying with ASTM A-48, Class 35B iron and AASHTO 1. M-306.
 - 2. Provide a minimum recycled material content of 75 consisting of post-consumer material.

- 3. Provide uniform quality, free from sand holes, gas holes, shrinkage, cracks and other surface defects.
- 4. Grind smooth and clean by shot blasting.
- 5. Cast or machine bearing surfaces between grates and frames with such precision to prevent rocking.
- 6. Casting dimensional tolerances shall be +/- 1/16" per foot.
- 7. All published casting weights may vary no more than +/-5%.
- 8. Conduct a first article proof load test and provide the results of that proof load upon request.
 - Conduct in accordance with the method and procedure that is outlined in a. AASHTO M-306.
 - Test on a suitable and calibrated load testing machine. Casting shall hold a b. 40,000 pound proof load for one minute without experiencing any cracks or detrimental permanent deformation.
 - Test results for each lot of castings be maintained Foundry to for a minimum of с. seven years. Make available upon request. Inspect in accordance with AASHTO M-306.
- 9.
- 10. Furnish a foundry certification stating that samples representing each lot have been tested, inspected, and are in accordance with this specification.
- Each casting shall be identifiable and show, at a minimum, the following: name of the 11. producing foundry, country of manufacture, ASTM material designation, recycle symbol, individual part number, cast or heat date.
- Častings shall include all lettering as shown on the specification drawings. 12.
- Patterns and weights shall be as indicated on the Contract Drawings. 13.
- 14. Coat frames and covers with two (2) shop coats of water based bitumastic paint, MC4 MPFC by Molecular Coating Specialist of Cedar Hill, Texas or approved equal.
- 15. All castings are to be manufactured in the United States.
- D. Trench Drain.
 - Provide prefabricated modular trench drains with a top grate which will be pedestrian 1. rated.
 - 2. The drains will have a removable grating to allow easy maintenance access.
 - 3. Use "Sportsedge Polydrain" or approved equal.

2.4 **Manholes**

- Use precast manholes: A.
 - 1. Provide reinforced precast concrete ring and eccentric cone sections complying with ASTM C-478 and the following.
 - Use portland cement complying with ASTM C-150, Type II.
 - 2. 3. Cast ladder rungs into the units.
 - 4. Provide tongue and groove or o-ring rubber gasketed joints.
 - Use vulcanized butyl rubber sealant with tongue and groove joints. 5.
 - 6. Provide flat slab tops where manhole depth is less than 4'0".
- Steps: Β.
 - Provide polypropylene plastic steps reinforced with 3/8" diameter steel rod, M.S.A. Industries, Inc. Model PS-K, or equal. 1.
 - 2. Provide steps having non-skid top surfaces, safety slope at each end, minimum width of 10" and not less than 5" projection from wall.
- C. Frames and covers:
 - Provide gray iron castings, complying with ASTM A 48, Class 35B iron and AASHTO 1. M-306.
 - Provide a minimum recycled material content of 75 consisting of post-consumer 2. material.

- 3. Castings shall be of uniform quality, free from sand holes, gas holes, shrinkage, cracks and other surface defects ground smooth and clean by shot blasting.
- 4. Cast or machine bearing surfaces between rings and covers with such precision to prevent rocking.
- 5. Casting dimensional tolerances shall be $\pm 1/16$ per foot.
- 6. Conduct a first article proof load test and make the results of that proof load available upon request.
 - a. Conduct in accordance with the method and procedure outlined in AASHTO M-306.
 - b. Test casting on a suitable and calibrated load testing machine. Casting shall hold a 40,000 pound proof load for one minute without experiencing any cracks or detrimental permanent deformation.
 - c. Maintain test results for each lot of castings by the foundry for a minimum of seven years. Make available upon request.
- 7. Provide inspections in accordance with AASHTO M-306 and furnish results of these tests upon request.
- 8. Furnish a foundry certification stating that samples representing each lot have been tested, inspected, and are in accordance with this specification.
- 9. Each casting shall be identifiable and show, at a minimum, the following: name of the producing foundry, country of manufacturer, ASTM material designation, recycle symbol, individual part number, cast or heat date.
- 10. Provide frames and covers weighing not less than 285 lbs. with inside opening between 22" and 24".
- 11. Provide circular cover with two "pick" holes, one 1" diameter vent hole, and weighing not less than 130 lbs.
- 12. Covers to have the words "STORM SEWER" cast in the metal.
- 13. Coat frames and covers with two (2) shop coats of water based bitumastic paint, MC4 MPFC by Molecular Coating Specialist of Cedar Hill, Texas or approved equal.
- 14. All castings are to be manufactured in the United States.
- 15. Provide East Jordan Iron Works, Inc. Model V-1384 or approved equal.

2.5 Other Materials

A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Engineer.

PART 3 - EXECUTION

3.1 Laying Out Work

- A. Provide all materials, labor, instruments, etc. required to lay out Work.
- B. Prepare "cut sheets" under direct supervision of the Engineer.
- C. Exercise proper precaution to verify figures on the drawings prior to laying out Work. Contractor will be held responsible for any errors therein that otherwise might have been avoided.
- D. Promptly inform Engineer of errors or discrepancies found, in order that proper corrections may be made.

3.2 Installation

- A. Trench, backfill and compact for the work of this Section in strict accordance with pertinent provisions of these specifications, and the following requirements:
 - 1. Maximum trench widths, depths and bedding methods.

- Install all sewers complying with tables for depths of cut and class of bedding a.
- included hereinafter. Where trenches are excavated beyond specified widths, or trench walls collapse, lay sewer complying with requirements of the next better class of bedding at no additional cost to the Owner. Include cost of special bedding and tamping in unit prices bid for sewer. b.
- c.
- 2. Reinforced concrete pipe (RCP) - Type III:

MAXIMUM DEPTHS IN FEET						
		CLASS OF BEDDING				
		D	С	В	Α	
	—	Flat	Type 1	Special	Special	
Pipe	Max. Trench	Bottom	or	Earth	Concrete	
Size	Width	Trench	Type 2	Bedding	Bedding	
12"	2'-6"	7.5	11.5	20	30	
15"	2'-10"	7.0	11.0	15	30	
18"	3'-2"	10.5	16.5	22.5	30	
21"	3'-6"	9.0	14.0	22	30	
24"	3'-10"	9.0	13.5	22	30	
30"	4'-7"	10.0	14.5	20.5	30	
36"	5'-5"	10.0	13.5	18	30	
42"	6'-1"	11.0	14.5	19.5	30	
48"	6'-6"	12.0	15.5	21	30	

High density polyethylene pipe (HDPE) to be installed per ASTM D2321 and AASHTO Section 30 requirements. 3.

4.	High density	polvethylene	pipe (HDPE) and	polyvinyl chloride p	ipe (PVC):
	0				$\mathbf{r} = \mathbf{v} + \mathbf{r} + \mathbf{v}$

MAXIMUM DEPTHS IN FEET						
		CLASS OF BEDDING				
		D	С	В	Α	
	Min.	Flat	Type 1		Special	
Pipe	Trench	Bottom	or	TYPE 2*	Concrete	
Size	Width	Trench	Type 2	ONLY	Bedding	
4"	2'0"	**	**	30	**	
6"	2'2"	**	**	30	**	
8"	2'4"	**	**	30	**	
10"	2'6"	**	**	30	**	
12"	3'0"	**	**	30	**	
15"	3'3"	**	**	30	**	
18"	3'6"	**	**	30	**	
24"	4'0"	**	**	30	**	
30"	5'6"	**	**	30	**	
36"	6'6"	**	**	30	**	
42"	7'0''	**	**	30	**	
48"	7'8''	**	**	30	**	
* Class B Bedding (Type 2) shall extend to the top of the pipe.						
** Do not use this Class of bedding for this pipe size and trench width.						

03/16/12

- B. Bedding and tamping requirements for the various classes of bedding shall comply with the following specifications:
 - 1. Člass A Bedding Excavate trench to one-fourth of nominal pipe diameter below pipe grade; lay pipe to grade on concrete blocking; place 2500 psi concrete around pipe for full width of trench up to one-fourth nominal pipe diameter above the invert.
 - 2. Class B (Type 1) Bedding Shape bottom of trench to a level two inches below bottom of pipe; bring bed to proper level by spreading and thoroughly tamping fine granulated moist earth and sand to conform accurately to one-fourth circumference of pipe barrel; provide suitable material if not available from trench excavation; lay pipe, backfill and hand tamp in thin layers to height three-fourths of pipe diameter, using material same as bedding material; complete trench backfill complying with Section 02221.
 - a. Bring trenches excavated to excess depths to grade with stone or gravel bedding at the Contractor's expense.
 - b. Exercise care to avoid disturbing pipe grade, alignment or joints at all times.
 - c. In lieu of this class bedding, Contractor may elect to use Class B (Type 2) bedding.
 - 3. Class B (Type 2) Bedding Undercut 4" below pipe barrel, full width of trench; bring pipe to grade with crushed stone complying with SCDOT Aggregate No. 5; except for HDPE and PVC, use SCDOT Aggregate No. 57.
 - a. For RCP pipe, place stone in 6" layers to mid-point of pipe, compacting by slicing with shovel.
 - b. For HDPE and PVC pipe, place stone (Aggregate No. 57) in 6" layers to the top of the pipe, compacting by slicing with shovel.
 - c. Complete trench backfill complying with Section 02221.
 - 4. Class C (Type 1) bedding Shape trench bottom by hand to conform accurately to bottom one-quarter of pipe barrel circumference.
 - a. Use Class C (Type 2) bedding if unable to properly shape trench bottom.
 - b. If shaping is not performed accurately, the Contractor will be required to use Class C (Type 2) bedding.
 - 5. Class C (Type 2) Bedding Undercut 4" below bottom of pipe barrel; full width of trench; bring pipe to grade with compacted crushed stone complying with SCDOT Aggregate No. 5; lay pipe; place stone in six-inch layers to quarter-point of pipe, compacting by slicing with shovel; complete backfill complying with Section 02221.
 - 6. Class D Bedding:
 - a. For RCP Excavate bell holes in flat bottomed trench; lay pipe; backfill complying with Section 02221.
 - 7. Where piping is installed under roadways, use controlled density fill for trench backfill to a distance of two (2) feet beyond edge of pavement.
- C. Pipe laying:
 - 1. General:
 - a. Protect pipe during handling against shocks and free fall. Remove extraneous material from the pipe interior.
 - b. Lay pipe by proceeding upgrade with the spigot ends of bell-and-spigot pipe pointing in direction of flow.
 - c. Lay each pipe accurately to the indicated line and grade, aligning so the sewer has a uniform invert.
 - d. Continually clear interior of the pipe free from foreign material.
 - e. Before making pipe joints, clean and dry all surfaces of the pipe to be joined.
 - f. Use gasket lubricants or joint primers as recommended by the pipe manufacturer.
 - g. Place, fit, join and adjust the joints to obtain the degree of water tightness required.
 - 2. High density polyethylene pipe (HDPE):
 - a. Provide proper equipment for hoisting and lowering pipe into the trench without damaging the pipe or disturbing the bedding and the sides of the trench.
 - b. Remove shipping collars prior to placing pipe in trench.

- c.
- d.
- Lay pipe with the green stripe up. Align the joint and push the spigot home. Use a bar and wood block on larger diameters when necessary making sure the e. block protects the pipe end from the bar.
- When pushing the joint home, make sure the bedding material is not pulled into the bell by the spigot. f.
- Take up and re-lay any pipe which is not in alignment or which shows any undue g. settlement after laying, without additional compensation.
- 3. Reinforced concrete pipe (RCP):
 - Select proper bedding class from preceding table as determined by pipe size and a. depth of cut.
 - Provide uniform and continuous support of pipe barrel between bell holes when b. utilizing Class D bedding.
 - c. Joints:
 - 1) O-ring gaskets: Lubricate and install gaskets in accordance with manufacturer's recommendations.
 - Align the pipe with previously installed pipe, and push the joint a) together. Using feeler gage, determine that gasket is properly fitted.
 - 2) Preformed plastic gaskets:
 - Apply primer to clean, dry joint surfaces and allow to dry. a)
 - Attach plastic strips end to end to the leading edge of the tongue, b) forming a continuous gasket around the entire circumference of the joint.
 - Align pipe with previously laid joint and push the joint together. c) Sufficient pressure shall be applied to assure the joint is home and slight squeeze out of the gasket materials occurs.

3.3 **Manholes And Precast Structures**

- A. Set bases level so that walls will be plumb.
- B. Apply joint sealer, or ring gasket to wall section(s), set firmly in place to assure watertight joints.
- C. Form manhole invert channels directly in the concrete of the manhole base, with mortar, or by laying full section sewer pipe through the manhole and breaking out the top half after surrounding concrete has hardened. Smooth the floor of the manhole outside the channels, and slope toward the channels at not less than 1" per foot nor more than 2" per foot.
 - 1. Shape the invert channels to be smooth and semicircular, conforming to the inside of the adjacent sewer section.
 - 2. Make changes in direction of flow with a smooth curve of as large a radius as the size of the manhole will permit.
 - Make changes in size and grade of channels smoothly and evenly. 3.
 - 4. Slope invert uniformly from invert of inlet to invert of outlet.

3.4 **Built-In-Place Structures**

- Construct bottom of all structures using 3000 psi concrete complying with Section 030000, to A. dimensions indicated on the Contract Drawings.
- Lay brick carefully embedded in mortar on bottom and ends. B.
- C. Plaster outside of structures with a smooth coat of cement mortar.
- D. Set frames and tops to grades indicated, mortar into place.

- A. General:
 - 1. Clean and prepare for observation each block or section of sewer upon completion, or at such other time as the Engineer may direct.
 - 2. Each section between manholes shall show a full circle of light when viewed from either end.
 - 3. Repair all visible leaks.
 - 4. Correct broken or cracked pipe, mislaid pipe and other defects.
 - 5. All repairs, relaying of sewers, etc. required to bring the sewers to specified status shall be made at no additional cost to the Owner.

3.6 Measurement and Payment

A. No separate measurement or direct payment will be made for the items under this Section and all costs for same shall be included in the lump sum price bid for the project.

END OF SECTION 334100