



DISCOVERY I
1ST, 3RD, 4TH, 5TH FLOORS UPFIT

JPA PROJECT No. 11USC396
USC PROJECT No. H27-6080-CA

BID DOCUMENTS
PROJECT MANUAL

OCTOBER 15, 2012

Jenkins•Peer Architects
112 South Tryon Street
Charlotte, NC 28284
704/372-6665

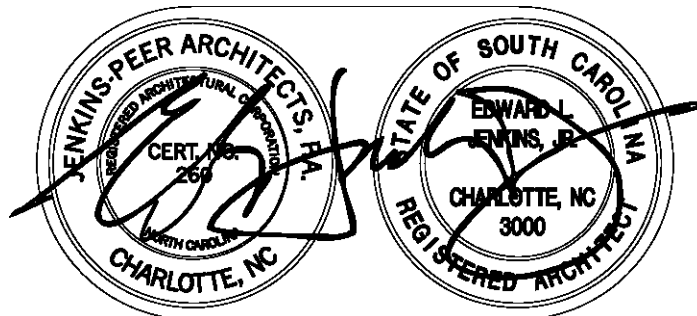


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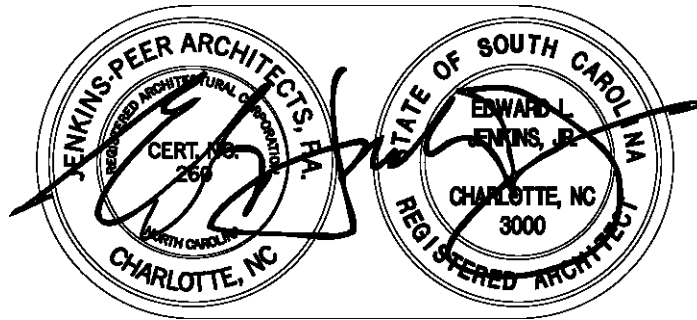
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RMF Engineering
194 Seven Farms Drive
Suite G
Charleston, SC 29492
(843)971-9639

RMF Project No. 311068.B0
Date: 10/8/12

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RMF Engineering
194 Seven Farms Drive
Suite G
Charleston, SC 29492
(843)971-9639

RMF Project No. 311068.B0
Date: 10/8/12

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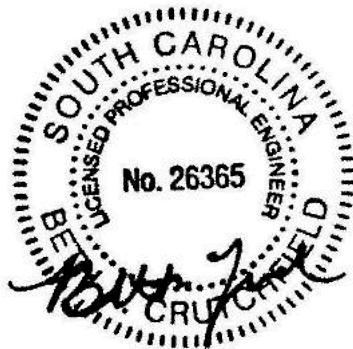


RMF Engineering
194 Seven Farms Drive
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Charleston, SC 29492
(843)971-9639

RMF Project No. 311068.B0
Date: 10/8/12

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RMF Engineering
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(843)971-9639

RMF Project No. 311068.B0
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RMF Engineering
194 Seven Farms Drive
Suite G
Charleston, SC 29492
(843)971-9639

RMF Project No. 311068.B0
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RMF Engineering
194 Seven Farms Drive
Suite G
Charleston, SC 29492
(843)971-9639

RMF Project No. 311068.B0
Date: 10/8/12

DISCOVERY I – 1st, 3rd, 4th, 5th FLOORS UPFIT

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END OF LIST

**SE-310
REQUEST FOR ADVERTISEMENT**

2011 Edition
Rev. 7/20/2011

PROJECT NAME: Discovery One Upfit

PROJECT NUMBER: H27-6080-CA

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: \$9,000,000 - \$11,000,000

DESCRIPTION OF PROJECT: Project consists of approximately 58,000sf of office, wet laboratory and dry laboratory upfits in the partially occupied five story Discovery I Biomedical Research shell building on the USC Columbia campus. Significant portions of the work include partitions, finishes, laboratory equipment and furnishings and mechanical equipment. A site visit will occur as part of the Pre-Bid Conference. One additional site visit will be scheduled after the Pre-Bid Conference. Bidders are encouraged to visit

A/E NAME: Jenkins Peer Architects

A/E CONTACT: Glenn Johnson

A/E ADDRESS: Street/PO Box: 112 South Tryon Street, Suite 1300

City: Charlotte

State: NC ZIP: 28284-

EMAIL: gjohnson@jenkinspeer.com

TELEPHONE: 704-940-6925

FAX: _____

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

BIDDING DOCUMENTS/PLANS MAY BE OBTAINED FROM: http://purchasing.sc.edu

PLAN DEPOSIT AMOUNT: \$0.00 IS DEPOSIT REFUNDABLE: Yes No

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):*

It is the Contractor's responsibility to download specifications, plans, addenda and award from purchasing website http://purchasing.sc.edu

PRE-BID CONFERENCE? Yes No MANDATORY ATTENDANCE? Yes No

DATE: 11/7/2012 TIME: 1:00 pm. PLACE: 743 Greene Street, Conference Room 53, Columbia, SC 29208.

AGENCY: University of South Carolina

NAME OF AGENCY PROCUREMENT OFFICER: Juaquana Brookins, Procurement Specialist

ADDRESS: Street/PO Box: 743 Greene Street

City: Columbia

State: SC ZIP: 29208-

EMAIL: jbrookins@fmc.sc.edu

TELEPHONE: 803-777-5812

FAX: _____

BID CLOSING DATE: 11/29/2012 TIME: 1:00 p.m. LOCATION: 743 Greene Street, Conference Room 53, Columbia, SC 29208.

BID DELIVERY ADDRESSES:

HAND-DELIVERY:

Attn: Juaquana Brookins

USC Facilities Management Center

743 Greene Street

Columbia, SC 29208

MAIL SERVICE:

Attn: Juaquana Brookins

USC Facilities Management Center

743 Greene Street

Columbia, SC 29208

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

SE-310
REQUEST FOR ADVERTISEMENT

2011 Edition
Rev. 7/20/2011

APPROVED BY (*Office of State Engineer*): _____

DATE: _____

OSE FORM 00201**STANDARD SUPPLEMENTAL INSTRUCTIONS TO BIDDERS**

OWNER: University of South Carolina**PROJECT NUMBER:** H27-6080-CA**PROJECT NAME:** Discovery One Upfit**PROJECT LOCATION:** Columbia, SC**PROCUREMENT OFFICER:** Juaquana Brookins**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 A201, 2007 Edition as modified by OSE Form 00811 – Standard Supplementary Conditions.

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 pre-bid 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.

OSE FORM 00201**STANDARD SUPPLEMENTAL INSTRUCTIONS TO BIDDERS**

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

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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

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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.

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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.

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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.

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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-Authority 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.”*

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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: www.sctax.org

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 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

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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): <http://purchasing.sc.edu>

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.

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STANDARD SUPPLEMENTAL INSTRUCTIONS TO BIDDERS

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, Phone: (803) 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

N/A

-
-
-
-

END OF DOCUMENT

SECTION 00 31 00 - AVAILABLE PROJECT INFORMATION

PART 1 - GENERAL

1.1 EXISTING CONDITIONS

- A. Certain information relating to existing surface and subsurface conditions and structures is available to bidders but will not be part of the Contract Documents, as follows:
- B. Hazardous Material Surveys: Entitled Hazmat Survey, Sample Analysis and Asbestos Analysis of Bulk Materials, dated September 12, 2012 are included in the Project Manual.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

FM00407008

USC Work Order

Description HAZMAT SURVEY

Site	COLUMBIA	Assigned To	JPROVENCE
Building	230 DISCOVERY I BUILDING	Crew	HAZMAT
Floor	Room:	Start Date	Priority 3
Equipment		Due date	27-SEP-12
		Request Date	13-SEP-12
		by	JABRAMS

Request #	FM00407008	Description	HAZMAT SURVEY
Parent WO #			

CP Number	CP00291151	DISCOVERY 1 UPFIT
------------------	------------	-------------------

State/Internal Project Number	H27-6080
--------------------------------------	----------

Requestor	ABRAMS,JEFF	Project Manager	ABRAMS, JEFFREY R
Telephone	239-8074	Telephone	777-3594
Alternate		Estimated Cost	\$ 0.00
Telephone		Billing	FIXED PRICE
Non-Available Time		53100-W777-57120	(DISC I THIRD FOURTH FIFTH FLOORS UPFIT)

Task List
 THIS IS FOR SURVEYING FOR THE UPFIT OF FLOORS 3,4,5 AND SOME ADDITIONAL WORK ON FIRST FLOOR AND ROOF.
 THANK YOU, JEFF ABRAMS, SEPT 13, 2012

DATE WORK STARTED	CAUSE
DATE WORK COMPLETED	CONDITION
EQUIPMENT	
CLOSING REMARKS	
BENCHSTOCK MATERIALS	
Qty	Description
	Price Per Unit

Supervisor's Approval _____

Note Date	Title
17-SEP-12	HAZMAT SURVEY RESULTS
SURVEY DATE: SEPT-12-12	
INSPECTOR #: DARRYL WASHINGTON II BI-00568	
STATUS: THE FOLLOWING MATERIALS HAVE BEEN TESTED FOR ASBESTOS CONTAINING MATERIALS RESULTS FOLLOWS	
SHEET ROCK- NEGATIVE FOR ASBESTOS CONTAINING MATERIALS	
JOINT COMPOUND- NEGATIVE FOR ASBESTOS CONTAINING MATERIALS	
FIREPROOFING- NEGATIVE FOR ASBESTOS CONTAINING MATERIALS	
NO SUSPECT MATERIALS IN PLACE. THE FLOORING IN THE BUILDING IS CONCRETE WITH A METAL DECKING IN PLACE. INSPECTORS DID NOT DISTURB ANY HVAC SYSTEM COMPONENTS DUE TO BEING NEW IN PLACE, BUT IF CONTRACTOR HAS TO TIE INTO DUCT WHERE THE HVAC MASTIC IS LOCATED PLEASE CONTACT HAZMAT TO TEST MATERIAL. IT APPEARS THAT THIS BUILDING DOES NOT HAVE ANY SUSPECT MATERIALS IN PLACE.	

IF YOU ENCOUNTER ANY SUSPECT MATERIALS IN PLACE AND DEEM IT SUSPECT FOR ASBESTOS AND IT IS NOT LISTED ABOVE PLEASE STOP WORK AND CALL THE ASBESTOS PROGRAM MANAGER FOR FURTHER TESTING OR ABATEMENT

REFER TO THE SURVEY RESULTS DOCUMENT ATTACHED TO THE WO FOR DETAILED INFORMATION.



EMSL ANALYTICAL, INC.
LABORATORY • PRODUCTS • TRAINING

Chain of Custody

EMSL Order Number (Lab Use Only):

5053

EMSL ANALYTICAL, INC.
200 ROUTE 130 NORTH
CINNAMINSON, NJ 08077
PHONE: (800) 220-3675
FAX: (856) 786-5974

Company: <i>University of South Carolina</i>		EMSL-Bill to: <input type="checkbox"/> Same <input type="checkbox"/> Different If Bill to is Different note instructions in Comments**	
Street: <i>743 Green St</i>		Third Party Billing requires written authorization from third party	
City: <i>Columbia</i>	State/Province: <i>SC</i>	Zip/Postal Code:	Country:
Report To (Name): <i>ED Pitts + Darryl Washington</i>		Fax #:	
Telephone #: <i>803-917-0517 + 803-917-0241</i>		Email Address:	
Project Name/Number: <i>Discovery</i>			
Please Provide Results: <input type="checkbox"/> Fax <input checked="" type="checkbox"/> Email		Purchase Order:	U.S. State Samples Taken:
Turnaround Time (TAT) Options* - Please Check			
<input type="checkbox"/> 3 Hour	<input type="checkbox"/> 6 Hour	<input checked="" type="checkbox"/> 24 Hour	<input type="checkbox"/> 48 Hour <input type="checkbox"/> 72 Hour <input type="checkbox"/> 96 Hour <input type="checkbox"/> 1 Week <input type="checkbox"/> 2 Week
*For RUSH TAT's Please Call Ahead to Confirm Lab Hours and Availability. Not all TAT options are valid for every test. Materials Science and IAQ TATs are in Business Days rather than Hours (i.e. 24 Hour = End of Next Business Day)			
Asbestos			
PCM - Air <input type="checkbox"/> NIOSH 7400 <input type="checkbox"/> w/ 8hr. TWA TEM - Air <input type="checkbox"/> 4-4.5hr TAT (AHERA ONLY) <input type="checkbox"/> AHERA 40 CFR, Part 763 <input type="checkbox"/> NIOSH 7402 <input type="checkbox"/> EPA Level II <input type="checkbox"/> ISO 10312 TEM - Water Fibers $\geq 10\mu\text{m}$ <input type="checkbox"/> Waste <input type="checkbox"/> Drinking All Fiber Sizes <input type="checkbox"/> Waste <input type="checkbox"/> Drinking		PLM - Bulk <input checked="" type="checkbox"/> PLM EPA 600/R-93/116 <input type="checkbox"/> PLM EPA NOB (<1%) <input type="checkbox"/> NYS 198.1 (friable-NY) <input type="checkbox"/> NYS 198.6 (non-friable-NY) Point Count <input type="checkbox"/> 400 (<0.25%) <input type="checkbox"/> 1000 (<0.1%) Point Count w/ Gravimetric <input type="checkbox"/> 400 (<0.25%) <input type="checkbox"/> 1000 (<0.1%) TEM - Dust <input type="checkbox"/> Microvac - ASTM D 5755 <input type="checkbox"/> Wipe-ASTM D6480	
		TEM - Bulk <input type="checkbox"/> TEM EPA NOB <input type="checkbox"/> NYS NOB 198.4 (non-friable-NY) <input type="checkbox"/> Chatfield SOP Soil/Rock/Vermiculite <input type="checkbox"/> PLM CARB 435 - A (0.25% sensitivity) <input type="checkbox"/> PLM CARB 435 - B (0.1% sensitivity) <input type="checkbox"/> TEM CARB 435 - B (0.1% sensitivity) <input type="checkbox"/> EPA Reg. 1 Screening Protocol (Qualitative) Other:	
Lead (Pb)		Materials Science	
Flame Atomic Absorption <input type="checkbox"/> Chips SW846-7000B or AOAC 974.02 <input type="checkbox"/> Soil SW846-7000B/7420 <input type="checkbox"/> Air NIOSH 7082 <input type="checkbox"/> Wastewater SM3111B or SW846-7000B/7420 <input type="checkbox"/> ASTM Wipe SW846-7000B/7420 <input type="checkbox"/> non ASTM Wipe SW846-7000B/7420 <input type="checkbox"/> TCLP SW846-1311/7420/SM 3111B		ICP <input type="checkbox"/> Air NIOSH 7300 Modified <input type="checkbox"/> non ASTM Wipe SW846-6010B or C <input type="checkbox"/> ASTM Wipe SW846-6010B or C <input type="checkbox"/> Soil SW846-6010 B or C <input type="checkbox"/> Waste Water SW846-6010B or C <input type="checkbox"/> TCLP SW846-6010B or C Other: <input type="checkbox"/>	
Graphite Furnace Atomic Absorption <input type="checkbox"/> Soil SW846-7421 <input type="checkbox"/> Wastewater EPA 200.9 <input type="checkbox"/> Air NIOSH 7105 <input type="checkbox"/> Drinking Water EPA 200.9			
Microbiology			
Wipe and Bulk Samples <input type="checkbox"/> Mold & Fungi - Direct Examination <input type="checkbox"/> Mold & Fungi Culture (Genus Only) <input type="checkbox"/> Mold & Fungi Culture (Genus & Species) <input type="checkbox"/> Bacterial Count & ID (Up to Three Types) <input type="checkbox"/> Bacterial Count & ID (Up to Five Types) <input type="checkbox"/> MRSA <input type="checkbox"/> <i>Pseudomonas aeruginosa</i>		Air Samples <input type="checkbox"/> Mold & Fungi (Spore Trap) <input type="checkbox"/> Mold & Fungi Culture (Genus Only) <input type="checkbox"/> Mold & Fungi (Genus & Species) <input type="checkbox"/> Bacterial Culture & ID (Up to Three Types) <input type="checkbox"/> Bacterial Culture & ID (Up to Five Types) <input type="checkbox"/> Endotoxin Testing Real Time Q-PCR (See Analytical Guide for Code) Code:	
Water Samples <input type="checkbox"/> Total Coliform & E.coli (P/A) <input type="checkbox"/> Fecal Coliform (SM 9222D) <input type="checkbox"/> Sewage Screen <input type="checkbox"/> Heterotrophic Plate Count (SM 9215)		Legionella <input type="checkbox"/> Level 1 <input type="checkbox"/> Level 2 <input type="checkbox"/> Level 3 <input type="checkbox"/> Level 4 Other: <input type="checkbox"/>	
**Comments/Special Instructions:			
Client Sample #'s		Total # of Samples:	
Relinquished (Client):		Date:	
Received (Lab): <i>KE</i>		Date: <i>9/14</i>	
		Time: <i>10:15</i>	



51053

Reset Form Print Form

Building # DISCOVERY

Sample Analysis Type of Analysis: Lead / Asbestos Date: 09-12-2012

Turn Around Time 24 HRS

Area	Sample ID	Material Sampled	Material Location	F/NF	Cond	Quantity	Pot to Disturb
A	1	FIRE PROOFING	DISCOVERY 3RD FLOOR	F	G	>5000 SQFT	LOW
A	2	FIRE PROOFING	DISCOVERY 3RD FLOOR	F	G	>5000 SQFT	LOW
A	3	FIRE PROOFING	DISCOVERY 3RD FLOOR	F	G	>5000 SQFT	LOW
A	4	FIRE PROOFING	DISCOVERY 3RD FLOOR	F	G	>5000 SQFT	LOW
A	5	FIRE PROOFING	DISCOVERY 3RD FLOOR	F	G	>5000 SQFT	LOW
A	6	FIRE PROOFING	DISCOVERY 4TH FLOOR	F	G	>5000 SQFT	LOW
A	7	FIRE PROOFING	DISCOVERY 4TH FLOOR	F	G	>5000 SQFT	LOW
A	8	FIRE PROOFING	DISCOVERY 4TH FLOOR	F	G	>5000 SQFT	LOW
A	9	FIRE PROOFING	DISCOVERY 4TH FLOOR	F	G	>5000 SQFT	LOW
A	10	FIRE PROOFING	DISCOVERY 4TH FLOOR	F	G	>5000 SQFT	LOW

License # # 00568

FM# TBD

Signature

Requestor ABRAMS, JEFF

Send lab results in PDF format as soon as possible to:

Ed Pitts 803-777-3296

720 College St.
Columbia, SC 29208

EHP@fmc.sc.edu

Darryl Washington 803-777-2399

720 College St.
Columbia, SC 29208

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Ty Russell 803-777-1208

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NTRussell@fmc.sc.edu

Fax # 803-777-3990



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Building # DISCOVERYSample Analysis Type of Analysis: Lead / Asbestos Date: 09-12-2012Turn Around Time 24 HRS

Area	Sample ID	Material Sampled	Material Location	F/NF	Cond	Quantity	Pot to Disturb
A	11	FIRE PROOFING	DISCOVERY 5TH FLOOR	F	G	>5000 SQFT	LOW
A	12	FIRE PROOFING	DISCOVERY 5TH FLOOR	F	G	>5000 SQFT	LOW
A	13	FIRE PROOFING	DISCOVERY 5TH FLOOR	F	G	>5000 SQFT	LOW
A	14	FIRE PROOFING	DISCOVERY 5TH FLOOR	F	G	>5000 SQFT	LOW
A	15	FIRE PROOFING	DISCOVERY 5TH FLOOR	F	G	>5000 SQFT	LOW
B	16	SHEET ROCK	DISCOVERY 3RD FLOOR SE COLUM	F	G	>5000 SQFT	LOW
B	17	SHEET ROCK	DISCOVERY 3RD FLOOR @ ELEVATOR	F	G	>5000 SQFT	LOW
B	18	SHEET ROCK	DISCOVERY 3RD FLOOR @ ELEVATOR SHAFT	F	G	>5000 SQFT	LOW
B	19	SHEET ROCK	DISCOVERY 3RD FLOOR SW WALL BY STAIR CASE	F	G	>5000 SQFT	LOW
B	20	SHEET ROCK	DISCOVERY 3RD FLOOR NW WALL	F	G	>5000 SQFT	LOW

License # # 00568

FM#

Signature

Requestor ABRAMS, JEFF

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Building # DISCOVERY

Sample Analysis Type of Analysis: Lead / Asbestos Date: 09-12-2012

Turn Around Time 24 HRS

Area	Sample ID	Material Sampled	Material Location	F/NF	Cond	Quantity	Pot to Disturb
B	21	SHEET ROCK	DISCOVERY 4TH FLOOR NORTH WALL	F	G	>5000 SQFT	LOW
B	22	SHEET ROCK	DISCOVERY 4TH FLOOR MIDDLE COLUM	F	G	>5000 SQFT	LOW
B	23	SHEET ROCK	DISCOVERY 4TH FLOOR SE SECTION	F	G	>5000 SQFT	LOW
B	24	SHEET ROCK	DISCOVERY 4TH FLOOR @ SECOND ELEVATOR SHAFT	F	G	>5000 SQFT	LOW
B	25	SHEET ROCK	DISCOVERY 4TH FLOOR WOMEN'S ROOM	F	G	>5000 SQFT	LOW
B	26	SHEET ROCK	DISCOVERY 5TH FLOOR COLUM	F	G	>5000 SQFT	LOW
B	27	SHEET ROCK	DISCOVERY 5TH FLOOR BACK COLUM	F	G	>5000 SQFT	LOW
B	28	SHEET ROCK	DISCOVERY 5TH FLOOR COLUM	F	G	>5000 SQFT	LOW
B	29	SHEET ROCK	DISCOVERY 5TH FLOOR BACK WALL	F	G	>5000 SQFT	LOW
B	30	SHEET ROCK	DISCOVERY 5TH FLOOR BACK WALL	F	G	>5000 SQFT	LOW

License # # 00568

FM#

Signature

Requestor ABRAMS, JEFF

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Building # DISCOVERY

Sample Analysis Type of Analysis: Lead / Asbestos

Date: 09-12-2012

Turn Around Time 24 HRS

Area	Sample ID	Material Sampled	Material Location	F/NF	Cond	Quantity	Pot to Disturb
C	31	JOINT COMPOUND	DISCOVERY 3RD FLOOR SE WALL	F	G	>5000 SQFT	LOW
C	32	JOINT COMPOUND	DISCOVERY 3RD FLOOR SW CONER WALL	F	G	>5000 SQFT	LOW
C	33	JOINT COMPOUND	DISCOVERY 3RD FLOOR NW WALL	F	G	>5000 SQFT	LOW
C	34	JOINT COMPOUND	DISCOVERY 3RD FLOOR @ ELEVATOR COLUM	F	G	>5000 SQFT	LOW
C	35	JOINT COMPOUND	DISCOVERY 3RD FLOOR @ ELEVATOR	F	G	>5000 SQFT	LOW
C	36	JOINT COMPOUND	DISCOVERY 4TH FLOOR @ 1ST SHAFT	F	G	>5000 SQFT	LOW
C	37	JOINT COMPOUND	DISCOVERY 4TH FLOOR @ 2ND ELEVATOR SHAFT	F	G	>5000 SQFT	LOW
C	38	JOINT COMPOUND	DISCOVERY 4TH FLOOR @ WOMEN'S RESTROOM	F	G	>5000 SQFT	LOW
C	39	JOINT COMPOUND	DISCOVERY 4TH FLOOR SE BREK SECTION	F	G	>5000 SQFT	LOW
C	40	JOINT COMPOUND	DISCOVERY 4TH FLOOR NORTH WALL	F	G	>5000 SQFT	LOW

License # # 00568

FM#

Signature

Requestor ABRAMS, JEFF

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Reset Form

Print Form

Building # DISCOVERY Sample Analysis Type of Analysis: Lead / Asbestos Date: 09-12-2012 Turn Around Time 24 HRS

Area	Sample ID	Material Sampled	Material Location	F/NF	Cond	Quantity	Pot to Disturb
C	41	JOINT COMPOUND	DISCOVERY 5TH FLOOR SHAFT WALL	F	G	>5000 SQFT	LOW
C	42	JOINT COMPOUND	DISCOVERY 5TH FLOOR CENTER COLUMN	F	G	>5000 SQFT	LOW
C	43	JOINT COMPOUND	DISCOVERY 5TH FLOOR BACK WALL	F	G	>5000 SQFT	LOW
C	44	JOINT COMPOUND	DISCOVERY 5TH FLOOR BACK COLUMN	F	G	>5000 SQFT	LOW
C	45	JOINT COMPOUND	DISCOVERY 5TH FLOOR CENTER COLUMN	F	G	>5000 SQFT	LOW

License # # 00568 FM# Signature ABRAMS, JEFF Requestor

Send lab results in PDF format as soon as possible to:

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Fax # 803-777-3990



EMSL Analytical, Inc.

706 Gralin Street, Kernersville, NC 27284
Phone/Fax: (336) 992-1025 / (336) 992-4175
greensborolab@emsl.com

EMSL Order: 021205653
CustomerID: UNSC62
CustomerPO:
ProjectID:

Attn: **Ed Pitts**
University of South Carolina
743 Greene Street
Columbia, SC 29208

Phone: (803) 777-7000
Fax: (803) 777-7334
Received: 09/14/12 10:15 AM
Analysis Date: 9/14/2012
Collected:

Project: **Discovery**

Test Report: Asbestos Analysis of Bulk Materials via EPA 600/R-93/116 and/or EPA 600/M4-82-020 Method(s) using Polarized Light Microscopy

Sample	Description	Appearance	Non-Asbestos		Asbestos
			% Fibrous	% Non-Fibrous	% Type
1 021205653-0001	Fire Proofing	Gray Fibrous Heterogeneous	75% Min. Wool <1% Cellulose	25% Non-fibrous (other)	None Detected
2 021205653-0002	Fire Proofing	Gray Fibrous Heterogeneous	75% Min. Wool <1% Cellulose	25% Non-fibrous (other)	None Detected
3 021205653-0003	Fire Proofing	Gray Fibrous Heterogeneous	75% Min. Wool <1% Cellulose	25% Non-fibrous (other)	None Detected
4 021205653-0004	Fire Proofing	Gray Fibrous Heterogeneous	75% Min. Wool <1% Cellulose	25% Non-fibrous (other)	None Detected
5 021205653-0005	Fire Proofing	Gray Fibrous Heterogeneous	75% Min. Wool <1% Cellulose	25% Non-fibrous (other)	None Detected
6 021205653-0006	Fire Proofing	Gray Fibrous Heterogeneous	75% Min. Wool <1% Cellulose	25% Non-fibrous (other)	None Detected
7 021205653-0007	Fire Proofing	Gray Fibrous Heterogeneous	75% Min. Wool <1% Cellulose	25% Non-fibrous (other)	None Detected
8 021205653-0008	Fire Proofing	Gray Fibrous Heterogeneous	75% Min. Wool <1% Cellulose	25% Non-fibrous (other)	None Detected

Analyst(s)

Kristie Elliott (42)
Scott Combs (3)

Stephen Bennett, Laboratory Manager
or other approved signatory

EMSL maintains liability limited to cost of analysis. This report relates only to the samples reported and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities or analytical method limitations. Interpretation and use of test results are the responsibility of the client. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST or any agency of the federal government. Non-friable organically bound materials present a problem matrix and therefore EMSL recommends gravimetric reduction prior to analysis. Samples received in good condition unless otherwise noted. Estimated accuracy, precision and uncertainty data available upon request. Unless requested by the client, building materials manufactured with multiple layers (i.e. linoleum, wallboard, etc.) are reported as a single sample. Reporting limit is 1%
Samples analyzed by EMSL Analytical, Inc. Kernersville, NC NVLAP Lab Code 102104-0, CA ELAP 2689, Virginia 3333-000228, West Virginia LT000321

Initial report from 09/14/2012 15:10:21



EMSL Analytical, Inc.

706 Gralin Street, Kernersville, NC 27284
Phone/Fax: (336) 992-1025 / (336) 992-4175
greensborolab@emsl.com

EMSL Order: 021205653
CustomerID: UNSC62
CustomerPO:
ProjectID:

Attn: **Ed Pitts**
University of South Carolina
743 Greene Street
Columbia, SC 29208

Phone: (803) 777-7000
Fax: (803) 777-7334
Received: 09/14/12 10:15 AM
Analysis Date: 9/14/2012
Collected:

Project: **Discovery**

Test Report: Asbestos Analysis of Bulk Materials via EPA 600/R-93/116 and/or EPA 600/M4-82-020 Method(s) using Polarized Light Microscopy

Sample	Description	Appearance	Non-Asbestos		Asbestos
			% Fibrous	% Non-Fibrous	% Type
9 021205653-0009	Fire Proofing	Gray Fibrous Heterogeneous	75% Min. Wool <1% Cellulose	25% Non-fibrous (other)	None Detected
10 021205653-0010	Fire Proofing	Gray Fibrous Heterogeneous	75% Min. Wool <1% Cellulose	25% Non-fibrous (other)	None Detected
11 021205653-0011	Fire Proofing	Gray Non-Fibrous Heterogeneous	75% Min. Wool <1% Cellulose	25% Non-fibrous (other)	None Detected
12 021205653-0012	Fire Proofing	Gray Fibrous Heterogeneous	75% Min. Wool <1% Cellulose	25% Non-fibrous (other)	None Detected
13 021205653-0013	Fire Proofing	Gray Fibrous Heterogeneous	75% Min. Wool <1% Cellulose	25% Non-fibrous (other)	None Detected
14 021205653-0014	Fire Proofing	Gray Fibrous Heterogeneous	75% Min. Wool <1% Cellulose	25% Non-fibrous (other)	None Detected
15 021205653-0015	Fire Proofing	Gray Fibrous Heterogeneous	75% Min. Wool 1% Cellulose	24% Non-fibrous (other)	None Detected
16 021205653-0016	Sheetrock	Beige Non-Fibrous Heterogeneous	1% Cellulose	99% Non-fibrous (other)	None Detected

Analyst(s)

Kristie Elliott (42)
Scott Combs (3)

Stephen Bennett, Laboratory Manager
or other approved signatory

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Samples analyzed by EMSL Analytical, Inc. Kernersville, NC NVLAP Lab Code 102104-0, CA ELAP 2689, Virginia 3333-000228, West Virginia LT000321

Initial report from 09/14/2012 15:10:21



EMSL Analytical, Inc.

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Project: **Discovery**

Test Report: Asbestos Analysis of Bulk Materials via EPA 600/R-93/116 and/or EPA 600/M4-82-020 Method(s) using Polarized Light Microscopy

Sample	Description	Appearance	Non-Asbestos		Asbestos
			% Fibrous	% Non-Fibrous	% Type
17 021205653-0017	Sheetrock	Beige Fibrous Heterogeneous	1% Cellulose	99% Non-fibrous (other)	None Detected
18 021205653-0018	Sheetrock	Beige Non-Fibrous Heterogeneous	1% Cellulose	99% Non-fibrous (other)	None Detected
19 021205653-0019	Sheetrock	Beige Fibrous Heterogeneous	2% Cellulose	98% Non-fibrous (other)	None Detected
20 021205653-0020	Sheetrock	Beige Non-Fibrous Heterogeneous	2% Cellulose	98% Non-fibrous (other)	None Detected
21 021205653-0021	Sheetrock	Beige Non-Fibrous Heterogeneous	1% Cellulose	99% Non-fibrous (other)	None Detected
22 021205653-0022	Sheetrock	Gray Fibrous Heterogeneous	1% Cellulose	99% Non-fibrous (other)	None Detected
23 021205653-0023	Sheetrock	Beige Non-Fibrous Heterogeneous	1% Cellulose	99% Non-fibrous (other)	None Detected
24 021205653-0024	Sheetrock	Beige Fibrous Heterogeneous	2% Cellulose	98% Non-fibrous (other)	None Detected

Analyst(s)

Kristie Elliott (42)
Scott Combs (3)

Stephen Bennett, Laboratory Manager
or other approved signatory

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Samples analyzed by EMSL Analytical, Inc. Kernersville, NC NVLAP Lab Code 102104-0, CA ELAP 2689, Virginia 3333-000228, West Virginia LT000321

Initial report from 09/14/2012 15:10:21



EMSL Analytical, Inc.

706 Gralin Street, Kernersville, NC 27284
Phone/Fax: (336) 992-1025 / (336) 992-4175
greensborolab@emsl.com

EMSL Order: 021205653
CustomerID: UNSC62
CustomerPO:
ProjectID:

Attn: **Ed Pitts**
University of South Carolina
743 Greene Street
Columbia, SC 29208

Phone: (803) 777-7000
Fax: (803) 777-7334
Received: 09/14/12 10:15 AM
Analysis Date: 9/14/2012
Collected:

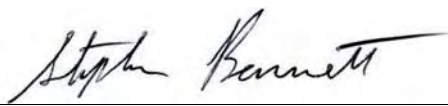
Project: **Discovery**

Test Report: Asbestos Analysis of Bulk Materials via EPA 600/R-93/116 and/or EPA 600/M4-82-020 Method(s) using Polarized Light Microscopy

Sample	Description	Appearance	Non-Asbestos		Asbestos
			% Fibrous	% Non-Fibrous	% Type
25 021205653-0025	Sheetrock	Beige Non-Fibrous Heterogeneous	2% Cellulose	98% Non-fibrous (other)	None Detected
26 021205653-0026	Sheetrock	Beige Fibrous Heterogeneous	1% Cellulose	99% Non-fibrous (other)	None Detected
27 021205653-0027	Sheetrock	Beige Fibrous Heterogeneous	2% Cellulose	98% Non-fibrous (other)	None Detected
28 021205653-0028	Sheetrock	Beige Fibrous Heterogeneous	1% Cellulose	99% Non-fibrous (other)	None Detected
29 021205653-0029	Sheetrock	Beige Fibrous Heterogeneous	2% Cellulose	98% Non-fibrous (other)	None Detected
30 021205653-0030	Sheetrock	Gray Non-Fibrous Heterogeneous	2% Cellulose <1% Glass	98% Non-fibrous (other)	None Detected
31 021205653-0031	Joint Compound	White Non-Fibrous Heterogeneous	<1% Cellulose	100% Non-fibrous (other)	None Detected
32 021205653-0032	Joint Compound	White Non-Fibrous Heterogeneous	<1% Cellulose	100% Non-fibrous (other)	None Detected

Analyst(s) _____

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Fax: (803) 777-7334
Received: 09/14/12 10:15 AM
Analysis Date: 9/14/2012
Collected:

Project: **Discovery**

Test Report: Asbestos Analysis of Bulk Materials via EPA 600/R-93/116 and/or EPA 600/M4-82-020 Method(s) using Polarized Light Microscopy

Sample	Description	Appearance	Non-Asbestos		Asbestos
			% Fibrous	% Non-Fibrous	% Type
33 021205653-0033	Joint Compound	White Non-Fibrous Heterogeneous	<1% Cellulose	100% Non-fibrous (other)	None Detected
34 021205653-0034	Joint Compound	White Non-Fibrous Heterogeneous	<1% Cellulose	100% Non-fibrous (other)	None Detected
35 021205653-0035	Joint Compound	White Non-Fibrous Heterogeneous	<1% Cellulose	100% Non-fibrous (other)	None Detected
36 021205653-0036	Joint Compound	White Non-Fibrous Heterogeneous	<1% Cellulose	100% Non-fibrous (other)	None Detected
37 021205653-0037	Joint Compound	White Non-Fibrous Heterogeneous	<1% Cellulose	100% Non-fibrous (other)	None Detected
38 021205653-0038	Joint Compound	White Non-Fibrous Heterogeneous	<1% Cellulose	100% Non-fibrous (other)	None Detected
39 021205653-0039	Joint Compound	White Non-Fibrous Heterogeneous	<1% Cellulose	100% Non-fibrous (other)	None Detected
40 021205653-0040	Joint Compound	White Non-Fibrous Heterogeneous	<1% Cellulose	100% Non-fibrous (other)	None Detected

Analyst(s)

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Test Report: Asbestos Analysis of Bulk Materials via EPA 600/R-93/116 and/or EPA 600/M4-82-020 Method(s) using Polarized Light Microscopy

Sample	Description	Appearance	Non-Asbestos		Asbestos
			% Fibrous	% Non-Fibrous	% Type
41 <i>021205653-0041</i>	Joint Compound	White Non-Fibrous Heterogeneous	<1% Cellulose	100% Non-fibrous (other)	None Detected
42 <i>021205653-0042</i>	Joint Compound	White Non-Fibrous Heterogeneous	<1% Cellulose	100% Non-fibrous (other)	None Detected
43 <i>021205653-0043</i>	Joint Compound	White Non-Fibrous Heterogeneous	<1% Cellulose	100% Non-fibrous (other)	None Detected
44 <i>021205653-0044</i>	Joint Compound	White Non-Fibrous Heterogeneous	<1% Cellulose	100% Non-fibrous (other)	None Detected
45 <i>021205653-0045</i>	Joint Compound	White Non-Fibrous Heterogeneous	<1% Cellulose	100% Non-fibrous (other)	None Detected

Analyst(s)

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Samples analyzed by EMSL Analytical, Inc. Kernersville, NC NVLAP Lab Code 102104-0, CA ELAP 2689, Virginia 3333-000228, West Virginia LT000321

Initial report from 09/14/2012 15:10:21

**SE-330 – LUMP SUM BID
BID FORM**

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

BID SUBMITTED BY: _____
(Bidder's Name)

BID SUBMITTED TO: University of South Carolina
(Owner's Name)

FOR PROJECT: PROJECT NAME Discovery I - 1st, 3rd, 4th, 5th Floors Upfit
PROJECT NUMBER H27-6080-CA

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 60 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):* _____,

_____, which sum is hereafter called the Base Bid.

(Bidder - insert Base Bid Amount on line above)

**SE-330 – LUMP SUM BID
BID FORM**

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

ALTERNATE # 1 (Brief Description): NA

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): NA

ADD TO or DEDUCT FROM BASE BID: _____

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

ALTERNATE # 3 (Brief Description): NA

ADD TO or DEDUCT FROM BASE BID: _____

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

**SE-330 – LUMP SUM BID
 BID FORM**

§ 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 Contractors Air Conditioning Heating Packaged Equipment Electrical Plumbing		
ALTERNATE 1		
NA	NA	NA
ALTERNATE 2		
NA	NA	NA
ALTERNATE 3		
NA	NA	NA

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.

**SE-330 – LUMP SUM BID
BID FORM**

§ 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 292 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 \$750.00 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: _____

**SE-330 – LUMP SUM BID
BID FORM**

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: _____

ADDRESS: _____

BY: _____
(Signature)

DATE: _____

TITLE: _____

TELEPHONE: _____

EMAIL: _____



AIA® Document A310™ – 2010

Bid Bond

CONTRACTOR:

(Name, legal status and address)

SURETY:

(Name, legal status and principal place of business)

OWNER:

(Name, legal status and address)

The University of South Carolina (USC)
USC Facilities and Planning
743 Greene Street
Columbia, SC 29208

BOND AMOUNT: \$

PROJECT:

(Name, location or address, and Project number, if any)

Discovery I - 1st, 3rd, 4th, 5th Floor Upfit
Discovery I Building
915 Greene Street
Columbia, SC 29208
OSE Project #H27-6080-CA

ADDITIONS AND DELETIONS:

The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes added information as well as revisions to the standard form text is available from the author and should be reviewed. A vertical line in the left margin of this document indicates where the author has added necessary information and where the author has added to or deleted from the original AIA text.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

Any singular reference to Contractor, Surety, Owner or other party shall be considered plural where applicable.

The Contractor and Surety are bound to the Owner in the amount set forth above, for the payment of which the Contractor and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, as provided herein. The conditions of this Bond are such that if the Owner accepts the bid of the Contractor within the time specified in the bid documents, or within such time period as may be agreed to by the Owner and Contractor, and the Contractor either (1) enters into a contract with the Owner in accordance with the terms of such bid, and gives such bond or bonds as may be specified in the bidding or Contract Documents, with a surety admitted in the jurisdiction of the Project and otherwise acceptable to the Owner, for the faithful performance of such Contract and for the prompt payment of labor and material furnished in the prosecution thereof; or (2) pays to the Owner the difference, not to exceed the amount of this Bond, between the amount specified in said bid and such larger amount for which the Owner may in good faith contract with another party to perform the work covered by said bid, then this obligation shall be null and void, otherwise to remain in full force and effect. The Surety hereby waives any notice of an agreement between the Owner and Contractor to extend the time in which the Owner may accept the bid. Waiver of notice by the Surety shall not apply to any extension exceeding sixty (60) days in the aggregate beyond the time for acceptance of bids specified in the bid documents, and the Owner and Contractor shall obtain the Surety's consent for an extension beyond sixty (60) days.

If this Bond is issued in connection with a subcontractor's bid to a Contractor, the term Contractor in this Bond shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.

When this Bond has been furnished to comply with a statutory or other legal requirement in the location of the Project, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such

Init.

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User Notes:

(2020368717)



AIA[®] Document A101[™] – 2007

Standard Form of Agreement Between Owner and Contractor where the basis of payment is a Stipulated Sum

AGREEMENT made as of the day of in the year
(In words, indicate day, month and year.)

BETWEEN the Owner:
(Name, legal status, address and other information)

University of South Carolina (USC), USC Facilities and Planning
743 Greene Street
Columbia, SC 29208

and the Contractor:
(Name, legal status, address and other information)

for the following Project:
(Name, location and detailed description)

Discovery I - 1st, 3rd, 4th, 5th Floor Upfit
Discovery I Building
915 Greene Street
Columbia, SC 29208

The Architect:
(Name, legal status, address and other information)

Jenkins Peer Architects P.A.
112 S. Tryon Street
Suite 1300
Charlotte, NC 28284
Telephone Number: 704 372-6665

The Owner and Contractor agree as follows.

ADDITIONS AND DELETIONS:

The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes added information as well as revisions to the standard form text is available from the author and should be reviewed. A vertical line in the left margin of this document indicates where the author has added necessary information and where the author has added to or deleted from the original AIA text.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

AIA Document A201[™]–2007, General Conditions of the Contract for Construction, is adopted in this document by reference. Do not use with other general conditions unless this document is modified.

TABLE OF ARTICLES

- 1 THE CONTRACT DOCUMENTS
- 2 THE WORK OF THIS CONTRACT
- 3 DATE OF COMMENCEMENT AND SUBSTANTIAL COMPLETION
- 4 CONTRACT SUM
- 5 PAYMENTS
- 6 DISPUTE RESOLUTION
- 7 TERMINATION OR SUSPENSION
- 8 MISCELLANEOUS PROVISIONS
- 9 ENUMERATION OF CONTRACT DOCUMENTS
- 10 INSURANCE AND BONDS

ARTICLE 1 THE CONTRACT DOCUMENTS

The Contract Documents consist of this Agreement, Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications, Addenda issued prior to execution of this Agreement, other documents listed in this Agreement and Modifications issued after execution of this Agreement, all of which form the Contract, and are as fully a part of the Contract as if attached to this Agreement or repeated herein. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations or agreements, either written or oral. An enumeration of the Contract Documents, other than a Modification, appears in Article 9.

ARTICLE 2 THE WORK OF THIS CONTRACT

The Contractor shall fully execute the Work described in the Contract Documents, except as specifically indicated in the Contract Documents to be the responsibility of others.

ARTICLE 3 DATE OF COMMENCEMENT AND SUBSTANTIAL COMPLETION

§ 3.1 The date of commencement of the Work shall be the date of this Agreement unless a different date is stated below or provision is made for the date to be fixed in a notice to proceed issued by the Owner.

(Insert the date of commencement if it differs from the date of this Agreement or, if applicable, state that the date will be fixed in a notice to proceed.)

The commencement date will be fixed in a notice to proceed.

If, prior to the commencement of the Work, the Owner requires time to file mortgages and other security interests, the Owner's time requirement shall be as follows:

§ 3.2 The Contract Time shall be measured from the date of commencement.

§ 3.3 The Contractor shall achieve Substantial Completion of the entire Work not later than () days from the date of commencement, or as follows:

(Insert number of calendar days. Alternatively, a calendar date may be used when coordinated with the date of commencement. If appropriate, insert requirements for earlier Substantial Completion of certain portions of the Work.)

Init.

Portion of Work

Substantial Completion Date

, subject to adjustments of this Contract Time as provided in the Contract Documents.
(Insert provisions, if any, for liquidated damages relating to failure to achieve Substantial Completion on time or for bonus payments for early completion of the Work.)

ARTICLE 4 CONTRACT SUM

§ 4.1 The Owner shall pay the Contractor the Contract Sum in current funds for the Contractor’s performance of the Contract. The Contract Sum shall be (\$), subject to additions and deductions as provided in the Contract Documents.

§ 4.2 The Contract Sum is based upon the following alternates, if any, which are described in the Contract Documents and are hereby accepted by the Owner:
(State the numbers or other identification of accepted alternates. If the bidding or proposal documents permit the Owner to accept other alternates subsequent to the execution of this Agreement, attach a schedule of such other alternates showing the amount for each and the date when that amount expires.)

§ 4.3 Unit prices, if any:
(Identify and state the unit price; state quantity limitations, if any, to which the unit price will be applicable.)

Item	Units and Limitations	Price Per Unit (\$0.00)
------	-----------------------	-------------------------

§ 4.4 Allowances included in the Contract Sum, if any:
(Identify allowance and state exclusions, if any, from the allowance price.)

Item	Price
------	-------

ARTICLE 5 PAYMENTS

§ 5.1 PROGRESS PAYMENTS

§ 5.1.1 Based upon Applications for Payment submitted to the Architect by the Contractor and Certificates for Payment issued by the Architect, the Owner shall make progress payments on account of the Contract Sum to the Contractor as provided below and elsewhere in the Contract Documents.

§ 5.1.2 The period covered by each Application for Payment shall be one calendar month ending on the last day of the month, or as follows:

§ 5.1.3 Provided that an Application for Payment is received by the Architect not later than the day of a month, the Owner shall make payment of the certified amount to the Contractor not later than the day of the month. If an Application for Payment is received by the Architect after the application date fixed above, payment shall be made by the Owner not later than () days after the Architect receives the Application for Payment.
(Federal, state or local laws may require payment within a certain period of time.)

§ 5.1.4 Each Application for Payment shall be based on the most recent schedule of values submitted by the Contractor in accordance with the Contract Documents. The schedule of values shall allocate the entire Contract Sum among the various portions of the Work. The schedule of values shall be 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.

§ 5.1.5 Applications for Payment shall show the percentage of completion of each portion of the Work as of the end of the period covered by the Application for Payment.

§ 5.1.6 Subject to other provisions of the Contract Documents, the amount of each progress payment shall be computed as follows:

- .1 Take that portion of the Contract Sum properly allocable to completed Work as determined by multiplying the percentage completion of each portion of the Work by the share of the Contract Sum allocated to that portion of the Work in the schedule of values, less retainage of percent (%). Pending final determination of cost to the Owner of changes in the Work, amounts not in dispute shall be included as provided in Section 7.3.9 of AIA Document A201™–2007, General Conditions of the Contract for Construction;
- .2 Add that portion of the Contract Sum properly allocable to materials and equipment delivered and suitably stored at the site for subsequent incorporation in the completed construction (or, if approved in advance by the Owner, suitably stored off the site at a location agreed upon in writing), less retainage of percent (%);
- .3 Subtract the aggregate of previous payments made by the Owner; and
- .4 Subtract amounts, if any, for which the Architect has withheld or nullified a Certificate for Payment as provided in Section 9.5 of AIA Document A201–2007.

§ 5.1.7 The progress payment amount determined in accordance with Section 5.1.6 shall be further modified under the following circumstances:

- .1 Add, upon Substantial Completion of the Work, a sum sufficient to increase the total payments to the full amount of the Contract Sum, less such amounts as the Architect shall determine for incomplete Work, retainage applicable to such work and unsettled claims; and
(Section 9.8.5 of AIA Document A201–2007 requires release of applicable retainage upon Substantial Completion of Work with consent of surety, if any.)
- .2 Add, if final completion of the Work is thereafter materially delayed through no fault of the Contractor, any additional amounts payable in accordance with Section 9.10.3 of AIA Document A201–2007.

§ 5.1.8 Reduction or limitation of retainage, if any, shall be as follows:

(If it is intended, prior to Substantial Completion of the entire Work, to reduce or limit the retainage resulting from the percentages inserted in Sections 5.1.6.1 and 5.1.6.2 above, and this is not explained elsewhere in the Contract Documents, insert here provisions for such reduction or limitation.)

§ 5.1.9 Except with the Owner's prior approval, the Contractor shall not make advance payments to suppliers for materials or equipment which have not been delivered and stored at the site.

§ 5.2 FINAL PAYMENT

§ 5.2.1 Final payment, constituting the entire unpaid balance of the Contract Sum, shall be made by the Owner to the Contractor when

- .1 the Contractor has fully performed the Contract except for the Contractor's responsibility to correct Work as provided in Section 12.2.2 of AIA Document A201–2007, and to satisfy other requirements, if any, which extend beyond final payment; and
- .2 a final Certificate for Payment has been issued by the Architect.

§ 5.2.2 The Owner's final payment to the Contractor shall be made no later than 30 days after the issuance of the Architect's final Certificate for Payment, or as follows:

Init.

ARTICLE 6 DISPUTE RESOLUTION

§ 6.1 INITIAL DECISION MAKER

The Architect will serve as Initial Decision Maker pursuant to Section 15.2 of AIA Document A201–2007, unless the parties appoint below another individual, not a party to this Agreement, to serve as Initial Decision Maker. *(If the parties mutually agree, insert the name, address and other contact information of the Initial Decision Maker, if other than the Architect.)*

§ 6.2 BINDING DISPUTE RESOLUTION

For any Claim subject to, but not resolved by, mediation pursuant to Section 15.3 of AIA Document A201–2007, the method of binding dispute resolution shall be as follows:

(Check the appropriate box. If the Owner and Contractor do not select a method of binding dispute resolution below, or do not subsequently agree in writing to a binding dispute resolution method other than litigation, Claims will be resolved by litigation in a court of competent jurisdiction.)

- Arbitration pursuant to Section 15.4 of AIA Document A201–2007
- Litigation in a court of competent jurisdiction
- Other *(Specify)*

ARTICLE 7 TERMINATION OR SUSPENSION

§ 7.1 The Contract may be terminated by the Owner or the Contractor as provided in Article 14 of AIA Document A201–2007.

§ 7.2 The Work may be suspended by the Owner as provided in Article 14 of AIA Document A201–2007.

ARTICLE 8 MISCELLANEOUS PROVISIONS

§ 8.1 Where reference is made in this Agreement to a provision of AIA Document A201–2007 or another Contract Document, the reference refers to that provision as amended or supplemented by other provisions of the Contract Documents.

§ 8.2 Payments due and unpaid under the Contract shall bear interest from the date payment is due at the rate stated below, or in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located.

(Insert rate of interest agreed upon, if any.)

%

§ 8.3 The Owner’s representative:
(Name, address and other information)

§ 8.4 The Contractor’s representative:
(Name, address and other information)

§ 8.5 Neither the Owner's nor the Contractor's representative shall be changed without ten days written notice to the other party.

§ 8.6 Other provisions:

ARTICLE 9 ENUMERATION OF CONTRACT DOCUMENTS

§ 9.1 The Contract Documents, except for Modifications issued after execution of this Agreement, are enumerated in the sections below.

§ 9.1.1 The Agreement is this executed AIA Document A101–2007, Standard Form of Agreement Between Owner and Contractor.

§ 9.1.2 The General Conditions are AIA Document A201–2007, General Conditions of the Contract for Construction.

§ 9.1.3 The Supplementary and other Conditions of the Contract:

Document	Title	Date	Pages
----------	-------	------	-------

§ 9.1.4 The Specifications:

(Either list the Specifications here or refer to an exhibit attached to this Agreement.)

Section	Title	Date	Pages
---------	-------	------	-------

§ 9.1.5 The Drawings:

(Either list the Drawings here or refer to an exhibit attached to this Agreement.)

Number	Title	Date
--------	-------	------

§ 9.1.6 The Addenda, if any:

Number	Date	Pages
--------	------	-------

Portions of Addenda relating to bidding requirements are not part of the Contract Documents unless the bidding requirements are also enumerated in this Article 9.

§ 9.1.7 Additional documents, if any, forming part of the Contract Documents:

- 1 AIA Document E201™–2007, Digital Data Protocol Exhibit, if completed by the parties, or the following:

Init.

- .2 Other documents, if any, listed below:
(List here any additional documents that are intended to form part of the Contract Documents. AIA Document A201–2007 provides that bidding requirements such as advertisement or invitation to bid, Instructions to Bidders, sample forms and the Contractor’s bid are not part of the Contract Documents unless enumerated in this Agreement. They should be listed here only if intended to be part of the Contract Documents.)

ARTICLE 10 INSURANCE AND BONDS

The Contractor shall purchase and maintain insurance and provide bonds as set forth in Article 11 of AIA Document A201–2007.

(State bonding requirements, if any, and limits of liability for insurance required in Article 11 of AIA Document A201–2007.)

Type of insurance or bond	Limit of liability or bond amount (\$0.00)
---------------------------	--

This Agreement entered into as of the day and year first written above.

 OWNER *(Signature)*

 CONTRACTOR *(Signature)*

(Printed name and title)

(Printed name and title)

OSE FORM 00501
STANDARD MODIFICATIONS TO AGREEMENT BETWEEN
OWNER AND CONTRACTOR

OWNER: University of South Carolina

PROJECT NUMBER: H27-6080-CA

PROJECT NAME: Discovery I - 1st, 3rd, 4th, 5th Floors Upfit

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 one-half percent (3.5%).”

OSE FORM 00501
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 Manager
Address: 743 Greene Street, Columbia, South Carolina 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: Jeff Abrams
Title: Project Manager
Address: 743 Greene Street, Columbia, South Carolina 29208
Telephone: 803-777-8074 **FAX:** 803-777-8739
Email: JAbrams@fmc.sc.edu

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: Ben Benson
Title: Principle, Jenkins Peer Architects
Address: 112 South Tryon Street, Suite 1300, Charlotte, North Carolina 28284
Telephone: 704-940-6913
Email: bbenson@jenkinspeer.com

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

Performance Bond

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
Columbia, South Carolina 29208

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: Discovery I - 1st, 3rd, 4th, 5th Floors Upfit
State Project Number: H27-6080-CA

Brief Description of Awarded Work, as found on the SE-330, Bid Form:
Project consists of approximately 58,000sf of office, wet laboratory and dry laboratory upfits in the partially occupied five story Discovery I Biomedical Research shell building on the USC Columbia campus. Significant portions of the work include partitions, finishes, laboratory equipment and furnishings and mechanical equipment. A site visit will occur as part of the Pre-Bid Conference. One additional site visit will be scheduled after the Pre-Bid Conference. Bidders are encouraged to visit the site prior to submitting bids.

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

Name: Jenkins Peer Architects
Address: 112 South Tryon Street, Suite 1300
Charlotte, North Carolina 28284

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 this _____ day of _____, 2_____ BOND NUMBER _____
(shall be no earlier than Date of Contract)

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 set-off 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.

SE-357 Labor and Material Payment Bond

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
Columbia, South Carolina 29208

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: Discovery I - 1st, 3rd, 4th, 5th Floors Upfit

Project Number: H-27-6080-CA

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

Project consists of approximately 58,000sf of office, wet laboratory and dry laboratory upfits in the partially occupied five story Discovery I Biomedical Research shell building on the USC Columbia campus. Significant portions of the work include partitions, finishes, laboratory equipment and furnishings and mechanical equipment. A site visit will occur as part of the Pre-Bid Conference. One additional site visit will be scheduled after the Pre-Bid Conference. Bidders are encouraged to visit the site prior to submitting bids.

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

Name: Jenkins Peer Architects
Address: 112 South Tryon Street, Suite 1300
Charlotte, North Carolina 28284

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 this _____ day of _____, 2_____ BOND NUMBER _____
(shall be no earlier than Date of Contract)

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)

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 one 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.

Project Name: Discovery I – 1st, 3rd, 4th, 5th Floors Upfit

Project Number: H27-6080-CA

University of South Carolina

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 wherefrom, 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 office of the Contracting Firm.

SWORN TO before me this _____ day of _____, 2____ (seal)

_____ State

My commission expires _____

AIA[®] Document A201[™] – 2007

General Conditions of the Contract for Construction

for the following PROJECT:

(Name and location or address)

Discovery I - 1st, 3rd, 4th, 5th Floor Upfit
Discovery I Building
915 Greene Street
Columbia, SC 29208

THE OWNER:

(Name, legal status and address)

University of South Carolina (USC), USC Facilities and Planning
743 Greene Street
Columbia, SC 29208

THE ARCHITECT:

(Name, legal status and address)

Jenkins Peer Architects P.A.
112 S. Tryon Street
Suite 1300
Charlotte, NC 28284

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ADDITIONS AND DELETIONS:

The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes added information as well as revisions to the standard form text is available from the author and should be reviewed. A vertical line in the left margin of this document indicates where the author has added necessary information and where the author has added to or deleted from the original AIA text.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

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ARTICLE 1 GENERAL PROVISIONS

§ 1.1 BASIC DEFINITIONS

§ 1.1.1 THE CONTRACT DOCUMENTS

The Contract Documents are enumerated in the Agreement between the Owner and Contractor (hereinafter the Agreement) and consist of the Agreement, Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications, Addenda issued prior to execution of the Contract, other documents listed in the Agreement and Modifications issued after execution of the Contract. A Modification is (1) a written amendment to the Contract signed by both parties, (2) a Change Order, (3) a Construction Change Directive or (4) a written order for a minor change in the Work issued by the Architect. Unless specifically enumerated in the Agreement, the Contract Documents do not include the advertisement or invitation to bid, Instructions to Bidders, sample forms, other information furnished by the Owner in anticipation of receiving bids or proposals, the Contractor's bid or proposal, or portions of Addenda relating to bidding requirements.

§ 1.1.2 THE CONTRACT

The Contract Documents form the Contract for Construction. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations or agreements, either written or oral. The Contract may be amended or modified only by a Modification. The Contract Documents shall not be construed to create a contractual relationship of any kind (1) between the Contractor and the Architect or the Architect's consultants, (2) between the Owner and a Subcontractor or a Sub-subcontractor, (3) between the Owner and the Architect or the Architect's consultants or (4) between any persons or entities other than the Owner and the Contractor. The Architect shall, however, be entitled to performance and enforcement of obligations under the Contract intended to facilitate performance of the Architect's duties.

§ 1.1.3 THE WORK

The term "Work" means the construction and services required by the Contract Documents, whether completed or partially completed, and includes all other labor, materials, equipment and services provided or to be provided by the Contractor to fulfill the Contractor's obligations. The Work may constitute the whole or a part of the Project.

§ 1.1.4 THE PROJECT

The Project is the total construction of which the Work performed under the Contract Documents may be the whole or a part and which may include construction by the Owner and by separate contractors.

§ 1.1.5 THE DRAWINGS

The Drawings are the graphic and pictorial portions of the Contract Documents showing the design, location and dimensions of the Work, generally including plans, elevations, sections, details, schedules and diagrams.

§ 1.1.6 THE SPECIFICATIONS

The Specifications are that portion of the Contract Documents consisting of the written requirements for materials, equipment, systems, standards and workmanship for the Work, and performance of related services.

§ 1.1.7 INSTRUMENTS OF SERVICE

Instruments of Service are representations, in any medium of expression now known or later developed, of the tangible and intangible creative work performed by the Architect and the Architect's consultants under their respective professional services agreements. Instruments of Service may include, without limitation, studies, surveys, models, sketches, drawings, specifications, and other similar materials.

§ 1.1.8 INITIAL DECISION MAKER

The Initial Decision Maker is the person identified in the Agreement to render initial decisions on Claims in accordance with Section 15.2 and certify termination of the Agreement under Section 14.2.2.

§ 1.2 CORRELATION AND INTENT OF THE CONTRACT DOCUMENTS

§ 1.2.1 The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Work by the Contractor. The Contract Documents are complementary, and what is required by one shall be as binding as if required by all; performance by the Contractor shall be required only to the extent consistent with the Contract Documents and reasonably inferable from them as being necessary to produce the indicated results.

§ 1.2.2 Organization of the Specifications into divisions, sections and articles, and arrangement of Drawings shall not control the Contractor in dividing the Work among Subcontractors or in establishing the extent of Work to be performed by any trade.

§ 1.2.3 Unless otherwise stated in the Contract Documents, words that have well-known technical or construction industry meanings are used in the Contract Documents in accordance with such recognized meanings.

§ 1.3 CAPITALIZATION

Terms capitalized in these General Conditions include those that are (1) specifically defined, (2) the titles of numbered articles or (3) the titles of other documents published by the American Institute of Architects.

§ 1.4 INTERPRETATION

In the interest of brevity the Contract Documents frequently omit modifying words such as "all" and "any" and articles such as "the" and "an," but the fact that a modifier or an article is absent from one statement and appears in another is not intended to affect the interpretation of either statement.

§ 1.5 OWNERSHIP AND USE OF DRAWINGS, SPECIFICATIONS AND OTHER INSTRUMENTS OF SERVICE

§ 1.5.1 The Architect and the Architect's consultants shall be deemed the authors and owners of their respective Instruments of Service, including the Drawings and Specifications, 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 publication in derogation of the Architect's or Architect's consultants' reserved rights.

§ 1.5.2 The Contractor, Subcontractors, Sub-subcontractors and material or equipment suppliers are authorized to use and reproduce the Instruments of Service provided to them solely and exclusively for execution of the Work. All copies made under this authorization shall bear the copyright notice, if any, shown on the Instruments of Service. The Contractor, Subcontractors, Sub-subcontractors, and material or equipment suppliers may not use the Instruments of Service on other projects or for additions to this Project outside the scope of the Work without the specific written consent of the Owner, Architect and the Architect's consultants.

§ 1.6 TRANSMISSION OF DATA IN DIGITAL FORM

If the parties intend to transmit Instruments of Service or any other information or documentation in digital form, they shall endeavor to establish necessary protocols governing such transmissions, unless otherwise already provided in the Agreement or the Contract Documents.

ARTICLE 2 OWNER

§ 2.1 GENERAL

§ 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 otherwise provided in Section 4.2.1, the Architect does not have such authority. The term "Owner" means the Owner or the Owner's authorized representative.

§ 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 evaluate, give notice of or enforce mechanic's lien rights. Such information shall include a correct statement of the record legal title to the property on which the Project is located, usually referred to as the site, and the Owner's interest therein.

§ 2.2 INFORMATION AND SERVICES REQUIRED OF THE OWNER

§ 2.2.1 Prior to commencement of the Work, the Contractor may request in writing that the Owner provide reasonable evidence that the Owner has made financial arrangements to fulfill the Owner's obligations under the Contract. Thereafter, the Contractor may only request such evidence if (1) the Owner fails to make payments to the Contractor as the Contract Documents require; (2) a change in the Work materially changes the Contract Sum; or (3) the Contractor identifies in writing a reasonable concern regarding the Owner's ability to make payment when due. The Owner shall furnish such evidence as a condition precedent to commencement or continuation of the Work or

the portion of the Work affected by a material change. After the Owner furnishes the evidence, the Owner shall not materially vary such financial arrangements without prior notice to the Contractor.

§ 2.2.2 Except for permits and fees that are the responsibility of the Contractor under the Contract Documents, including those required under Section 3.7.1, the Owner shall secure and pay for necessary approvals, easements, assessments and charges required for construction, use or occupancy of permanent structures or for permanent changes in existing facilities.

§ 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. The Contractor shall be entitled to rely on the accuracy of information furnished by the Owner but shall exercise proper precautions relating to the safe performance of the Work.

§ 2.2.4 The Owner shall furnish information or services required of the Owner by the Contract Documents with reasonable promptness. The Owner shall also furnish any other information or services under the Owner's control and relevant to the Contractor's performance of the Work with reasonable promptness after receiving the Contractor's written request for such information or services.

§ 2.2.5 Unless otherwise provided in the Contract Documents, the Owner shall furnish to the Contractor one copy of the Contract Documents for purposes of making reproductions pursuant to Section 1.5.2.

§ 2.3 OWNER'S RIGHT TO STOP THE WORK

If the Contractor fails to correct Work that is not in accordance with the requirements of the Contract Documents as required by Section 12.2 or repeatedly fails to carry out Work in accordance with the Contract Documents, the Owner may issue a written order to the Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, the right of the Owner to stop the Work shall not give rise to a duty on the part of the Owner to exercise this right for the benefit of the Contractor or any other person or entity, except to the extent required by Section 6.1.3.

§ 2.4 OWNER'S RIGHT TO CARRY OUT THE WORK

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 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 Order 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. Such action by the Owner and amounts charged to the Contractor are both subject to prior approval of the Architect. If payments then or thereafter due the Contractor are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner.

ARTICLE 3 CONTRACTOR

§ 3.1 GENERAL

§ 3.1.1 The Contractor 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 Contractor shall be lawfully licensed, if required in the jurisdiction where the Project is located. The Contractor shall designate in writing a representative who shall have express authority to bind the Contractor with respect to all matters under this Contract. The term "Contractor" means the Contractor or the Contractor's authorized representative.

§ 3.1.2 The Contractor shall perform the Work in accordance with the Contract Documents.

§ 3.1.3 The Contractor shall not be relieved of obligations to perform the Work in accordance with the Contract Documents either by activities or duties of the Architect in the Architect's administration of the Contract, or by tests, inspections or approvals required or performed by persons or entities other than the Contractor.

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§ 3.2 REVIEW OF CONTRACT DOCUMENTS AND FIELD CONDITIONS BY CONTRACTOR

§ 3.2.1 Execution of the Contract by the Contractor is a representation that the Contractor has visited the site, become generally familiar with local conditions under which the Work is to be performed and correlated personal observations with requirements of the Contract Documents.

§ 3.2.2 Because the Contract Documents are complementary, the Contractor shall, before starting each portion of the Work, carefully study and compare the various Contract Documents relative to that portion of the Work, as well as the information furnished by the Owner pursuant to Section 2.2.3, shall take field measurements of any existing conditions related to that portion of the Work, and shall observe any conditions at the site affecting it. These obligations are for the purpose of facilitating coordination and construction by the Contractor and are not for the purpose of discovering errors, omissions, or inconsistencies in the Contract Documents; however, the Contractor shall promptly report to the Architect any errors, inconsistencies or omissions discovered by or made known to the Contractor as a request for information in such form as the Architect may require. It is recognized that the Contractor's review is made in the Contractor's capacity as a contractor and not as a licensed design professional, unless otherwise specifically provided in the Contract Documents.

§ 3.2.3 The Contractor is not required to ascertain that the Contract Documents are in accordance with applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, but the Contractor shall promptly report to the Architect any nonconformity discovered by or made known to the Contractor as a request for information in such form as the Architect may require.

§ 3.2.4 If the Contractor believes that additional cost or time is involved because of clarifications or instructions the Architect issues in response to the Contractor's notices or requests for information pursuant to Sections 3.2.2 or 3.2.3, the Contractor shall make Claims as provided in Article 15. If the Contractor fails to perform the obligations of Sections 3.2.2 or 3.2.3, the Contractor shall pay such costs and damages to the Owner as would have been avoided if the Contractor had performed such obligations. If the Contractor performs those obligations, the Contractor shall not be liable to the Owner or Architect for damages resulting from errors, inconsistencies or omissions in the Contract Documents, for differences between field measurements or conditions and the Contract Documents, or for nonconformities of the Contract Documents to applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities.

§ 3.3 SUPERVISION AND CONSTRUCTION PROCEDURES

§ 3.3.1 The Contractor shall supervise and direct the Work, using the Contractor's best skill and attention. The Contractor shall be solely responsible for, and have control over, construction means, methods, techniques, sequences and procedures and for coordinating all portions of the Work under the Contract, unless the Contract Documents give other specific instructions concerning these matters. If the Contract Documents give specific instructions concerning construction means, methods, techniques, sequences or procedures, the Contractor shall evaluate the jobsite safety thereof and, except as stated below, shall be fully and solely responsible for the jobsite safety of such means, methods, techniques, sequences or procedures. If the Contractor determines that such means, methods, techniques, sequences or procedures may not be safe, the Contractor shall give timely written notice to the Owner and Architect and shall not proceed with that portion of the Work without further written instructions from the Architect. If the Contractor is then instructed to proceed with the required means, methods, techniques, sequences or procedures without acceptance of changes proposed by the Contractor, the Owner shall be solely responsible for any loss or damage arising solely from those Owner-required means, methods, techniques, sequences or procedures.

§ 3.3.2 The Contractor shall be responsible to the Owner for acts and omissions of the Contractor's employees, Subcontractors and their agents and employees, and other persons or entities performing portions of the Work for, or on behalf of, the Contractor or any of its Subcontractors.

§ 3.3.3 The Contractor shall be responsible for inspection of portions of Work already performed to determine that such portions are in proper condition to receive subsequent Work.

§ 3.4 LABOR AND MATERIALS

§ 3.4.1 Unless otherwise provided in the Contract Documents, the Contractor shall provide and pay for labor, materials, equipment, tools, construction equipment and machinery, water, heat, utilities, transportation, and other

facilities and services necessary for proper execution and completion of the Work, whether temporary or permanent and whether or not incorporated or to be incorporated in the Work.

§ 3.4.2 Except in the case of minor changes in the Work authorized by the Architect in accordance with Sections 3.12.8 or 7.4, the Contractor may make substitutions only with the consent of the Owner, after evaluation by the Architect and in accordance with a Change Order or Construction Change Directive.

§ 3.4.3 The Contractor shall enforce strict discipline and good order among the Contractor's employees and other persons carrying out the Work. The Contractor shall not permit employment of unfit persons or persons not properly skilled in tasks assigned to them.

§ 3.5 WARRANTY

The Contractor warrants to the Owner and Architect that materials and equipment furnished under the Contract will be of good quality and new unless the Contract Documents require or permit otherwise. The Contractor further warrants that the Work will conform to the requirements of the Contract Documents and will be free from defects, except for those inherent in the quality of the Work the Contract Documents require or permit. Work, materials, or equipment not conforming to these requirements may be considered defective. 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. If required by the Architect, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment.

§ 3.6 TAXES

The Contractor shall pay sales, consumer, use and similar taxes for the Work provided by the Contractor that are legally enacted when bids are received or negotiations concluded, whether or not yet effective or merely scheduled to go into effect.

§ 3.7 PERMITS, FEES, NOTICES AND COMPLIANCE WITH LAWS

§ 3.7.1 Unless otherwise provided in the Contract Documents, the Contractor shall secure and pay for the building permit as well as for other permits, fees, licenses, and inspections by government agencies necessary for proper execution and completion of the Work that are customarily secured after execution of the Contract and legally required at the time bids are received or negotiations concluded.

§ 3.7.2 The Contractor shall comply with and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities applicable to performance of the Work.

§ 3.7.3 If the Contractor performs Work knowing it to be contrary to applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, the Contractor shall assume appropriate responsibility for such Work and shall bear the costs attributable to correction.

§ 3.7.4 Concealed or Unknown Conditions. If the Contractor encounters conditions at the site that are (1) subsurface or otherwise concealed physical conditions that differ materially from those indicated in the Contract Documents or (2) unknown physical conditions of an unusual nature, that differ materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the Contract Documents, the Contractor shall promptly provide notice to the Owner and the Architect before conditions are disturbed and in no event later than 21 days after first observance of the conditions. The Architect will promptly investigate such conditions and, if the Architect determines that they differ materially and cause an increase or decrease in the Contractor's cost of, or time required for, performance of any part of the Work, will recommend an equitable adjustment in the Contract Sum or Contract Time, or both. If the Architect determines that the conditions at the site are not materially different from those indicated in the Contract Documents and that no change in the terms of the Contract is justified, the Architect shall promptly notify the Owner and Contractor in writing, stating the reasons. If either party disputes the Architect's determination or recommendation, that party may proceed as provided in Article 15.

§ 3.7.5 If, in the course of the Work, the Contractor encounters human remains or recognizes the existence of burial markers, archaeological sites or wetlands not indicated in the Contract Documents, the Contractor shall immediately suspend any operations that would affect them and shall notify the Owner and Architect. Upon receipt of such notice, the Owner shall promptly take any action necessary to obtain governmental authorization required to resume

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the operations. The Contractor shall continue to suspend such operations until otherwise instructed by the Owner but shall continue with all other operations that do not affect those remains or features. Requests for adjustments in the Contract Sum and Contract Time arising from the existence of such remains or features may be made as provided in Article 15.

§ 3.8 ALLOWANCES

§ 3.8.1 The Contractor shall include in the Contract Sum all allowances stated in the Contract Documents. Items covered by allowances shall be supplied for such amounts and by such persons or entities as the Owner may direct, but the Contractor shall not be required to employ persons or entities to whom the Contractor has reasonable objection.

§ 3.8.2 Unless otherwise provided in the Contract Documents,

- .1 Allowances shall cover the cost to the Contractor of materials and equipment delivered at the site and all required taxes, less applicable trade discounts;
- .2 Contractor's costs for unloading and handling at the site, labor, installation costs, overhead, profit and other expenses contemplated for stated allowance amounts shall be included in the Contract Sum but not in the allowances; and
- .3 Whenever costs are more than or less than allowances, the Contract Sum shall be adjusted accordingly by Change Order. The amount of the Change Order shall reflect (1) the difference between actual costs and the allowances under Section 3.8.2.1 and (2) changes in Contractor's costs under Section 3.8.2.2.

§ 3.8.3 Materials and equipment under an allowance shall be selected by the Owner with reasonable promptness.

§ 3.9 SUPERINTENDENT

§ 3.9.1 The Contractor shall employ a competent superintendent and necessary assistants who shall be in attendance at the Project site during performance of the Work. The superintendent shall represent the Contractor, and communications given to the superintendent shall be as binding as if given to the Contractor.

§ 3.9.2 The Contractor, as soon as practicable after award of the Contract, shall furnish in writing to the Owner through the Architect the name and qualifications of a proposed superintendent. The Architect may reply within 14 days to the Contractor in writing stating (1) whether the Owner or the Architect has reasonable objection to the proposed superintendent or (2) that the Architect requires additional time to review. Failure of the Architect to reply within the 14 day period shall constitute notice of no reasonable objection.

§ 3.9.3 The Contractor shall not employ a proposed superintendent to whom the Owner or Architect has made reasonable and timely objection. The Contractor shall not change the superintendent without the Owner's consent, which shall not unreasonably be withheld or delayed.

§ 3.10 CONTRACTOR'S CONSTRUCTION SCHEDULES

§ 3.10.1 The Contractor, promptly after being awarded the Contract, shall prepare and submit for the Owner's and Architect's information a Contractor's construction schedule for the Work. The schedule shall not exceed time limits current under the Contract Documents, shall be revised at appropriate intervals as required by the conditions of the Work and Project, shall be related to the entire Project to the extent required by the Contract Documents, and shall provide for expeditious and practicable execution of the Work.

§ 3.10.2 The Contractor shall prepare a submittal schedule, promptly after being awarded the Contract and thereafter as necessary to maintain a current submittal schedule, and shall submit the schedule(s) for the Architect's approval. The Architect's approval shall not unreasonably be delayed or withheld. The submittal schedule shall (1) be coordinated with the Contractor's construction schedule, and (2) allow the Architect reasonable time to review submittals. If the Contractor fails to submit a submittal schedule, the Contractor shall not be entitled to any increase in Contract Sum or extension of Contract Time based on the time required for review of submittals.

§ 3.10.3 The Contractor shall perform the Work in general accordance with the most recent schedules submitted to the Owner and Architect.

§ 3.11 DOCUMENTS AND SAMPLES AT THE SITE

The Contractor shall maintain at the site for the Owner one copy of the Drawings, Specifications, Addenda, Change Orders and other Modifications, in good order and marked currently to indicate field changes and selections made during construction, and one copy of approved Shop Drawings, Product Data, Samples and similar required submittals. These shall be available to the Architect and shall be delivered to the Architect for submittal to the Owner upon completion of the Work as a record of the Work as constructed.

§ 3.12 SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

§ 3.12.1 Shop Drawings are drawings, diagrams, schedules and other data specially prepared for the Work by the Contractor or a Subcontractor, Sub-subcontractor, manufacturer, supplier or distributor to illustrate some portion of the Work.

§ 3.12.2 Product Data are illustrations, standard schedules, performance charts, instructions, brochures, diagrams and other information furnished by the Contractor to illustrate materials or equipment for some portion of the Work.

§ 3.12.3 Samples are physical examples that illustrate materials, equipment or workmanship and establish standards by which the Work will be judged.

§ 3.12.4 Shop Drawings, Product Data, Samples and similar submittals are not Contract Documents. Their purpose is to demonstrate the way by which the Contractor proposes to conform to the information given and the design concept expressed in the Contract Documents for those portions of the Work for which the Contract Documents require submittals. Review by the Architect is subject to the limitations of Section 4.2.7. Informational submittals upon which the Architect is not expected to take responsive action may be so identified in the Contract Documents. Submittals that are not required by the Contract Documents may be returned by the Architect without action.

§ 3.12.5 The Contractor shall review for compliance with the Contract Documents, approve and submit to the Architect Shop Drawings, Product Data, Samples and similar submittals required by the Contract Documents in accordance with the submittal schedule approved by the Architect or, in the absence of an approved submittal schedule, with reasonable promptness and in such sequence as to cause no delay in the Work or in the activities of the Owner or of separate contractors.

§ 3.12.6 By submitting Shop Drawings, Product Data, Samples and similar submittals, the Contractor represents to the Owner and Architect that the Contractor has (1) reviewed and approved them, (2) determined and verified materials, field measurements and field construction criteria related thereto, or will do so and (3) checked and coordinated the information contained within such submittals with the requirements of the Work and of the Contract Documents.

§ 3.12.7 The Contractor shall perform no portion of the Work for which the Contract Documents require submittal and review of Shop Drawings, Product Data, Samples or similar submittals until the respective submittal has been approved by the Architect.

§ 3.12.8 The Work shall be in accordance with approved submittals except that the Contractor shall not be relieved of responsibility for deviations from requirements of the Contract Documents by the Architect's approval of Shop Drawings, Product Data, Samples or similar submittals unless the Contractor has specifically informed the Architect in writing of such deviation at the time of submittal and (1) the Architect has given written approval to the specific deviation as a minor change in the Work, or (2) a Change Order or Construction Change Directive has been issued authorizing the deviation. The Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples or similar submittals by the Architect's approval thereof.

§ 3.12.9 The Contractor shall direct specific attention, in writing or on resubmitted Shop Drawings, Product Data, Samples or similar submittals, to revisions other than those requested by the Architect on previous submittals. In the absence of such written notice, the Architect's approval of a resubmission shall not apply to such revisions.

§ 3.12.10 The Contractor shall not be required to provide professional services that constitute the practice of architecture or engineering unless such services are specifically required by the Contract Documents for a portion of the Work or unless the Contractor needs to provide such services in order to carry out the Contractor's responsibilities for construction means, methods, techniques, sequences and procedures. The Contractor shall not be

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required to provide professional services in violation of applicable law. If professional design services or certifications by a design professional related to systems, materials or equipment are specifically required of the Contractor by the Contract Documents, the Owner and the Architect will specify all performance and design criteria that such services must satisfy. The Contractor shall cause such services or certifications to be provided by a properly licensed design professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, Shop Drawings and other submittals prepared by such professional. Shop Drawings and other submittals related to the Work designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to the Architect. The Owner and the Architect shall be entitled to rely upon the adequacy, accuracy and completeness of the services, certifications and approvals performed or provided by such design professionals, provided the Owner and Architect have specified to the Contractor all performance and design criteria that such services must satisfy. Pursuant to this Section 3.12.10, the Architect will review, approve or take other appropriate action on submittals only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. The Contractor shall not be responsible for the adequacy of the performance and design criteria specified in the Contract Documents.

§ 3.13 USE OF SITE

The Contractor shall confine operations at the site to areas permitted by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities and the Contract Documents and shall not unreasonably encumber the site with materials or equipment.

§ 3.14 CUTTING AND PATCHING

§ 3.14.1 The Contractor shall be responsible for cutting, fitting or patching required to complete the Work or to make its parts fit together properly. All areas requiring cutting, fitting and patching shall be restored to the condition existing prior to the cutting, fitting and patching, unless otherwise required by the Contract Documents.

§ 3.14.2 The Contractor shall not damage or endanger a portion of the Work or fully or partially completed construction of the Owner or separate contractors by cutting, patching or otherwise altering such construction, or by excavation. The Contractor shall not cut or otherwise alter such construction by the Owner or a separate contractor except with written consent of the Owner and of such separate contractor; such consent shall not be unreasonably withheld. The Contractor shall not unreasonably withhold from the Owner or a separate contractor the Contractor's consent to cutting or otherwise altering the Work.

§ 3.15 CLEANING UP

§ 3.15.1 The Contractor shall keep the premises and surrounding area free from accumulation of waste materials or rubbish caused by operations under the Contract. At completion of the Work, the Contractor shall remove waste materials, rubbish, the Contractor's tools, construction equipment, machinery and surplus materials from and about the Project.

§ 3.15.2 If the Contractor fails to clean up as provided in the Contract Documents, the Owner may do so and Owner shall be entitled to reimbursement from the Contractor.

§ 3.16 ACCESS TO WORK

The Contractor shall provide the Owner and Architect access to the Work in preparation and progress wherever located.

§ 3.17 ROYALTIES, PATENTS AND COPYRIGHTS

The Contractor shall pay all royalties and license fees. The Contractor shall defend suits or claims for infringement of copyrights and patent rights and shall hold the Owner and Architect harmless from loss on account thereof, but shall not be responsible for such defense or loss when a particular design, process or product of a particular manufacturer or manufacturers is required by the Contract Documents, or where the copyright violations are contained in Drawings, Specifications or other documents prepared by the Owner or Architect. However, if the Contractor has reason to believe that the required design, process or product is an infringement of a copyright or a patent, the Contractor shall be responsible for such loss unless such information is promptly furnished to the Architect.

§ 3.18 INDEMNIFICATION

§ 3.18.1 To the fullest extent permitted by law the Contractor shall indemnify and hold harmless the Owner, Architect, Architect's consultants, and agents and employees of any of them from and against claims, damages, losses and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work, provided that such claim, damage, loss or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), but only to the extent caused by the negligent acts or omissions of the Contractor, a Subcontractor, anyone directly or indirectly employed by them or anyone for whose acts they may be liable, regardless of whether or not such claim, damage, loss or expense is caused in part by a party indemnified hereunder. Such obligation shall not be construed to negate, abridge, or reduce other rights or obligations of indemnity that would otherwise exist as to a party or person described in this Section 3.18.

§ 3.18.2 In claims against any person or entity indemnified under this Section 3.18 by an employee of the Contractor, a Subcontractor, anyone directly or indirectly employed by them or anyone for whose acts they may be liable, the indemnification obligation under Section 3.18.1 shall not be limited by a limitation on amount or type of damages, compensation or benefits payable by or for the Contractor or a Subcontractor under workers' compensation acts, disability benefit acts or other employee benefit acts.

ARTICLE 4 ARCHITECT

§ 4.1 GENERAL

§ 4.1.1 The Owner shall retain an architect lawfully licensed to practice architecture or an entity lawfully practicing architecture in the jurisdiction where the Project is located. That person or entity is identified as the Architect in the Agreement and is referred to throughout the Contract Documents as if singular in number.

§ 4.1.2 Duties, responsibilities and limitations of authority of the Architect as set forth in the Contract Documents shall not be restricted, modified or extended without written consent of the Owner, Contractor and Architect. Consent shall not be unreasonably withheld.

§ 4.1.3 If the employment of the Architect is terminated, the Owner shall employ a successor architect as to whom the Contractor has no reasonable objection and whose status under the Contract Documents shall be that of the Architect.

§ 4.2 ADMINISTRATION OF THE CONTRACT

§ 4.2.1 The Architect will provide administration of the Contract as described in the Contract Documents and will be an Owner's representative during construction until the date the Architect issues the final Certificate for Payment. The Architect will have authority to act on behalf of the Owner only to the extent provided in the Contract Documents.

§ 4.2.2 The Architect will visit the site at intervals appropriate to the stage of construction, or as otherwise agreed with the Owner, to become generally familiar with the progress and quality of the portion of the Work completed, and to determine in general 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. However, the Architect will not be required to make exhaustive or continuous on-site inspections to check the quality or quantity of the Work. The Architect will not have control over, charge of, or responsibility for, the construction means, methods, techniques, sequences or procedures, or for the safety precautions and programs in connection with the Work, since these are solely the Contractor's rights and responsibilities under the Contract Documents, except as provided in Section 3.3.1.

§ 4.2.3 On the basis of the site visits, the Architect will keep the Owner reasonably informed about the progress and quality of the portion of the Work completed, and report to the Owner (1) known 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. The Architect will not be responsible for the Contractor's failure to perform the Work in accordance with the requirements of the Contract Documents. The Architect will not have control over or charge of and will not be responsible for acts or omissions of the Contractor, Subcontractors, or their agents or employees, or any other persons or entities performing portions of the Work.

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§ 4.2.4 COMMUNICATIONS FACILITATING CONTRACT ADMINISTRATION

Except as otherwise provided in the Contract Documents or when direct communications have been specially authorized, the Owner and Contractor shall endeavor to communicate with each other through the Architect about matters arising out of or relating to the Contract. Communications by and with the Architect's consultants shall be through the Architect. Communications by and with Subcontractors and material suppliers shall be through the Contractor. Communications by and with separate contractors shall be through the Owner.

§ 4.2.5 Based on the Architect's evaluations of the Contractor's Applications for Payment, the Architect will review and certify the amounts due the Contractor and will issue Certificates for Payment in such amounts.

§ 4.2.6 The Architect has authority to reject Work that does not conform to the Contract Documents. Whenever the Architect considers it necessary or advisable, the Architect will have authority to require inspection or testing of the Work in accordance with Sections 13.5.2 and 13.5.3, whether or not such Work is fabricated, installed or completed. However, neither this authority of the Architect nor a decision made in good faith either to exercise or not to exercise such authority shall give rise to a duty or responsibility of the Architect to the Contractor, Subcontractors, material and equipment suppliers, their agents or employees, or other persons or entities performing portions of the Work.

§ 4.2.7 The Architect will review and approve, or take other appropriate action upon, the Contractor's submittals such as Shop Drawings, Product Data and Samples, but only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. The Architect's action will be taken in accordance with the submittal schedule approved by the Architect or, in the absence of an approved submittal schedule, with reasonable promptness while allowing sufficient time in the Architect's professional judgment to permit adequate review. Review of such submittals is not conducted for the purpose of determining the accuracy and completeness of other details such as dimensions and quantities, or for substantiating instructions for installation or performance of equipment or systems, all of which remain the responsibility of the Contractor as required by the Contract Documents. The Architect's review of the Contractor's submittals shall not relieve the Contractor of the obligations under Sections 3.3, 3.5 and 3.12. The Architect's review shall not constitute approval of safety precautions or, unless otherwise specifically stated by the Architect, of any construction means, methods, techniques, sequences or procedures. The Architect's approval of a specific item shall not indicate approval of an assembly of which the item is a component.

§ 4.2.8 The Architect will prepare Change Orders and Construction Change Directives, and may authorize minor changes in the Work as provided in Section 7.4. The Architect will investigate and make determinations and recommendations regarding concealed and unknown conditions as provided in Section 3.7.4.

§ 4.2.9 The Architect will conduct inspections to determine the date or dates of Substantial Completion and the date of final completion; issue Certificates of Substantial Completion pursuant to Section 9.8; receive and forward to the Owner, for the Owner's review and records, written warranties and related documents required by the Contract and assembled by the Contractor pursuant to Section 9.10; and issue a final Certificate for Payment pursuant to Section 9.10.

§ 4.2.10 If the Owner and Architect agree, the Architect will provide one or more project representatives to assist in carrying out the Architect's responsibilities at the site. The duties, responsibilities and limitations of authority of such project representatives shall be as set forth in an exhibit to be incorporated in the Contract Documents.

§ 4.2.11 The Architect will interpret and decide matters concerning performance under, and requirements of, the Contract Documents on written request of either the Owner or Contractor. The Architect's response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness.

§ 4.2.12 Interpretations and decisions of the Architect will be consistent with the intent of, and reasonably inferable from, the Contract Documents and will be in writing or in the form of drawings. When making such interpretations and decisions, the Architect will endeavor to secure faithful performance by both Owner and Contractor, will not show partiality to either and will not be liable for results of interpretations or decisions rendered in good faith.

§ 4.2.13 The Architect's decisions on matters relating to aesthetic effect will be final if consistent with the intent expressed in the Contract Documents.

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§ 4.2.14 The Architect will review and respond to requests for information about the Contract Documents. The Architect's response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness. If appropriate, the Architect will prepare and issue supplemental Drawings and Specifications in response to the requests for information.

ARTICLE 5 SUBCONTRACTORS

§ 5.1 DEFINITIONS

§ 5.1.1 A Subcontractor is a person or entity who has a direct contract with the Contractor to perform a portion of the Work at the site. The term "Subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Subcontractor or an authorized representative of the Subcontractor. The term "Subcontractor" does not include a separate contractor or subcontractors of a separate contractor.

§ 5.1.2 A Sub-subcontractor is a person or entity who has a direct or indirect contract with a Subcontractor to perform a portion of the Work at the site. The term "Sub-subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Sub-subcontractor or an authorized representative of the Sub-subcontractor.

§ 5.2 AWARD OF SUBCONTRACTS AND OTHER CONTRACTS FOR PORTIONS OF THE WORK

§ 5.2.1 Unless otherwise stated in the Contract Documents or the bidding requirements, the Contractor, as soon as practicable after award of the Contract, shall furnish in writing to the Owner through the Architect the names of persons or entities (including those who are to furnish materials or equipment fabricated to a special design) proposed for each principal portion of the Work. The Architect may reply within 14 days to the Contractor in writing stating (1) whether the Owner or the Architect has reasonable objection to any such proposed person or entity or (2) that the Architect requires additional time for review. Failure of the Owner or Architect to reply within the 14-day period shall constitute notice of no reasonable objection.

§ 5.2.2 The Contractor shall not contract with a proposed person or entity to whom the Owner or Architect has made reasonable and timely objection. The Contractor shall not be required to contract with anyone to whom the Contractor has made reasonable objection.

§ 5.2.3 If the Owner or Architect has reasonable objection to a person or entity proposed by the Contractor, the Contractor shall propose another to whom the Owner or Architect has no reasonable objection. If the proposed but rejected Subcontractor was reasonably capable of performing the Work, the Contract Sum and Contract Time shall be increased or decreased by the difference, if any, occasioned by such change, and an appropriate Change Order shall be issued before commencement of the substitute Subcontractor's Work. However, no increase in the Contract Sum or Contract Time shall be allowed for such change unless the Contractor has acted promptly and responsively in submitting names as required.

§ 5.2.4 The Contractor shall not substitute a Subcontractor, person or entity previously selected if the Owner or Architect makes reasonable objection to such substitution.

§ 5.3 SUBCONTRACTUAL RELATIONS

By appropriate agreement, written where legally required for validity, 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 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.

§ 5.4 CONTINGENT ASSIGNMENT OF SUBCONTRACTS

§ 5.4.1 Each subcontract agreement for a portion of the Work is assigned by the Contractor to the Owner, provided that

- .1 assignment is effective only after termination of the Contract by the Owner for cause pursuant to Section 14.2 and only for those subcontract agreements that the Owner accepts by notifying the Subcontractor and Contractor in writing; and
- .2 assignment is subject to the prior rights of the surety, if any, obligated under bond relating to the Contract.

When the Owner accepts the assignment of a subcontract agreement, the Owner assumes the Contractor's rights and obligations under the subcontract.

§ 5.4.2 Upon such assignment, if the Work has been suspended for more than 30 days, the Subcontractor's compensation shall be equitably adjusted for increases in cost resulting from the suspension.

§ 5.4.3 Upon such assignment to the Owner under this Section 5.4, the Owner may further assign the subcontract to a successor contractor or other entity. If the Owner assigns the subcontract to a successor contractor or other entity, the Owner shall nevertheless remain legally responsible for all of the successor contractor's obligations under the subcontract.

ARTICLE 6 CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

§ 6.1 OWNER'S RIGHT TO PERFORM CONSTRUCTION AND TO AWARD SEPARATE CONTRACTS

§ 6.1.1 The Owner reserves the right to perform construction or operations related to the Project with the Owner's own forces, and to award separate contracts in connection with other portions of the Project or other construction or operations on the site under Conditions of the Contract identical or substantially similar to these including those portions related to insurance and waiver of subrogation. If the Contractor claims that delay or additional cost is involved because of such action by the Owner, the Contractor shall make such Claim as provided in Article 15.

§ 6.1.2 When separate contracts are awarded for different portions of the Project or other construction or operations on the site, the term "Contractor" in the Contract Documents in each case shall mean the Contractor who executes each separate Owner-Contractor Agreement.

§ 6.1.3 The Owner shall provide for coordination of the activities of the Owner's own forces and of each separate contractor with the Work of the Contractor, who shall cooperate with them. The Contractor shall participate with other separate contractors and the Owner in reviewing their construction schedules. The Contractor shall make any revisions to the construction schedule deemed necessary after a joint review and mutual agreement. The construction schedules shall then constitute the schedules to be used by the Contractor, separate contractors and the Owner until subsequently revised.

§ 6.1.4 Unless otherwise provided in the Contract Documents, when the Owner performs construction or operations related to the Project with the Owner's own forces, the Owner shall be deemed to be subject to the same obligations and to have the same rights that apply to the Contractor under the Conditions of the Contract, including, without excluding others, those stated in Article 3, this Article 6 and Articles 10, 11 and 12.

§ 6.2 MUTUAL RESPONSIBILITY

§ 6.2.1 The Contractor shall afford the Owner and separate contractors reasonable opportunity for introduction and storage of their materials and equipment and performance of their activities, and shall connect and coordinate the Contractor's construction and operations with theirs as required by the Contract Documents.

§ 6.2.2 If part of the Contractor's Work depends for proper execution or results upon construction or operations by the Owner or a separate contractor, the Contractor shall, prior to proceeding with that portion of the Work, promptly report to the Architect apparent discrepancies or defects in such other construction that would render it unsuitable for such proper execution and results. Failure of the Contractor so to report shall constitute an acknowledgment that

the Owner's or separate contractor's completed or partially completed construction is fit and proper to receive the Contractor's Work, except as to defects not then reasonably discoverable.

§ 6.2.3 The Contractor shall reimburse the Owner for costs the Owner incurs that are payable to a separate contractor because of the Contractor's delays, improperly timed activities or defective construction. The Owner shall be responsible to the Contractor for costs the Contractor incurs because of a separate contractor's delays, improperly timed activities, damage to the Work or defective construction.

§ 6.2.4 The Contractor shall promptly remedy damage the Contractor wrongfully causes to completed or partially completed construction or to property of the Owner or separate contractors as provided in Section 10.2.5.

§ 6.2.5 The Owner and each separate contractor shall have the same responsibilities for cutting and patching as are described for the Contractor in Section 3.14.

§ 6.3 OWNER'S RIGHT TO CLEAN UP

If a dispute arises among the Contractor, separate contractors and the Owner as to the responsibility under their respective contracts for maintaining the premises and surrounding area free from waste materials and rubbish, the Owner may clean up and the Architect will allocate the cost among those responsible.

ARTICLE 7 CHANGES IN THE WORK

§ 7.1 GENERAL

§ 7.1.1 Changes in the Work may be accomplished after execution of the Contract, and without invalidating the Contract, by Change Order, Construction Change Directive or order for a minor change in the Work, subject to the limitations stated in this Article 7 and elsewhere in the Contract Documents.

§ 7.1.2 A Change Order shall be based upon agreement among the Owner, Contractor and Architect; a Construction Change Directive requires agreement by the Owner and Architect and may or may not be agreed to by the Contractor; an order for a minor change in the Work may be issued by the Architect alone.

§ 7.1.3 Changes in the Work shall be performed under applicable provisions of the Contract Documents, and the Contractor shall proceed promptly, unless otherwise provided in the Change Order, Construction Change Directive or order for a minor change in the Work.

§ 7.2 CHANGE ORDERS

§ 7.2.1 A Change Order is a written instrument prepared by the Architect 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.

§ 7.3 CONSTRUCTION CHANGE DIRECTIVES

§ 7.3.1 A Construction Change Directive is a written order prepared by the Architect and signed by the Owner and Architect, directing a change in the Work prior to agreement on adjustment, if any, in the Contract Sum or Contract Time, or both. The Owner may by Construction Change Directive, without invalidating the Contract, order changes in the Work within the general scope of the Contract consisting of additions, deletions or other revisions, the Contract Sum and Contract Time being adjusted accordingly.

§ 7.3.2 A Construction Change Directive shall be used in the absence of total agreement on the terms of a Change Order.

§ 7.3.3 If the Construction Change Directive provides for an adjustment to the Contract Sum, the adjustment shall be based on one of the following methods:

- .1 Mutual acceptance of a lump sum properly itemized and supported by sufficient substantiating data to permit evaluation;
- .2 Unit prices stated in the Contract Documents or subsequently agreed upon;
- .3 Cost to be determined in a manner agreed upon by the parties and a mutually acceptable fixed or percentage fee; or

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.4 As provided in Section 7.3.7.

§ 7.3.4 If unit prices are stated in the Contract Documents or subsequently agreed upon, and if quantities originally contemplated are materially changed in a proposed Change Order or Construction Change Directive so that application of such unit prices to quantities of Work proposed will cause substantial inequity to the Owner or Contractor, the applicable unit prices shall be equitably adjusted.

§ 7.3.5 Upon receipt of a Construction Change Directive, the Contractor shall promptly proceed with the change in the Work involved and advise the Architect of the Contractor's agreement or disagreement with the method, if any, provided in the Construction Change Directive for determining the proposed adjustment in the Contract Sum or Contract Time.

§ 7.3.6 A Construction Change Directive signed by the Contractor indicates the Contractor's agreement therewith, including adjustment in Contract Sum and Contract Time or the method for determining them. Such agreement shall be effective immediately and shall be recorded as a Change Order.

§ 7.3.7 If the Contractor does not respond promptly or disagrees with the method for adjustment in the Contract Sum, the Architect shall determine 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 the Agreement, or if no such amount is set forth in the Agreement, a reasonable amount. In such case, and also under Section 7.3.3.3, 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;
- .4 Costs of premiums for all bonds and insurance, permit fees, and sales, use or similar taxes related to the Work; and
- .5 Additional costs of supervision and field office personnel directly attributable to the change.

§ 7.3.8 The amount of credit to be allowed by the Contractor to the Owner for a deletion or change that results in a net decrease in the Contract Sum shall be actual net cost as confirmed by the Architect. When both additions and credits covering related Work or substitutions are involved in a change, the allowance for overhead and profit shall be figured on the basis of net increase, if any, with respect to that change.

§ 7.3.9 Pending final determination of the total cost of a Construction Change Directive to the Owner, the Contractor may request payment for Work completed under the Construction Change Directive in Applications for Payment. The Architect will make an interim determination for purposes of monthly certification for payment for those costs and certify for payment the amount that the Architect determines, in the Architect's professional judgment, to be reasonably justified. 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.

§ 7.3.10 When the Owner and Contractor agree with a determination made by the Architect concerning the adjustments in the Contract Sum and Contract Time, or otherwise reach agreement upon the adjustments, such agreement shall be effective immediately and the Architect will prepare a Change Order. Change Orders may be issued for all or any part of a Construction Change Directive.

§ 7.4 MINOR CHANGES IN THE WORK

The Architect has authority to order minor changes in the Work not involving adjustment in the Contract Sum or extension of the Contract Time and not inconsistent with the intent of the Contract Documents. Such changes will be effected by written order signed by the Architect and shall be binding on the Owner and Contractor.

ARTICLE 8 TIME

§ 8.1 DEFINITIONS

§ 8.1.1 Unless otherwise provided, Contract Time is the period of time, including authorized adjustments, allotted in the Contract Documents for Substantial Completion of the Work.

§ 8.1.2 The date of commencement of the Work is the date established in the Agreement.

§ 8.1.3 The date of Substantial Completion is the date certified by the Architect in accordance with Section 9.8.

§ 8.1.4 The term "day" as used in the Contract Documents shall mean calendar day unless otherwise specifically defined.

§ 8.2 PROGRESS AND COMPLETION

§ 8.2.1 Time limits stated in the Contract Documents are of the essence of the Contract. By executing the Agreement the Contractor confirms that the Contract Time is a reasonable period for performing the Work.

§ 8.2.2 The Contractor shall not knowingly, except by agreement or instruction of the Owner in writing, prematurely commence operations on the site or elsewhere prior to the effective date of 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 insurance.

§ 8.2.3 The Contractor shall proceed expeditiously with adequate forces and shall achieve Substantial Completion within the Contract Time.

§ 8.3 DELAYS AND EXTENSIONS OF TIME

§ 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 Contractor's control; or by delay authorized by the Owner pending mediation and arbitration; or by other causes that the Architect determines may justify delay, then the Contract Time shall be extended by Change Order for such reasonable time as the Architect may determine.

§ 8.3.2 Claims relating to time shall be made in accordance with applicable provisions of Article 15.

§ 8.3.3 This Section 8.3 does not preclude recovery of damages for delay by either party under other provisions of the Contract Documents.

ARTICLE 9 PAYMENTS AND COMPLETION

§ 9.1 CONTRACT SUM

The Contract Sum is stated in the Agreement and, including authorized adjustments, is the total amount payable by the Owner to the Contractor for performance of the Work under the Contract Documents.

§ 9.2 SCHEDULE OF VALUES

Where the Contract is based on a stipulated sum or Guaranteed Maximum Price, the Contractor shall submit to the Architect, before the first Application for Payment, 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.

§ 9.3 APPLICATIONS FOR PAYMENT

§ 9.3.1 At least ten days before the date established for each progress payment, 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 if provided for in the Contract Documents.

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§ 9.3.1.1 As provided in Section 7.3.9, such applications may include requests for payment on account of changes in the Work that have been properly authorized by Construction Change Directives, or by interim determinations of the Architect, but not yet included in Change Orders.

§ 9.3.1.2 Applications for Payment shall not include requests for payment for portions of the Work for which the Contractor does not intend to pay a Subcontractor or material supplier, unless such Work has been performed by others whom the Contractor intends to pay.

§ 9.3.2 Unless otherwise provided in the Contract Documents, payments shall be made on account of materials and equipment delivered and suitably stored at the site for subsequent incorporation in the Work. If approved in advance by the Owner, payment may similarly be made for materials and equipment suitably stored off the site at a location agreed upon in writing. Payment for materials and equipment stored on or off the site shall be conditioned upon compliance by the Contractor with procedures satisfactory to the Owner to establish the Owner's title to such materials and equipment or otherwise protect the Owner's interest, and shall include the costs of applicable insurance, storage and transportation to the site for such materials and equipment stored off the site.

§ 9.3.3 The Contractor warrants that title to all Work covered by an Application for Payment will pass to the Owner no later than the time of payment. The Contractor further warrants that upon submittal of an Application for Payment all Work for which Certificates for Payment have been previously issued and payments received from the Owner shall, to the best of the Contractor's knowledge, information and belief, be free and clear of liens, claims, security interests or encumbrances in favor of the Contractor, Subcontractors, material suppliers, or other persons or entities making a claim by reason of having provided labor, materials and equipment relating to the Work.

§ 9.4 CERTIFICATES FOR PAYMENT

§ 9.4.1 The Architect will, within seven days after receipt of the Contractor's Application for Payment, either issue to the Owner a Certificate for Payment, with a copy to the Contractor, for such amount as the Architect determines is properly due, or notify the Contractor and Owner in writing of the Architect's reasons for withholding certification in whole or in part as provided in Section 9.5.1.

§ 9.4.2 The issuance of a Certificate for Payment will constitute a representation by the Architect to the Owner, based on the Architect's evaluation of the Work and the data comprising the Application for Payment, that, to the best of the Architect's knowledge, information and belief, the Work has progressed to the point indicated and that the quality of the Work is in accordance with the Contract Documents. The foregoing representations are subject to an evaluation of the Work for conformance with the Contract Documents upon Substantial Completion, to results of subsequent tests and inspections, to correction of minor deviations from the Contract Documents prior to completion and to specific qualifications expressed by the Architect. The issuance of a Certificate for Payment will further constitute a representation that the Contractor is entitled to payment in the amount certified. However, the issuance of a Certificate for Payment will not be a representation that the Architect has (1) made exhaustive or continuous on-site inspections to check the quality or quantity of the Work, (2) reviewed construction means, methods, techniques, sequences or procedures, (3) reviewed copies of requisitions received from Subcontractors and material suppliers and other data requested by the Owner to substantiate the Contractor's right to payment, or (4) made examination to ascertain how or for what purpose the Contractor has used money previously paid on account of the Contract Sum.

§ 9.5 DECISIONS TO WITHHOLD CERTIFICATION

§ 9.5.1 The Architect may withhold a Certificate for Payment in whole or in part, to the extent reasonably necessary to protect the Owner, if in the Architect's opinion the representations to the Owner required by Section 9.4.2 cannot be made. If the Architect is unable to certify payment in the amount of the Application, the Architect will notify the Contractor and Owner as provided in Section 9.4.1. If the Contractor and Architect cannot agree on a revised amount, the Architect will promptly issue a Certificate for Payment for the amount for which the Architect is able to make such representations to the Owner. The Architect may also withhold a Certificate for Payment or, because of subsequently discovered evidence, may nullify the whole or a part of a Certificate for Payment previously issued, to such extent as may be necessary in the Architect's opinion to protect the Owner from loss for which the Contractor is responsible, including loss resulting from acts and omissions described in Section 3.3.2, because of

- .1 defective Work not remedied;
- .2 third party claims filed or reasonable evidence indicating probable filing of such claims unless security acceptable to the Owner is provided by the Contractor;

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- .3 failure of the Contractor to make payments properly to Subcontractors or for labor, materials or equipment;
- .4 reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum;
- .5 damage to the Owner or a separate contractor;
- .6 reasonable evidence that the Work will not be completed within the Contract Time, and that the unpaid balance would not be adequate to cover actual or liquidated damages for the anticipated delay; or
- .7 repeated failure to carry out the Work in accordance with the Contract Documents.

§ 9.5.2 When the above reasons for withholding certification are removed, certification will be made for amounts previously withheld.

§ 9.5.3 If the Architect withholds certification for payment under Section 9.5.1.3, the Owner may, at its sole option, issue joint checks to the Contractor and to any Subcontractor or material or equipment suppliers to whom the Contractor failed to make payment for Work properly performed or material or equipment suitably delivered. If the Owner makes payments by joint check, the Owner shall notify the Architect and the Architect will reflect such payment on the next Certificate for Payment.

§ 9.6 PROGRESS PAYMENTS

§ 9.6.1 After the Architect has issued a Certificate for Payment, the Owner shall make payment in the manner and within the time provided in the Contract Documents, and shall so notify the Architect.

§ 9.6.2 The Contractor shall pay each Subcontractor no later than seven days after receipt of payment from the Owner the amount to which the Subcontractor is entitled, reflecting percentages actually retained from payments to the Contractor on account of the Subcontractor's portion of the Work. The Contractor shall, by appropriate agreement with each Subcontractor, require each Subcontractor to make payments to Sub-subcontractors in a similar manner.

§ 9.6.3 The Architect will, on request, furnish to a Subcontractor, if practicable, information regarding percentages of completion or amounts applied for by the Contractor and action taken thereon by the Architect and Owner on account of portions of the Work done by such Subcontractor.

§ 9.6.4 The Owner has the right to request written evidence from the Contractor that the Contractor has properly paid Subcontractors and material and equipment suppliers amounts paid by the Owner to the Contractor for subcontracted Work. If the Contractor fails to furnish such evidence within seven days, the Owner shall have the right to contact Subcontractors to ascertain whether they have been properly paid. Neither the Owner nor Architect shall have an obligation to pay or to see to the payment of money to a Subcontractor, except as may otherwise be required by law.

§ 9.6.5 Contractor payments to material and equipment suppliers shall be treated in a manner similar to that provided in Sections 9.6.2, 9.6.3 and 9.6.4.

§ 9.6.6 A Certificate for Payment, a progress payment, or partial or entire use or occupancy of the Project by the Owner shall not constitute acceptance of Work not in accordance with the Contract Documents.

§ 9.6.7 Unless the Contractor provides the Owner with a payment bond in the full penal sum of the Contract Sum, payments received by the Contractor for Work properly performed by Subcontractors and suppliers shall be held by the Contractor for those Subcontractors or suppliers who performed Work or furnished materials, or both, under contract with the Contractor for which payment was made by the Owner. Nothing contained herein shall require money to be placed in a separate account and not commingled with money of the Contractor, shall create any fiduciary liability or tort liability on the part of the Contractor for breach of trust or shall entitle any person or entity to an award of punitive damages against the Contractor for breach of the requirements of this provision.

§ 9.7 FAILURE OF PAYMENT

If the Architect does not issue a Certificate for Payment, 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 date established in the Contract Documents the amount certified by the Architect or awarded by binding dispute resolution, then the Contractor may, upon seven additional days' written notice to the Owner and Architect,

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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 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.

§ 9.8 SUBSTANTIAL COMPLETION

§ 9.8.1 Substantial Completion is the stage in the progress of the Work when the Work or designated portion thereof is sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work for its intended use.

§ 9.8.2 When the Contractor considers that the Work, or a portion thereof which the Owner agrees to accept separately, is substantially complete, the Contractor shall prepare and submit to the Architect a comprehensive list of items to be completed or corrected prior to final payment. Failure to include an item on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.

§ 9.8.3 Upon receipt of the Contractor's list, the Architect will make an inspection to determine whether the Work or designated portion thereof is substantially complete. 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.

§ 9.8.4 When the Work or designated portion thereof is substantially complete, the Architect will prepare a Certificate of Substantial Completion that shall establish the date of Substantial Completion, shall establish responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance, and shall fix the time within which the Contractor shall finish all items on the list accompanying the Certificate. Warranties required by the Contract Documents shall commence on the date of Substantial Completion of the Work or designated portion thereof unless otherwise provided in the Certificate of Substantial Completion.

§ 9.8.5 The Certificate of Substantial Completion shall be submitted to the Owner and Contractor for their written acceptance of responsibilities assigned to them in such Certificate. Upon such acceptance and consent of surety, if any, the Owner shall make payment of retainage applying to such Work or designated portion thereof. Such payment shall be adjusted for Work that is incomplete or not in accordance with the requirements of the Contract Documents.

§ 9.9 PARTIAL OCCUPANCY OR USE

§ 9.9.1 The Owner may occupy or use any completed or partially completed portion of the Work at any stage when such portion is designated by separate agreement with the Contractor, provided such occupancy or use is consented to by the insurer as required under Section 11.3.1.5 and authorized by public authorities having jurisdiction over the Project. Such partial occupancy or use may commence whether or not the portion is substantially complete, provided the Owner and Contractor have accepted in writing the responsibilities assigned to each of them for payments, retainage, if any, security, maintenance, heat, utilities, damage to the Work and insurance, and have agreed in writing concerning the period for correction of the Work and commencement of warranties required by the Contract Documents. When the Contractor considers a portion substantially complete, the Contractor shall prepare and submit a list to the Architect as provided under Section 9.8.2. Consent of the Contractor to partial occupancy or use shall not be unreasonably withheld. The stage of the progress of the Work shall be determined by written agreement between the Owner and Contractor or, if no agreement is reached, by decision of the Architect.

§ 9.9.2 Immediately prior to such partial occupancy or use, the Owner, Contractor and Architect shall jointly inspect the area to be occupied or portion of the Work to be used in order to determine and record the condition of the Work.

§ 9.9.3 Unless otherwise agreed upon, partial occupancy or use of a portion or portions of the Work shall not constitute acceptance of Work not complying with the requirements of the Contract Documents.

§ 9.10 FINAL COMPLETION AND FINAL PAYMENT

§ 9.10.1 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 will promptly make such inspection and, when the

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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.

§ 9.10.2 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 and (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, to the extent and in such form as may be designated by the Owner. If a Subcontractor refuses to furnish a release or waiver required by the Owner, the Contractor may furnish a bond satisfactory to the Owner to indemnify the Owner against such lien. If such lien remains unsatisfied after payments are made, the Contractor shall refund to the Owner all money that the Owner may be compelled to pay in discharging such lien, including all costs and reasonable attorneys' fees.

§ 9.10.3 If, after Substantial Completion of the Work, final completion thereof is materially delayed 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. If the remaining balance for Work not fully completed or corrected is less than retainage stipulated in the Contract Documents, and if bonds have been furnished, the written consent of surety to payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by the Contractor to the Architect prior to certification of such payment. Such payment shall be made under terms and conditions governing final payment, except that it shall not constitute a waiver of claims.

§ 9.10.4 The making of final payment shall constitute a waiver of Claims by the Owner except those arising from

- .1 liens, Claims, security interests or encumbrances arising out of the Contract and unsettled;
- .2 failure of the Work to comply with the requirements of the Contract Documents; or
- .3 terms of special warranties required by the Contract Documents.

§ 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 previously made in writing and identified by that payee as unsettled at the time of final Application for Payment.

ARTICLE 10 PROTECTION OF PERSONS AND PROPERTY

§ 10.1 SAFETY PRECAUTIONS AND PROGRAMS

The Contractor shall be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the performance of the Contract.

§ 10.2 SAFETY OF PERSONS AND PROPERTY

§ 10.2.1 The Contractor shall take reasonable precautions for safety of, and shall provide reasonable protection to prevent damage, injury or loss to

- .1 employees on the Work and other persons who may be affected thereby;
- .2 the Work and materials and equipment to be incorporated therein, whether in storage on or off the site, under care, custody or control of the Contractor or the Contractor's Subcontractors or Sub-subcontractors; and
- .3 other property at the site or adjacent thereto, such as trees, shrubs, lawns, walks, pavements, roadways, structures and utilities not designated for removal, relocation or replacement in the course of construction.

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§ 10.2.2 The Contractor shall comply with and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities bearing on safety of persons or property or their protection from damage, injury or loss.

§ 10.2.3 The Contractor shall erect and maintain, as required by existing conditions and performance of the Contract, reasonable safeguards for safety and protection, including posting danger signs and other warnings against hazards, promulgating safety regulations and notifying owners and users of adjacent sites and utilities.

§ 10.2.4 When use or storage of explosives or other hazardous materials or equipment or unusual methods are necessary for execution of the Work, the Contractor shall exercise utmost care and carry on such activities under supervision of properly qualified personnel.

§ 10.2.5 The Contractor shall promptly remedy damage and loss (other than damage or loss insured under property insurance required by the Contract Documents) to property referred to in Sections 10.2.1.2 and 10.2.1.3 caused in whole or in part by the Contractor, a Subcontractor, a Sub-subcontractor, or anyone directly or indirectly employed by any of them, or by anyone for whose acts they may be liable and for which the Contractor is responsible under Sections 10.2.1.2 and 10.2.1.3, except damage or loss attributable to acts or omissions of the Owner or Architect or anyone directly or indirectly employed by either of them, or by anyone for whose acts either of them may be liable, and not attributable to the fault or negligence of the Contractor. The foregoing obligations of the Contractor are in addition to the Contractor's obligations under Section 3.18.

§ 10.2.6 The Contractor shall designate a responsible member of the Contractor's organization at the site whose duty shall be the prevention of accidents. This person shall be the Contractor's superintendent unless otherwise designated by the Contractor in writing to the Owner and Architect.

§ 10.2.7 The Contractor shall not permit any part of the construction or site to be loaded so as to cause damage or create an unsafe condition.

§ 10.2.8 INJURY OR DAMAGE TO PERSON OR PROPERTY

If either party suffers injury or damage to person or property because of an act or omission of the other party, or of others for whose acts such party is legally responsible, written notice of such injury or damage, whether or not insured, shall be given to the other party within a reasonable time not exceeding 21 days after discovery. The notice shall provide sufficient detail to enable the other party to investigate the matter.

§ 10.3 HAZARDOUS MATERIALS

§ 10.3.1 The Contractor is responsible for compliance with any requirements included in the Contract Documents regarding hazardous materials. If the Contractor encounters a hazardous material or substance not addressed in the Contract Documents and if reasonable precautions will be inadequate to prevent foreseeable bodily injury or death to persons resulting from a material or substance, including but not limited to asbestos or polychlorinated biphenyl (PCB), 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.

§ 10.3.2 Upon receipt of the Contractor's written notice, the Owner shall obtain the services of a licensed laboratory to verify the presence or absence of the material or substance reported by the Contractor and, in the event such material or substance is found to be present, to cause it to be rendered harmless. Unless otherwise required by the Contract Documents, the Owner shall furnish in writing to the Contractor and Architect the names and qualifications of persons or entities who are to perform tests verifying the presence or absence of such material or substance or who are to perform the task of removal or safe containment of such material or substance. The Contractor and the Architect will promptly reply to the Owner in writing stating whether or not either has reasonable objection to the persons or entities proposed by the Owner. If either the Contractor or Architect has an objection to a person or entity proposed by the Owner, the Owner shall propose another to whom the Contractor and the Architect have no reasonable objection. When the material or substance has been rendered harmless, Work in the affected area shall resume upon written agreement of the Owner and Contractor. By Change Order, the Contract Time shall be extended appropriately and the Contract Sum shall be increased in the amount of the Contractor's reasonable additional costs of shut-down, delay and start-up.

§ 10.3.3 To the fullest extent permitted by law, the Owner shall indemnify and hold harmless the Contractor, Subcontractors, Architect, Architect's consultants and agents and employees of any of them from and against claims, damages, losses and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work in the affected area if in fact the material or substance presents the risk of bodily injury or death as described in Section 10.3.1 and has not been rendered harmless, provided that such claim, damage, loss or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), except to the extent that such damage, loss or expense is due to the fault or negligence of the party seeking indemnity.

§ 10.3.4 The Owner shall not be responsible under this Section 10.3 for materials or substances the Contractor brings to the site unless such materials or substances are required by the Contract Documents. The Owner shall be responsible for materials or substances required by the Contract Documents, except to the extent of the Contractor's fault or negligence in the use and handling of such materials or substances.

§ 10.3.5 The Contractor shall indemnify the Owner for the cost and expense the Owner incurs (1) for remediation of a material or substance the Contractor brings to the site and negligently handles, or (2) where the Contractor fails to perform its obligations under Section 10.3.1, except to the extent that the cost and expense are due to the Owner's fault or negligence.

§ 10.3.6 If, without negligence on the part of the Contractor, the Contractor is held liable by a government agency for the cost of remediation of a hazardous material or substance solely by reason of performing Work as required by the Contract Documents, the Owner shall indemnify the Contractor for all cost and expense thereby incurred.

§ 10.4 EMERGENCIES

In an emergency affecting safety of persons or property, the Contractor shall act, at the Contractor's discretion, to prevent threatened damage, injury or loss. Additional compensation or extension of time claimed by the Contractor on account of an emergency shall be determined as provided in Article 15 and Article 7.

ARTICLE 11 INSURANCE AND BONDS

§ 11.1 CONTRACTOR'S LIABILITY INSURANCE

§ 11.1.1 The Contractor shall purchase from and maintain in a company or companies lawfully authorized to do business in the jurisdiction in which the Project is located such insurance as will protect the Contractor from claims set forth below which may arise out of or result from the Contractor's operations and completed operations under the Contract and for which the Contractor may be legally liable, whether such operations be by the Contractor or by a Subcontractor or by anyone directly or indirectly employed by any of them, or by anyone for whose acts any of them may be liable:

- .1 Claims under workers' compensation, disability benefit and other similar employee benefit acts that are applicable to the Work to be performed;
- .2 Claims for damages because of bodily injury, occupational sickness or disease, or death of the Contractor's employees;
- .3 Claims for damages because of bodily injury, sickness or disease, or death of any person other than the Contractor's employees;
- .4 Claims for damages insured by usual personal injury liability coverage;
- .5 Claims for damages, other than to the Work itself, because of injury to or destruction of tangible property, including loss of use resulting therefrom;
- .6 Claims for damages because of bodily injury, death of a person or property damage arising out of ownership, maintenance or use of a motor vehicle;
- .7 Claims for bodily injury or property damage arising out of completed operations; and
- .8 Claims involving contractual liability insurance applicable to the Contractor's obligations under Section 3.18.

§ 11.1.2 The insurance required by Section 11.1.1 shall be written for not less than limits of liability specified in the Contract Documents or required by law, whichever coverage is greater. Coverages, whether written on an occurrence or claims-made basis, 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

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of Work or for such other period for maintenance of completed operations coverage as specified in the Contract Documents.

§ 11.1.3 Certificates of insurance acceptable to the Owner shall be filed with the Owner prior to commencement of the Work and thereafter upon renewal or replacement of each required policy of insurance. These certificates and the insurance policies required by this Section 11.1 shall contain a provision that coverages afforded under the policies will not be canceled or allowed to expire until at least 30 days' prior written notice has been given to the Owner. An additional certificate evidencing continuation of liability coverage, including coverage for completed operations, 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.

§ 11.1.4 The Contractor shall cause the commercial liability coverage required by the Contract Documents to include (1) the Owner, the Architect and the Architect's consultants as additional insureds for claims caused in whole or in part by the Contractor's negligent acts or omissions during the Contractor's operations; and (2) the Owner as an additional insured for claims caused in whole or in part by the Contractor's negligent acts or omissions during the Contractor's completed operations.

§ 11.2 OWNER'S LIABILITY INSURANCE

The Owner shall be responsible for purchasing and maintaining the Owner's usual liability insurance.

§ 11.3 PROPERTY INSURANCE

§ 11.3.1 Unless otherwise provided, the Owner 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 without optional deductibles. Such property insurance shall be maintained, unless otherwise provided in the Contract Documents or otherwise agreed in writing by all persons and entities who are beneficiaries of such insurance, until final payment has been made as provided in Section 9.10 or until no person or entity other than the Owner has an insurable interest in the property required by this Section 11.3 to be covered, whichever is later. This insurance shall include interests of the Owner, the Contractor, Subcontractors and Sub-subcontractors in the Project.

§ 11.3.1.1 Property insurance shall be on an "all-risk" or equivalent policy form and shall include, without limitation, insurance against the perils of fire (with extended coverage) and physical loss or damage including, without duplication of coverage, theft, vandalism, malicious mischief, collapse, earthquake, flood, windstorm, falsework, testing and startup, temporary buildings and debris removal including demolition occasioned by enforcement of any applicable legal requirements, and shall cover reasonable compensation for Architect's and Contractor's services and expenses required as a result of such insured loss.

§ 11.3.1.2 If the Owner does not intend to purchase such property insurance required by the Contract and with all of the coverages in the amount described above, the Owner shall so inform the Contractor in writing prior to commencement of the Work. The Contractor may then effect insurance that will protect the interests of the Contractor, Subcontractors and Sub-subcontractors in the Work, and by appropriate Change Order the cost thereof shall be charged to the Owner. If the Contractor is damaged by the failure or neglect of the Owner to purchase or maintain insurance as described above, without so notifying the Contractor in writing, then the Owner shall bear all reasonable costs properly attributable thereto.

§ 11.3.1.3 If the property insurance requires deductibles, the Owner shall pay costs not covered because of such deductibles.

§ 11.3.1.4 This property insurance shall cover portions of the Work stored off the site, and also portions of the Work in transit.

§ 11.3.1.5 Partial occupancy or use in accordance with Section 9.9 shall not commence until the insurance company or companies providing property insurance have consented to such partial occupancy or use by endorsement or

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otherwise. The Owner and the Contractor shall take reasonable steps to obtain consent of the insurance company or companies and shall, without mutual written consent, take no action with respect to partial occupancy or use that would cause cancellation, lapse or reduction of insurance.

§ 11.3.2 BOILER AND MACHINERY INSURANCE

The Owner 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 be named insureds.

§ 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. 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.

§ 11.3.4 If the Contractor 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 Owner shall, if possible, include such insurance, and the cost thereof shall be charged to the Contractor by appropriate Change Order.

§ 11.3.5 If during the Project construction period the Owner insures properties, real or personal or both, at or adjacent to the site by property insurance under policies separate from those insuring the Project, or if after final payment property insurance is to be provided on the completed Project through a policy or policies other than those insuring the Project during the construction period, the Owner shall waive all rights in accordance with the terms of Section 11.3.7 for damages caused by fire or other causes of loss covered by this separate property insurance. All separate policies shall provide this waiver of subrogation by endorsement or otherwise.

§ 11.3.6 Before an exposure to loss may occur, the Owner shall file with the Contractor 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 Contractor.

§ 11.3.7 WAIVERS OF SUBROGATION

The Owner and Contractor waive all rights against (1) each other and any of their subcontractors, sub-subcontractors, 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 covered by property insurance obtained pursuant to this Section 11.3 or other property insurance applicable to the Work, except such rights as they have to proceeds of such insurance held by the Owner as fiduciary. The Owner or Contractor, as appropriate, shall require of the Architect, Architect's consultants, separate contractors described in Article 6, if any, and the subcontractors, sub-subcontractors, agents and employees of any of them, by appropriate agreements, written where legally required for validity, similar waivers each in favor of other parties enumerated herein. The policies shall provide such waivers of subrogation by endorsement or otherwise. A waiver of subrogation shall be effective as to a person or entity even though that person or entity would otherwise have a duty of indemnification, contractual or otherwise, did not pay the insurance premium directly or indirectly, and whether or not the person or entity had an insurable interest in the property damaged.

§ 11.3.8 A loss insured under the Owner's property insurance shall be adjusted by the Owner as fiduciary and made payable to the Owner as fiduciary for the insureds, as their interests may appear, subject to requirements of any applicable mortgagee clause and of Section 11.3.10. The Contractor shall pay Subcontractors their just shares of insurance proceeds received by the Contractor, and by appropriate agreements, written where legally required for validity, shall require Subcontractors to make payments to their Sub-subcontractors in similar manner.

§ 11.3.9 If required in writing by a party in interest, the Owner as fiduciary shall, upon occurrence of an insured loss, give bond for proper performance of the Owner's duties. The cost of required bonds shall be charged against proceeds received as fiduciary. The Owner shall deposit in a separate account proceeds so received, which the

Owner shall distribute in accordance with such agreement as the parties in interest may reach, or as determined in accordance with the method of binding dispute resolution selected in the Agreement between the Owner and Contractor. 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 after notification of a Change in the Work in accordance with Article 7.

§ 11.3.10 The Owner 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 Owner's exercise of this power; if such objection is made, the dispute shall be resolved in the manner selected by the Owner and Contractor as the method of binding dispute resolution in the Agreement. If the Owner and Contractor have selected arbitration as the method of binding dispute resolution, the Owner as fiduciary shall make settlement with insurers or, in the case of a dispute over distribution of insurance proceeds, in accordance with the directions of the arbitrators.

§ 11.4 PERFORMANCE BOND AND PAYMENT BOND

§ 11.4.1 The Owner shall have the right to require the Contractor to furnish bonds covering faithful performance of the Contract and payment of obligations arising thereunder as stipulated in bidding requirements or specifically required in the Contract Documents on the date of execution of the Contract.

§ 11.4.2 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.

ARTICLE 12 UNCOVERING AND CORRECTION OF WORK

§ 12.1 UNCOVERING OF WORK

§ 12.1.1 If a portion of the Work is covered contrary to the Architect's request or to requirements specifically expressed in the Contract Documents, it must, if requested in writing by the Architect, be uncovered for the Architect's examination and be replaced at the Contractor's expense without change in the Contract Time.

§ 12.1.2 If a portion of the Work has been covered that the Architect has not specifically requested to examine prior to its being covered, the Architect may request to see such Work and it shall be uncovered by the Contractor. If such Work is in accordance with the Contract Documents, costs of uncovering and replacement shall, by appropriate Change Order, be at the Owner's expense. If such Work is not in accordance with the Contract Documents, such costs and the cost of correction shall be at the Contractor's expense unless the condition was caused by the Owner or a separate contractor in which event the Owner shall be responsible for payment of such costs.

§ 12.2 CORRECTION OF WORK

§ 12.2.1 BEFORE OR AFTER SUBSTANTIAL COMPLETION

The Contractor shall promptly correct Work rejected by the Architect or failing to conform to the requirements of the Contract Documents, whether discovered before or after Substantial Completion and whether or not fabricated, installed or completed. Costs of correcting such rejected Work, including additional testing and inspections, the cost of uncovering and replacement, and compensation for the Architect's services and expenses made necessary thereby, shall be at the Contractor's expense.

§ 12.2.2 AFTER SUBSTANTIAL COMPLETION

§ 12.2.2.1 In addition to the Contractor's obligations under Section 3.5, if, within one year after the date of Substantial Completion of the Work or designated portion thereof or after the date for commencement of warranties established under Section 9.9.1, or by terms of an applicable special warranty required by the Contract Documents, any of the Work is found to be not in accordance with the requirements of the Contract Documents, the Contractor shall correct it promptly after receipt of written notice from the Owner to do so unless the Owner has previously given the Contractor a written acceptance of such condition. The Owner shall give such notice promptly after discovery of the condition. During the one-year period for correction of Work, if the Owner fails to notify the Contractor and give the Contractor an opportunity to make the correction, the Owner waives the rights to require correction by the Contractor and to make a claim for breach of warranty. If the Contractor fails to correct nonconforming Work within a reasonable time during that period after receipt of notice from the Owner or Architect, the Owner may correct it in accordance with Section 2.4.

§ 12.2.2.2 The one-year period for correction of Work shall be extended with respect to portions of Work first performed after Substantial Completion by the period of time between Substantial Completion and the actual completion of that portion of the Work.

§ 12.2.2.3 The one-year period for correction of Work shall not be extended by corrective Work performed by the Contractor pursuant to this Section 12.2.

§ 12.2.3 The Contractor shall remove from the site portions of the Work that are not in accordance with the requirements of the Contract Documents and are neither corrected by the Contractor nor accepted by the Owner.

§ 12.2.4 The Contractor shall bear the cost of correcting destroyed or damaged construction, whether completed or partially completed, of the Owner or separate contractors caused by the Contractor's correction or removal of Work that is not in accordance with the requirements of the Contract Documents.

§ 12.2.5 Nothing contained in this Section 12.2 shall be construed to establish a period of limitation with respect to other obligations the Contractor has under the Contract Documents. Establishment of the one-year period for correction of Work as described in Section 12.2.2 relates only to the specific obligation of the Contractor to correct the Work, and has no relationship to the time within which the obligation to comply with the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish the Contractor's liability with respect to the Contractor's obligations other than specifically to correct the Work.

§ 12.3 ACCEPTANCE OF NONCONFORMING WORK

If the Owner prefers to accept Work that is not in accordance with the requirements of the Contract Documents, the Owner may do so instead of requiring its removal and correction, in which case the Contract Sum will be reduced as appropriate and equitable. Such adjustment shall be effected whether or not final payment has been made.

ARTICLE 13 MISCELLANEOUS PROVISIONS

§ 13.1 GOVERNING LAW

The Contract shall be governed by the law of the place where the Project is located except that, if the parties have selected arbitration as the method of binding dispute resolution, the Federal Arbitration Act shall govern Section 15.4.

§ 13.2 SUCCESSORS AND ASSIGNS

§ 13.2.1 The Owner and Contractor respectively bind themselves, their partners, successors, assigns and legal representatives to covenants, agreements and obligations contained in the Contract Documents. Except as provided in Section 13.2.2, neither party to the Contract shall assign the Contract as a whole without written consent of the other. 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.

§ 13.2.2 The Owner may, without consent of the Contractor, assign the Contract to a lender providing construction financing for the Project, if the lender assumes the Owner's rights and obligations under the Contract Documents. The Contractor shall execute all consents reasonably required to facilitate such assignment.

§ 13.3 WRITTEN NOTICE

Written notice shall be deemed to have been duly served if delivered in person to the individual, to a member of the firm or entity, or to an officer of the corporation for which it was intended; or if delivered at, or sent by registered or certified mail or by courier service providing proof of delivery to, the last business address known to the party giving notice.

§ 13.4 RIGHTS AND REMEDIES

§ 13.4.1 Duties and obligations imposed by the Contract Documents and rights and remedies available thereunder shall be in addition to and not a limitation of duties, obligations, rights and remedies otherwise imposed or available by law.

§ 13.4.2 No action or failure to act by the Owner, Architect or Contractor shall constitute a waiver of a right or duty afforded them under the Contract, nor shall such action or failure to act constitute approval of or acquiescence in a breach there under, except as may be specifically agreed in writing.

§ 13.5 TESTS AND INSPECTIONS

§ 13.5.1 Tests, inspections and approvals of portions of the Work shall be made as required by the Contract Documents and by applicable laws, statutes, ordinances, codes, rules and regulations or lawful orders of public authorities. Unless otherwise provided, the Contractor shall make arrangements for such tests, inspections and approvals with an independent testing laboratory or entity acceptable to the Owner, or with the appropriate public authority, and shall bear all related costs of tests, inspections and approvals. The Contractor shall give the Architect timely notice of when and where tests and inspections are to be made so that the Architect may be present for such procedures. The Owner shall bear costs of (1) tests, inspections or approvals that do not become requirements until after bids are received or negotiations concluded, and (2) tests, inspections or approvals where building codes or applicable laws or regulations prohibit the Owner from delegating their cost to the Contractor.

§ 13.5.2 If the Architect, Owner or public authorities having jurisdiction determine that portions of the Work require additional testing, inspection or approval not included under Section 13.5.1, the Architect will, upon written authorization from the Owner, instruct the Contractor to make arrangements for such additional testing, inspection or approval by an entity acceptable to the Owner, and the Contractor shall give timely notice to the Architect of when and where tests and inspections are to be made so that the Architect may be present for such procedures. Such costs, except as provided in Section 13.5.3, shall be at the Owner's expense.

§ 13.5.3 If such procedures for testing, inspection or approval under Sections 13.5.1 and 13.5.2 reveal failure of the portions of the Work to comply with requirements established by the Contract Documents, all costs made necessary by such failure including those of repeated procedures and compensation for the Architect's services and expenses shall be at the Contractor's expense.

§ 13.5.4 Required certificates of testing, inspection or approval shall, unless otherwise required by the Contract Documents, be secured by the Contractor and promptly delivered to the Architect.

§ 13.5.5 If the Architect is to observe tests, inspections or approvals required by the Contract Documents, the Architect will do so promptly and, where practicable, at the normal place of testing.

§ 13.5.6 Tests or inspections conducted pursuant to the Contract Documents shall be made promptly to avoid unreasonable delay in the Work.

§ 13.6 INTEREST

Payments due and unpaid under the Contract Documents shall bear interest from the date payment is due at such rate as the parties may agree upon in writing or, in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located.

§ 13.7 TIME LIMITS ON CLAIMS

The Owner and Contractor shall commence all claims and causes of action, whether in contract, tort, breach of warranty or otherwise, against the other arising out of or related to the Contract in accordance with the requirements of the final dispute resolution method selected in the Agreement within the time period specified by applicable law, but in any case not more than 10 years after the date of Substantial Completion of the Work. The Owner and Contractor waive all claims and causes of action not commenced in accordance with this Section 13.7.

ARTICLE 14 TERMINATION OR SUSPENSION OF THE CONTRACT

§ 14.1 TERMINATION BY THE CONTRACTOR

§ 14.1.1 The Contractor may terminate the Contract if the Work is stopped for a period of 30 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 all Work to be stopped;
- .2 An act of government, such as a declaration of national emergency that requires 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; or
- .4 The Owner has failed to furnish to the Contractor promptly, upon the Contractor's request, reasonable evidence as required by Section 2.2.1.

§ 14.1.2 The Contractor may terminate the Contract if, 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, repeated suspensions, delays or interruptions of the entire Work by the Owner as described in Section 14.3 constitute in the aggregate more than 100 percent of the total number of days scheduled for completion, or 120 days in any 365-day period, whichever is less.

§ 14.1.3 If one of the reasons described in Section 14.1.1 or 14.1.2 exists, the Contractor may, upon seven days' written notice to the Owner and Architect, terminate the Contract and recover from the Owner payment for Work executed, including reasonable overhead and profit, costs incurred by reason of such termination, and damages.

§ 14.1.4 If the Work is stopped for a period of 60 consecutive days through no act or fault of the Contractor or a Subcontractor or their agents or employees or any other persons performing portions of the Work under contract with the Contractor because the Owner has repeatedly failed to fulfill the Owner's obligations under the Contract Documents with respect to matters important to the progress of the Work, the Contractor may, upon seven additional days' written notice to the Owner and the Architect, terminate the Contract and recover from the Owner as provided in Section 14.1.3.

§ 14.2 TERMINATION BY THE OWNER FOR CAUSE

§ 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;
- .2 fails to make payment to Subcontractors for materials or labor in accordance with 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.

§ 14.2.2 When any of the above reasons exist, the Owner, upon certification by the Initial Decision Maker that sufficient cause exists to justify such action, may without prejudice to any other rights or remedies of the Owner and after giving the Contractor and the Contractor's surety, if any, seven days' written notice, terminate employment of the Contractor and may, subject to any prior rights of the surety:

- .1 Exclude the Contractor from the site and take possession of all materials, equipment, tools, and construction equipment and machinery thereon owned by the Contractor;
- .2 Accept assignment of subcontracts pursuant to Section 5.4; and
- .3 Finish the Work by whatever reasonable method the Owner may deem expedient. Upon written request of the Contractor, the Owner shall furnish to the Contractor a detailed accounting of the costs incurred by the Owner in finishing the Work.

§ 14.2.3 When the Owner terminates the Contract for one of the reasons stated in Section 14.2.1, the Contractor shall not be entitled to receive further payment until the Work is finished.

§ 14.2.4 If the unpaid balance of the Contract Sum exceeds costs of finishing the Work, including compensation for the Architect's services and expenses made necessary thereby, and other damages incurred by the Owner and not expressly waived, such excess shall be paid to the Contractor. If such costs and damages exceed the unpaid balance, the Contractor shall pay the difference to the Owner. The amount to be paid to the Contractor or Owner, as the case may be, shall be certified by the Initial Decision Maker, upon application, and this obligation for payment shall survive termination of the Contract.

§ 14.3 SUSPENSION BY THE OWNER FOR CONVENIENCE

§ 14.3.1 The Owner may, without cause, order the Contractor in writing to suspend, delay or interrupt the Work in whole or in part for such period of time as the Owner may determine.

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§ 14.3.2 The Contract Sum and Contract Time shall be adjusted for increases in the cost and time caused by suspension, delay or interruption as described in Section 14.3.1. Adjustment of the Contract Sum shall include profit. No adjustment shall be made to the extent

- .1 that performance is, was or would have been so suspended, delayed or interrupted by another cause for which the Contractor is responsible; or
- .2 that an equitable adjustment is made or denied under another provision of the Contract.

§ 14.4 TERMINATION BY THE OWNER FOR CONVENIENCE

§ 14.4.1 The Owner may, at any time, terminate the Contract for the Owner's convenience and without cause.

§ 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; and
- .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.

§ 14.4.3 In case of such termination for the Owner's convenience, the Contractor shall be entitled to receive payment for Work executed, and costs incurred by reason of such termination, along with reasonable overhead and profit on the Work not executed.

ARTICLE 15 CLAIMS AND DISPUTES

§ 15.1 CLAIMS

§ 15.1.1 DEFINITION

A Claim is a demand or assertion by one of the parties seeking, as a matter of right, payment of money, or other relief with respect to the terms of the Contract. The term "Claim" also includes other disputes and matters in question between the Owner and Contractor arising out of or relating to the Contract. The responsibility to substantiate Claims shall rest with the party making the Claim.

§ 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 Initial Decision Maker with a copy sent to the Architect, if the Architect is not serving as the Initial Decision Maker. Claims by either party 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.

§ 15.1.3 CONTINUING CONTRACT PERFORMANCE

Pending final resolution of a Claim, 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 prepare Change Orders and issue Certificates for Payment in accordance with the decisions of the Initial Decision Maker.

§ 15.1.4 CLAIMS FOR ADDITIONAL COST

If the Contractor wishes to make a Claim for an increase in the Contract Sum, written notice as provided herein shall be given before proceeding to execute the Work. Prior notice is not required for Claims relating to an emergency endangering life or property arising under Section 10.4.

§ 15.1.5 CLAIMS FOR ADDITIONAL TIME

§ 15.1.5.1 If the Contractor wishes to make a Claim for an increase in the Contract Time, written notice as provided herein shall be given. The Contractor's Claim shall include an estimate of cost and of probable effect of delay on progress of the Work. In the case of a continuing delay, only one Claim is necessary.

§ 15.1.5.2 If adverse weather conditions are the basis for a Claim for additional time, such Claim shall be documented by data substantiating that weather conditions were abnormal for the period of time, could not have been reasonably anticipated and had an adverse effect on the scheduled construction.

§ 15.1.6 CLAIMS FOR CONSEQUENTIAL DAMAGES

The Contractor and Owner waive Claims against each other for consequential damages arising out of or relating to this Contract. This mutual waiver includes

- .1 damages incurred by the Owner for rental expenses, for losses of use, income, profit, financing, business and reputation, and for loss of management or employee productivity or of the services of such persons; and
- .2 damages incurred by the Contractor for principal office expenses including the compensation of personnel stationed there, for losses of financing, business and reputation, and for loss of profit except anticipated profit arising directly from the Work.

This mutual waiver is applicable, without limitation, to all consequential damages due to either party's termination in accordance with Article 14. Nothing contained in this Section 15.1.6 shall be deemed to preclude an award of liquidated damages, when applicable, in accordance with the requirements of the Contract Documents.

§ 15.2 INITIAL DECISION

§ 15.2.1 Claims, excluding those arising under Sections 10.3, 10.4, 11.3.9, and 11.3.10, shall be referred to the Initial Decision Maker for initial decision. The Architect will serve as the Initial Decision Maker, unless otherwise indicated in the Agreement. Except for those Claims excluded by this Section 15.2.1, an initial decision shall be required as a condition precedent to mediation of any Claim arising prior to the date final payment is due, unless 30 days have passed after the Claim has been referred to the Initial Decision Maker with no decision having been rendered. Unless the Initial Decision Maker and all affected parties agree, the Initial Decision Maker will not decide disputes between the Contractor and persons or entities other than the Owner.

§ 15.2.2 The Initial Decision Maker will review Claims and within ten days of the receipt of a Claim take one or more of the following actions: (1) request additional supporting data from the claimant or a response with supporting data from the other party, (2) reject the Claim in whole or in part, (3) approve the Claim, (4) suggest a compromise, or (5) advise the parties that the Initial Decision Maker is unable to resolve the Claim if the Initial Decision Maker lacks sufficient information to evaluate the merits of the Claim or if the Initial Decision Maker concludes that, in the Initial Decision Maker's sole discretion, it would be inappropriate for the Initial Decision Maker to resolve the Claim.

§ 15.2.3 In evaluating Claims, the Initial Decision Maker may, but shall not be obligated to, consult with or seek information from either party or from persons with special knowledge or expertise who may assist the Initial Decision Maker in rendering a decision. The Initial Decision Maker may request the Owner to authorize retention of such persons at the Owner's expense.

§ 15.2.4 If the Initial Decision Maker 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 Initial Decision Maker when the response or supporting data will be furnished or (3) advise the Initial Decision Maker that no supporting data will be furnished. Upon receipt of the response or supporting data, if any, the Initial Decision Maker will either reject or approve the Claim in whole or in part.

§ 15.2.5 The Initial Decision Maker will render an initial decision approving or rejecting the Claim, or indicating that the Initial Decision Maker is unable to resolve the Claim. This initial decision shall (1) be in writing; (2) state the reasons therefor; and (3) notify the parties and the Architect, if the Architect is not serving as the Initial Decision Maker, of any change in the Contract Sum or Contract Time or both. The initial decision shall be final and binding on the parties but subject to mediation and, if the parties fail to resolve their dispute through mediation, to binding dispute resolution.

§ 15.2.6 Either party may file for mediation of an initial decision at any time, subject to the terms of Section 15.2.6.1.

§ 15.2.6.1 Either party may, within 30 days from the date of an initial decision, demand in writing that the other party file for mediation within 60 days of the initial decision. If such a demand is made and the party receiving the demand fails to file for mediation within the time required, then both parties waive their rights to mediate or pursue binding dispute resolution proceedings with respect to the initial decision.

§ 15.2.7 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.

§ 15.2.8 If a Claim relates to or is the subject of a mechanic's lien, the party asserting such Claim may proceed in accordance with applicable law to comply with the lien notice or filing deadlines.

§ 15.3 MEDIATION

§ 15.3.1 Claims, disputes, or other matters in controversy arising out of or related to the Contract except those waived as provided for in Sections 9.10.4, 9.10.5, and 15.1.6 shall be subject to mediation as a condition precedent to binding dispute resolution.

§ 15.3.2 The parties shall endeavor to resolve their Claims by mediation which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association in accordance with its Construction Industry Mediation Procedures in effect on the date of the Agreement. A request for mediation shall be made in writing, delivered to the other party to the Contract, and filed with the person or entity administering the mediation. The request may be made concurrently with the filing of binding dispute resolution proceedings but, in such event, mediation shall proceed in advance of binding dispute resolution proceedings, which shall be stayed pending mediation for a period of 60 days from the date of filing, unless stayed for a longer period by agreement of the parties or court order. If an arbitration is stayed pursuant to this Section 15.3.2, the parties may nonetheless proceed to the selection of the arbitrator(s) and agree upon a schedule for later proceedings.

§ 15.3.3 The parties shall share the mediator's fee and any filing fees equally. The mediation shall be held in the place where the Project is located, unless another location is mutually agreed upon. Agreements reached in mediation shall be enforceable as settlement agreements in any court having jurisdiction thereof.

§ 15.4 ARBITRATION

§ 15.4.1 If the parties have selected arbitration as the method for binding dispute resolution in the Agreement, any Claim subject to, but not resolved by, mediation shall be subject to arbitration which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association in accordance with its Construction Industry Arbitration Rules in effect on the date of the Agreement. A demand for arbitration shall be made in writing, delivered to the other party to the Contract, and filed with the person or entity administering the arbitration. The party filing a notice of demand for arbitration must assert in the demand all Claims then known to that party on which arbitration is permitted to be demanded.

§ 15.4.1.1 A demand for arbitration shall be made no earlier than concurrently with the filing of a request for mediation, but in no event shall it be made after the date when the institution of legal or equitable proceedings based on the Claim would be barred by the applicable statute of limitations. For statute of limitations purposes, receipt of a written demand for arbitration by the person or entity administering the arbitration shall constitute the institution of legal or equitable proceedings based on the Claim.

§ 15.4.2 The award rendered by the arbitrator or arbitrators shall be final, and judgment may be entered upon it in accordance with applicable law in any court having jurisdiction thereof.

§ 15.4.3 The foregoing agreement to arbitrate and other agreements to arbitrate with an additional person or entity duly consented to by parties to the Agreement shall be specifically enforceable under applicable law in any court having jurisdiction thereof.

§ 15.4.4 CONSOLIDATION OR JOINDER

§ 15.4.4.1 Either party, at its sole discretion, may consolidate an arbitration conducted under this Agreement with any other arbitration to which it is a party provided that (1) the arbitration agreement governing the other arbitration permits consolidation, (2) the arbitrations to be consolidated substantially involve common questions of law or fact, and (3) the arbitrations employ materially similar procedural rules and methods for selecting arbitrator(s).

§ 15.4.4.2 Either party, at its sole discretion, may include by joinder persons or entities substantially involved in a common question of law or fact whose presence is required if complete relief is to be accorded in arbitration, provided that the party sought to be joined consents in writing to such joinder. Consent to arbitration involving an

additional person or entity shall not constitute consent to arbitration of any claim, dispute or other matter in question not described in the written consent.

§ 15.4.4.3 The Owner and Contractor grant to any person or entity made a party to an arbitration conducted under this Section 15.4, whether by joinder or consolidation, the same rights of joinder and consolidation as the Owner and Contractor under this Agreement.

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OWNER: University of South Carolina
PROJECT NUMBER: H27-6080-CA
PROJECT NAME: Discovery I - 1st, 3rd, 4th, 5th Floors Upfit

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.

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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.

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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

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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))

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."*

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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.

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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

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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;

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- .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.

§ 7.3.3.2 Consistent 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:

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- .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.

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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 when such 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.

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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

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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, to the extent and in such form as may be designated by the Owner, (6) required Training Manuals, (7) equipment Operations and Maintenance 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.

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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."

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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 \$100,000 Per Acc.
 - \$500,000 Disease, Policy Limit
 - \$100,000 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.

3.82 *Delete Section 11.1.3 and substitute the following:*

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

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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.

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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, sub-subcontractors, 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.

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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 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.

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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 Carolina 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.

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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 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

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- .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;

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- .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.

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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 extent of the impact on the approved construction schedule. The remedy for this condition is for an 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 waived 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)

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attorney's fees, (vi) any interest; (vii) unamortized equipment costs; and, (viii) losses incurred by subcontractors for the types of damages the Contractor has waived 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.

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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 non-binding 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)*

- Civil: _____
- Structural: _____
- Mechanical: _____
- Plumbing: _____
- Electrical: _____
- Gas: _____
- Other *(list)*: _____

Remarks: _____

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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)*

NONE

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)*

See Division 01 Sections

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)*

See Division 01 Sections

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

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. Fraternalization 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 drug-free 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.

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 _____ 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. **Contractor must provide all O&M manuals, as-built drawings, and training of USC 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

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matting structurally functional.

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.

SECTION 01 10 00 - SUMMARY

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Work covered by the Contract Documents.
 - 2. Type of the Contract.
 - 3. Description of alterations work.
 - 4. Use of premises.
 - 5. Owner's occupancy requirements.
 - 6. Work restrictions.
 - 7. Materials returned to the Owner.
- B. Related Sections include the following:
 - 1. Division 01 Section "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.2 WORK COVERED BY CONTRACT DOCUMENTS

- A. Project Identification: Discovery I - 1st, 3rd, 4th, 5th Floors Upfit
- B. Owner: University of South Carolina.
- C. Architect: Jenkins Peer Architects, 112 South Tryon Street, Suite 1300, Charlotte, North Carolina 28284.
- D. The Work consists of the following:

Project consists of approximately 58,000sf of office, wet laboratory and dry laboratory upfits in the partially occupied five story Discovery I Biomedical Research shell building on the USC Columbia campus. Significant portions of the work include partitions, finishes, laboratory equipment and furnishings and mechanical equipment. A site visit will occur as part of the Pre-Bid Conference. One additional site visit will be scheduled after the Pre-Bid Conference. Bidders are encouraged to visit the site prior to submitting bids.
- E. Survey:
 - 1. The Contractor shall provide building layout work during the course of construction.

1.3 TYPE OF CONTRACT

- A. Project will be constructed under a single prime contract.

1.4 DESCRIPTION OF ALTERATIONS WORK

- A. Scope of demolition and removal work is shown on drawings and specified in Section 02 41 00.
- B. Plumbing: Alter existing system and add new construction, keeping existing in operation.
- C. HVAC: Alter existing system and add new construction, keeping existing in operation.
- D. Electrical Power and Lighting: Alter existing system and add new construction, keeping existing in operation.

- E. Fire Suppression Sprinklers: Alter existing system and add new construction, keeping existing in operation.
- F. Fire Alarm: Alter existing system and add new construction, keeping existing in operation.
- G. Telephone: Alter existing system and add new construction, keeping existing in operation.
- H. Contractor shall remove and deliver the following to Owner either prior to start of work or during demolition phase:
 - 1. Existing light fixtures not re-used.
 - 2. Existing stainless steel ductwork designated to be removed.
 - 3. Other items designated by the Owner.
- I. Contractor shall remove and store the following prior to start of work, for later reinstallation by Contractor:
 - 1. Window blinds.

1.5 WORK UNDER OTHER 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. Coordinate the Work of this Contract with work performed under separate contracts.
- B. Concurrent Work: Owner has awarded contract(s) for the following construction operations at Project site. Those operations will be conducted simultaneously with work under this Contract.
 - 1. Separate contracts will be awarded for cabling and door control. Some of this work will need to take place concurrent to the Work under the construction contract. The contractor shall accommodate the Owner's work forces and coordinate schedule and access with the Owner for installations required prior to substantial completion.

1.6 OWNER-FURNISHED PRODUCTS

- A. Owner will furnish products indicated. The Work includes providing support systems to receive Owner's equipment and making necessary electrical connections.
 - 1. Owner will arrange for and deliver Shop Drawings, Product Data, and Samples to Contractor.
 - 2. Owner will arrange and pay for delivery of Owner-furnished items according to Contractor's Construction Schedule.
 - 3. After delivery, Owner will inspect delivered items for damage. Contractor shall be present for and assist in Owner's inspection.
 - 4. If Owner-furnished items are damaged, defective, or missing, Owner will arrange for replacement.
 - 5. Owner will arrange for manufacturer's field services and for delivery of manufacturer's warranties to Contractor.
 - 6. Owner will furnish Contractor the earliest possible delivery date for Owner-furnished products. Using Owner-furnished earliest possible delivery dates, Contractor shall designate delivery dates of Owner-furnished items in Contractor's Construction Schedule.
 - 7. Contractor shall review Shop Drawings, Product Data, and Samples and return them to Architect noting discrepancies or anticipated problems in use of product.
 - 8. Contractor is responsible for receiving, unloading, and handling Owner-furnished items at Project site.
 - 9. Contractor is responsible for protecting Owner-furnished items from damage during

storage and handling, including damage from exposure to the elements.

10. If Owner-furnished items are damaged as a result of Contractor's operations, Contractor shall repair or replace them.
11. Contractor shall install and otherwise incorporate Owner-furnished items into the Work.

B. Owner-Furnished Products:

1. Animal MRI.
2. Human MRI

1.7 USE OF PREMISES

- A. Use of Site: Limit use of premises to work in areas indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
- B. Use of Existing Building: Maintain existing building condition throughout construction period. Repair damage caused by construction operations. Protect building and its occupants during construction period.
- C. Storage: Existing building area may not be used for any type of storage.

1.8 OWNER'S OCCUPANCY REQUIREMENTS

- A. Partial Owner Occupancy: Owner will occupy the premises during entire construction period, including some areas under construction. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's operations. This may require work outside of normal working hours. 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 authorities having jurisdiction.
 2. Provide not less than 72 hours' notice to Owner of activities that will affect Owner's operations.
 3. The drawings indicate demolition and new work scope in areas of the 2nd floor that will be fully occupied and in operation by the Owner during construction. Work in these areas shall be coordinated with the Owner and must take place outside of normal working hours and as coordinated and scheduled with the Owner in advance. Protection of Owner's furniture, equipment and all other surfaces other than those indicated to be removed and replaced shall be provided and shall be installed and removed on a daily basis as required to facilitate both the Owner's operations and the installation of the Work under this contract. No materials, tools or instruments of construction shall be stored in these areas. No work shall take place during the Owner's normal working hours unless specifically authorized in writing by USC. Daily cleaning, trash removal, removal of protection etc. are required to maintain the area in a condition as conducive to the Owner being able to operate with a minimum of inconvenience.

1.9 WORK RESTRICTIONS

- A. On-Site Work Hours: Work shall be generally performed inside the existing building during normal business working hours of 7:00 a.m. to 5:00 p.m., Monday through Friday. Unless otherwise indicated or required. See Owner's Occupancy Requirements.
- B. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or

others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Owner not less than seven (7) days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Owner's written permission.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 21 00 - ALLOWANCES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Cash allowances.

1.2 RELATED REQUIREMENTS

- A. Section 01 20 00 - Price and Payment Procedures: Additional payment and modification procedures.

1.3 CASH ALLOWANCES

- A. Costs Included in Cash Allowances: Cost of product to Contractor or subcontractor, less applicable trade discounts, less cost of delivery to site, less applicable taxes.
- B. Costs Included in the Contractor's Base Bid: Product handling at the site, including unloading, uncrating, and storage; protection of Products from elements and from damage; and labor for installation, if noted and finishing, Contractor's overhead and profit and time for removal and replacement of rock and unsuitable soil in the quantities specified in the Allowance section.
- C. Architect Responsibilities:
 - 1. Consult with Contractor for consideration and selection of products, suppliers, and installers.
 - 2. Select products in consultation with Owner and transmit decision to Contractor.
 - 3. Prepare Change Order.
- D. Contractor Responsibilities:
 - 1. Assist Architect in selection of products.
 - 2. Obtain proposals from suppliers or subcontractors and offer recommendations.
 - 3. On notification of selection by Architect/Engineer execute purchase agreement with designated supplier or subcontractor.
 - 4. Arrange for and process shop drawings, product data, and samples. Arrange for delivery.
 - 5. Promptly inspect products upon delivery for completeness, damage, and defects. Submit claims for transportation damage.
- E. Differences in costs will be adjusted by Change Order.

1.4 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. Coordinate and process submittals for allowance items in same manner as for other portions of the Work.

1.5 ALLOWANCES SCHEDULE

- A. Allowance No. 1: Exit signs. Provide labor and material for exit sign and 50 feet of conduit, boxes and conductors. Quantity of five (5) in addition to that required in the Contract Documents.

- B. Allowance No. 2: Receptacle outlet. Provide labor and material for 20A receptacle and 50 feet of conduit, boxes, and conductors associated with the outlet. Quantity of ten (10) in addition to that required in the Contract Documents.
- C. Allowance No. 3: Smoke detector. Provide labor and material for smoke detector and 50 feet of conduit, boxes and conductors associated with the smoke detector. Quantity of five (5) in addition to that required in the Contract Documents.
- D. Allowance No. 4: Pull station. Provide labor and material for pull station and 50 feet of conduit, boxes, and conductors associated with the horn/strobe. Quantity of one (1) in addition to that required in the Contract Documents.
- E. Allowance No. 5: Horn/Strobe. Provide labor and material for horn/strobe and 50 feet of conduit, boxes and conductors associated with the horn/strobe. Quantity of five (5) in addition to that required in the Contract Documents.
- F. Allowance No. 9: Data/voice outlet. Provide labor and material for data/voice outlet with 2 data and 2 voice cables, and 200 feet of conduit, boxes and cables associated with the outlet. Quantity of five (5) in addition to that required in the Contract Documents.
- G. Allowance No. 10: Duct smoke detector. Provide labor and material for duct smoke detector and 50 feet of conduit, boxes, and conductors associated with the duct smoke detector. Quantity of one (1) in addition to that required in the Contract Documents.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION 01 21 00

SECTION 01 22 00 - UNIT PRICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. List of unit prices, for use in preparing Bids.
- B. Measurement and payment criteria applicable to Work performed under a unit price payment method.

1.2 COSTS INCLUDED

- A. Unit Prices included on the Bid Form shall include full compensation for all required labor, products, tools, equipment, plant, transportation, services and incidentals; erection, application or installation of an item of the Work; overhead and profit.

1.3 MEASUREMENT OF QUANTITIES

- A. Measurement methods delineated in the individual specification sections complement the criteria of this section. In the event of conflict, the requirements of the individual specification section govern.
- B. Take all measurements and compute quantities. Measurements and quantities will be verified by Architect.
- C. Assist by providing necessary equipment, workers, and survey personnel as required.

1.4 PAYMENT

- A. Payment for Work governed by unit prices will be made on the basis of the actual measurements and quantities of Work that is incorporated in or made necessary by the Work and accepted by the Architect, multiplied by the unit price.
- B. Payment will not be made for any of the following:
 - 1. Products wasted or disposed of in a manner that is not acceptable.
 - 2. Products determined as unacceptable before or after placement.
 - 3. Products remaining on hand after completion of the Work.
 - 4. Loading, hauling, and disposing of rejected Products.

1.5 UNIT PRICES

- A. Schedule of Unit Prices:
 - 1. UP-1 - Exit signs and 50 ft. conduit, conductors and box per each.
 - 2. UP-2 - Receptacle outlet and 50 ft. conduit, conductors and box per each.
 - 3. UP-3 - Smoke detector and 50 ft. conduit, conductors and box per each.
 - 4. UP-4 - Pull Station and 50 ft. conduit, cable and box per each.
 - 5. UP-5 - Horn/Strobe and 50 ft. conduit, cable and box per each.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION 01 22 00

SECTION 01 30 00 - ADMINISTRATIVE REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Preconstruction meeting.
- B. Progress meetings.
- C. Pre-installation meetings.
- D. Construction progress schedule.
- E. Coordination drawings.
- F. Daily construction reports.
- G. RFI Procedures

1.2 RELATED REQUIREMENTS

- A. Document 00 73 00 - Supplementary Conditions: Dates for applications for payment.
- B. Section 01 70 00 - Execution Requirements: Additional coordination requirements.
- C. Section 01 78 13 - Project Record Documents: Project record documents.
- D. Section 01 91 13 - General Commissioning Requirements: Additional procedures for submittals relating to commissioning.
 - 1. Where submittals are indicated for review by both Architect and the Commissioning Authority, submit one extra and route to Architect first, for forwarding to the Commissioning Authority.
 - 2. Where submittals are not indicated to be reviewed by Architect, submit directly to the Commissioning Authority; otherwise, the procedures specified in this section apply to commissioning submittals.

1.3 PROJECT COORDINATION

- A. Project Coordinator: General Contractor.
- B. Cooperate with the Project Coordinator in allocation of mobilization areas of site; for field offices and sheds, for access, traffic, and parking facilities.
- C. During construction, coordinate use of site and facilities through the Project Coordinator.
- D. Comply with Project Coordinator's procedures for intra-project communications; submittals, reports and records, schedules, coordination drawings, and recommendations; and resolution of ambiguities and conflicts.
- E. Comply with instructions of the Project Coordinator for use of temporary utilities and construction facilities.
- F. Coordinate field engineering and layout work under instructions of the Project Coordinator.
- G. Make the following types of submittals to Architect through the Project Coordinator:
 - 1. Requests for information.
 - 2. Requests for substitution.

3. Shop drawings, product data, and samples.
 4. Test and inspection reports.
 5. Manufacturer's instructions and field reports.
 6. Applications for payment and change order requests.
 7. Progress schedules.
 8. Coordination drawings.
 9. Closeout submittals.
- H. The Project Coordinator shall maintain a record of all items noted on the Architect/Engineer's Observation of Work in Progress, the subcontractor responsible for completing the work, and the date the work was completed.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 PRECONSTRUCTION MEETING

- A. Architect will schedule a meeting after Notice of Award.
- B. Attendance Required:
1. Owner.
 2. Architect.
 3. Contractor.
 4. Prime Subcontractors.
 5. Others deemed necessary by the Architect and General Contractor.
- C. Agenda:
1. Submission of executed bonds and insurance certificates.
 2. Distribution of Contract Documents.
 3. Submission of list of Subcontractors, list of Products, schedule of values, and progress schedule.
 4. Designation of personnel representing the parties to Contract, Owner and Architect.
 5. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
 6. Scheduling.
- D. The General Contractor shall record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.2 PROGRESS MEETINGS

- A. The General Contractor shall schedule and administer meetings throughout progress of the Work at maximum bi-monthly intervals or as determined by the Architect and Owner.
- B. The General Contractor shall make arrangements for meetings, prepare agenda with copies for participants, preside at meetings.
- C. Attendance Required: Job superintendent, General Contractor's Project Manager, Owner's Representative and Architect, as appropriate to agenda topics for each meeting.

D. Agenda:

1. Review minutes of previous meetings.
2. Review of Work progress.
3. Field observations, problems, and decisions.
4. Identification of problems that impede, or will impede, planned progress.
5. Review of submittals schedule and status of submittals.
6. Review status of Architect/Engineer's Observation of Work in Progress (O.W.I.P.).
7. Maintenance of progress schedule.
8. Corrective measures to regain projected schedules.
9. Planned progress during succeeding work period.
10. Maintenance of quality and work standards.
11. Effect of proposed changes on progress schedule and coordination.
12. Other business relating to Work.

- E. The General Contractor shall record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.3 PREINSTALLATION CONFERENCES:

- A. Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.
- B. 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, and Owner's Commissioning Authority, of scheduled meeting dates.
- C. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
1. Contract Documents.
 2. Options.
 3. Related RFIs.
 4. Related Change Orders.
 5. Purchases.
 6. Deliveries.
 7. Submittals.
 8. Review of mockups.
 9. Possible conflicts.
 10. Compatibility problems.
 11. Time schedules.
 12. Weather limitations.
 13. Manufacturer's written recommendations.
 14. Warranty requirements.
 15. Compatibility of materials.
 16. Acceptability of substrates.
 17. Temporary facilities and controls.
 18. Space and access limitations.
 19. Regulations of authorities having jurisdiction.

20. Testing and inspecting requirements.
 21. Installation procedures.
 22. Coordination with other work.
 23. Required performance results.
 24. Protection of adjacent work.
 25. Protection of construction and personnel.
- D. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
- E. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
- F. 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.

3.4 CONSTRUCTION PROGRESS SCHEDULE: See 00 73 00 Standard Supplementary Conditions.

3.5 COORDINATION DRAWINGS

- A. Coordination Shop Drawings shall be prepared by the General Contractor indicating Mechanical, Plumbing, Fire Protection, and Electrical work. Drawings shall indicate all duct work, mechanical lines 2 inches and over, except all lines which require gravity draining are to be shown. All plumbing lines 2 inches and over, trunk lines of fire protection system and all sprinkler heads, and all major pieces of equipment are to be indicated. Electrical light fixtures need not be shown, but size and elevation conflicts for same shall be brought to the attention of other Contractors.
- B. Drawings shall be produced in 1/4 inch scale, except that mechanical rooms, air handling equipment rooms, and the like, shall be produced in 1/2 inch scale. Drawings shall be reproducible transparencies as indicated above under Shop Drawings.
- C. Sequence of production of Drawings shall be as follows:
1. Mechanical trade shall initiate these drawings including furnishing of reproducible sheets. Sequence of preparation shall be:
 - a. Ductwork
 - b. Remainder of mechanical work including equipment and piping.
 2. Plumbing trade shall show piping (supply, waste, vent, etc.) overlaid on the sheets furnished by mechanical trade.
 3. Fire protection work shall be shown on the same sheets after completion of plumbing work drawings.
 4. Electrical work shall be shown on the same sheets after completion of the above.
- D. Minimally, monthly meetings shall be held in order to review status of Drawings and to resolve conflicts.
- E. Drawings must be complete and submitted to the Architect/Engineer for his review 90 days after award of contract. The Architect/Engineer's review shall not denote responsibility of content of Drawings on his part, but to check for general conformity and requirements of the Contract Documents.

- F. Each Drawing shall have space allotted for each Contractor to sign, indicating acceptance and approval of all work shown. Space shall also be allowed for the Architect/Engineer's stamp.

3.6 DAILY CONSTRUCTION REPORTS

- A. Construction Manager shall maintain a daily Construction Report to include, but not limited to the following data:
 - 1. Reports are to be numbered consecutively with a report for every calendar day for the duration of the contract, commencing on the date of Notice to Proceed and terminating with Project Acceptance including weekends and holidays.
 - 2. Date.
 - 3. Each contractor and subcontractor to be listed separately with a brief description of work performed each day by each Contractor.
 - 4. Each Contractor's number of personnel indicating quantity by classification, i.e. foremen, journeymen, and apprentices. Personnel are to be totaled daily indicating total for day or report and cumulative man days to date. (Definition of man days; 6 men indicated on job = t man days).
 - 5. Visitors to site indicated by name and affiliation.
 - 6. Any unusual occurrences are to be reported in detail.
 - 7. Any outstanding information required, delays to the work, etc., are to be noted separately on the report.
 - 8. Weather and site conditions.
- B. Report shall be available to the Architect and Owner upon request.

3.7 REQUESTS FOR INTERPRETATION (RFIs)

- A. General: If, in the opinion of the Contractor, work is indicated or is specified in such manner as will make it impossible to produce a first-class of work, or should discrepancies appear within the Contract Documents, he shall refer same to the Designer for interpretation before proceeding with work. If the Contractor fails to make such reference, no excuse will thereafter be entertained for failure to carry out work in a satisfactory manner. Where only part of the work is indicated, similar parts shall be considered repetition. Where any detail is shown and the components therefore are fully described, similar details shall be construed to require equal materials and construction.
- B. Procedure: Immediately on discovery of the need for interpretation of the Contract Documents, and if not possible to request interpretation at Project meeting, prepare and submit an RFI in the form specified.
 - 1. RFIs shall originate with Construction Manager. RFIs submitted by entities other than Construction Manager will be returned with no response.
 - 2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Construction Manager's work or work of subcontractors.
 - 3. All RFI's shall be submitted to the Designer electronically via email. The CM and the Designer shall keep individual RFI logs to be reconciled on a regular basis. The Designer's log shall be recognized as the official Project log.
- C. Content of the RFI: Include a detailed, legible description of item needing interpretation and the following:
 - 1. Project name.
 - 2. Date.

3. Name of Contractor.
 4. Name of Architect.
 5. RFI number, numbered sequentially.
 - a. RFI's answered by the GC without input from the Designer or Owner shall not be included in the Project RFI logs.
 6. Specification Section number and title and related paragraphs, as appropriate.
 7. Drawing number and detail references, as appropriate.
 8. Field dimensions and conditions, as appropriate.
 9. Construction Manager's suggested solution(s). If Construction Manager's solution(s) impact the Contract Time or the Contract Sum, Construction Manager shall state impact in the RFI.
 10. Construction Manager's signature.
 11. Attachments: Include drawings, descriptions, measurements, photos, Product Data, Shop Drawings, and other information necessary to fully describe items needing interpretation.
 - a. Supplementary drawings prepared by Contractor shall include dimensions, thickness, structural grid references, and details of affected materials, assemblies, and attachments.
- D. Software-Generated RFIs: Software-generated form with substantially the same content as indicated above.
1. Attachments shall be electronic files in Adobe Acrobat PDF format.
- E. Architect's Action: Architect will review each RFI, determine action required, and return it. The Architect will respond to RFI's in an average of seven (7) working days. It is acknowledged and understood that some RFI's will require longer response time than others. RFIs received after 1:00 p.m. will be considered as received the following working day.
1. The following RFIs will be returned without action:
 - a. Requests for approval of submittals.
 - b. Requests for approval of substitutions.
 - c. Requests for coordination information already indicated in the Contract Documents.
 - d. Requests for adjustments in the Contract Time or the Contract Sum.
 - e. Requests for interpretation of Architect's actions on submittals.
 - f. Incomplete RFIs or RFIs with numerous errors.
 - g. RFI's requesting confirmation of written direction by other means from the Owner or Architect.
 2. Architect's action may include a request for additional information, in which case Architect's time for response will start again.
 3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Construction Manager to submit Change Proposal.
 - a. If Construction Manager 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.
- 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 Construction Manager disagrees with response.

- G. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. 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 dropped and not submitted.
 5. RFI description.
 6. Date the RFI was submitted.
 7. Date Architect's response was received.
 8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate

END OF SECTION

SECTION 01 33 00 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.
- B. Related Sections include the following:
 - 1. Division 01 Section "Construction Progress Documentation" for submitting schedules and reports, including Contractor's Construction Schedule and the Submittals Schedule.
 - 2. Division 1 Section "Quality Requirements" for submitting test and inspection reports and for mockup requirements.
 - 3. Division 01 Section "Closeout Procedures" for submitting warranties.
 - 4. Division 01 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
 - 5. Divisions 03 through 33 Sections for specific requirements for submittals in those Sections.

1.2 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require the Design Professional's responsive action.
- B. Informational Submittals: Written and graphic information and physical samples that do not require the Design Professional's responsive action.

1.3 SUBMITAL REQUIREMENTS

- A. In addition to the requirements in Article 5 of the General Conditions, Construction Manager shall provide the following:
 - 1. The submittal schedule shall be an excerpt from the CPM schedule described herein. This Schedule shall indicate the items, relevant specification sections, other related submittals, the date when such item will be furnished to the Architect, and the date by which Architect's review is necessary to maintain Construction Schedule. This schedule shall take into consideration the resubmission of shop drawings required to achieve acceptance of the Designer and Owner.
- B. The following shop drawings will take longer than 20 calendar days for review and return to the Contractor:
 - 1. Structural Steel.
 - 2. Mechanical Systems.
- C. All shop drawings, submittals, samples, and data shall be submitted to the Designer for review according to accepted CPM schedule from Article 5 (a). After these items have been reviewed by the Designer they will be returned to the Construction Manager for distribution. Samples and shop drawings required for evaluation of a substitution shall be submitted with the request for substitution. Shop drawings, submittals, samples, and data will not be considered by the Designer unless the submission clearly indicates that they have been checked, coordinated between Prime Subcontractors, and stamped approved by the Construction Manager and Fabricator or Construction Manager, Subcontractor, and Fabricator as the case may be. All shop drawings and catalog cuts submitted shall each receive the pre-approved stamp completed

and dated by the Construction Manager or submitting Prime Contractor. Samples shall have the stamp affixed to a tag attached to each sample.

- D. No extension of construction time will be allowed for delay in checking shop drawings, submittals, samples or data because of the Construction Manager's, Subcontractor's, or Fabricator's failure to check shop drawings before submitting them to the Designer. All shop drawings shall be prepared to show how the material relates specifically to the conditions of the Project. Standard manufacturer's drawings that do not show how and where the material is to be used will not be considered. Shop drawings shall not be reproductions or portions of reproductions of the Contract documents. Coordinated shop drawings at the same scale indicating all mechanical, electrical, and plumbing shall be required between all trades. The dominant Prime Subcontractor in a given area, as determined by the Construction Manager, shall submit its drawings to the other involved Subcontractors through the Prime Contractor.
- E. The CONTRACTOR'S will furnish and deliver to the Owner 1 copy of each shop drawing, submittal, sample, and data which has been reviewed by the Designer and which has received a "NO EXCEPTIONS TAKEN" or "APPROVED, REVISIONS NOTED" evaluation. The CONTRACTOR'S shall deliver these to the Owner within 14 calendar days of receiving each reviewed item from the Contractor following review by the Designer, or in the case where 1 copy of a sample was submitted, within 14 calendar days of receiving advice that the sample is "NO EXCEPTIONS TAKEN" or "APPROVED, REVISIONS NOTED". Coordinate delivery with the owner's project manager. The owner shall have the option of accepting submittal copies during construction or at closeout in which case the Construction Manager shall neatly store all items by division in "banker type" storage boxes or a separate file cabinet in the Construction Manager's office facility. All stored submittals and samples shall be accessible to owner at any time during normal working hours.
- F. After the Electrical, HVAC, and Plumbing shop drawing submittals have received a favorable review, the Construction Manager shall submit to the Designer for the Owner, complete operating and maintenance manuals as called for in Divisions 22, 23, 26, 27 and 28. These manuals shall be submitted not later than 14 calendar days before occupancy.
- G. Only Contract Documents, approved Change Orders, approved submittals to the extent they are in accordance with the Contract Documents, Designer bulletin drawings, and references specifically incorporated into Contract Documents constitute authoritative description of the Work. No other documents, including Contractor generated drawings, shall be considered authoritative.

1.4 SUBMITTAL PROCEDURES

- A. General: Electronic copies of CAD Drawings of the Contract Drawings will be provided by Architect for Contractor's use in preparing submittals according to Par.1.5 herein.
- 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. 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. Submittals Schedule: Comply with requirements in Division 1 Section "Construction Progress Documentation" for list of submittals and time requirements for scheduled performance of related construction activities.
- D. Processing Time: Allow enough 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 20 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 20 days for review of each resubmittal.
- E. Identification: Place a permanent label or title block on each submittal 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 on label or beside title block to record Contractor's review and approval markings and action taken by Architect and Construction Manager.
 3. Include the following information on label for processing and recording action taken:
 - a. Project name.
 - b. Date.
 - c. Name and address of Architect and Construction Manager.
 - d. Name and address of Contractor.
 - e. Name and address of subcontractor.
 - f. Name and address 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 for each required submittal identified in each specification section (e.g., 06 10 00.01 - Product Data; 06 10 00.02 - Shop Drawings etc.). Resubmittals shall be identified exactly as original submittal with a sequential revision number.
 - 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.
 - l. Other necessary identification.
- F. Deviations: Highlight or otherwise specifically identify deviations from the Contract Documents on submittals.
- G. Transmittal: Package each submittal individually and appropriately for transmittal and handling. Bundle all required submittals from each individual specification section together as a single package. Provide separate identifier numbers for each individual element of each bundled package (i.e. identify product data, shop drawings etc. as separate sub-items within a specification section submittal package). Incomplete packages or packages missing required

submittals shall be returned without review. Transmit each submittal using a transmittal form. Architect will return submittals, without review, received from sources other than Contractor.

1. Transmittal Form: Use form approved by the Architect.
 2. 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 label information as related submittal.
 3. Jenkins Peer can provide log-in permissions for web-based file sharing for processing of submittals. General Contractor will be the only contracting entity provided access for upload and download of submittals. Use of the Architect's file sharing site by any sub-contractor or supplier for the purpose of submittal process is strictly forbidden, and submittals uploaded by any other entity will be promptly removed from the site without review.
 - a. Initial submittals will be uploaded to the Sharefile site by the GC for review and distribution by the Architect.
 - b. Upon completing review, the Architect will upload the marked up submittal for return to and download by the GC.
 - c. The GC shall be responsible for distribution of submittals to sub-contractors and vendors/suppliers.
 - d. Resubmittal, when required, shall follow and repeat the process outlined above and follow other requirements herein for resubmittals.
- 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 "Approved: No Exceptions" or "Approved, Revisions Noted."
- 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: Use only final submittals with mark indicating approval by Architect as specified in 1.3.H.3 above.
- K. Additional Copies: Unless additional copies are required for final submittal, and unless Architect observes non-compliance with provisions in the Contract Documents, initial submittal may serve as final submittal.
1. Submit one copy of submittal directly to concurrent reviewer (Commissioning Agent) in addition to specified number of copies to Architect.

1.5 REQUEST FOR COPIES OF DRAWINGS

- A. Electronic copies of the Architectural drawings may be provided to the contractor upon receipt of a signed release and payment of \$100.00 per drawing sheet.
1. Electronic drawing copies for Civil, Structural, MEP and Landscaping Designers of Record are subject to each consultant's policy for distribution or may not be available to the Contractor.

2. The documents, including those in electronic form, prepared by the Architect or the Architect's consultants are Instruments of Service through which the Work to be executed by the Contractor is described. The Contractor nor any Subcontractor, Sub-subcontractor, material or equipment supplier shall own or claim a copyright in the documents prepared by the Architect or the Architect's consultants and unless otherwise indicated the Architect and the Architect's consultants shall be deemed the authors of them and will retain all common law, statutory and other reserved rights, in addition to the copyrights. Copies, including those in electronic form, furnished to the Contractor are for use solely with respect to this Project and shall not be used on other projects or for additions to this Project outside the scope of Work. The Contractor, Subcontractor, Sub-subcontractor, material or equipment supplier are authorized to use and reproduce applicable portions of the documents appropriate to and for use in the execution of their Work under the Contract Documents.
 - a.
3. The Contractor, Subcontractor, Sub-subcontractor, material or equipment supplier shall not submit all or portions of the Contract Documents for Shop Drawings. All Shop Drawings must be prepared specifically for this project by the appropriate Contractor, Subcontractor, Sub-subcontractor, material or equipment supplier. Documents, including those in electronic form supplied by the Architect or the Architect's consultants may only be use in the preparation of Shop Drawings as background information.
4. Electronic files are not Construction Documents. Significant differences may exist between the electronic files and the Construction Documents. The Architect and the Architect's consultants disclaim and make no representations, or warranties, expressed or implied, as to the merchantability, condition, accuracy, use, fitness for a particular purpose, suitability, durability of the information or the medium in or on which the information is furnished, of the transferred electronic information. The Architect and the Architect's consultants shall not be liable for any damages, use of the electronic files is at the sole risk of the Contractor, Subcontractor, Sub-subcontractor, material or equipment supplier. The Contractor, Subcontractor, Sub-subcontractor, material or equipment supplier, by use of electronic files, shall not be relieved of their duty to fully comply with the Contract Documents, including without limitation, the need to check, confirm and coordinate their work.
5. For the purpose of the contractor's coordination drawings, the only drawings that will be provided for use by the contractor are architectural floor plan and reflected ceiling background drawings. Under no circumstance, will plumbing, mechanical, fire protection or electrical drawings be provided in an electronic format for use in the development of the contractor's coordination drawings.

PART 2 - PRODUCTS

2.1 ACTION SUBMITTALS

- A. General: Prepare and submit Action Submittals required by individual Specification Sections.
- 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 printed 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 written recommendations.
 - b. Manufacturer's product data sheets indicating compliance with specified technical requirements..
 - 1) Do not submit manufacturer's guide specifications as product data. Guide specifications will be rejected without action.
 - c. Manufacturer's installation instructions.
 - d. Standard color charts.
 - e. Manufacturer's catalog cuts.
 - f. Wiring diagrams showing factory-installed wiring.
 - g. Printed performance curves.
 - h. Operational range diagrams.
 - i. Mill reports.
 - j. Standard product operation and maintenance manuals.
 - k. Compliance with specified referenced standards.
 - l. Testing by recognized testing agency.
 - m. Application of testing agency labels and seals.
 - n. Notation of coordination requirements.
 4. Submit Product Data before or concurrent with Samples.
 5. Number of Copies: Contractor shall submit product as follows:
 - a. One electronic copy in PDF format to Architect.
 - b. Architect will return electronic copy with redlines and disposition to Contractor.
 - 1) Contractor shall provide and distribute copies of submittals to sub-contractors from returned electronic copy.
 - 2) Contractor shall print and provide one hard copy of all approved shop drawings and submit to Owner for record purposes.
- 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.
1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Dimensions.
 - b. Identification of products.
 - c. Fabrication and installation drawings.
 - d. Roughing-in and setting diagrams.
 - e. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring.
 - f. Shopwork manufacturing instructions.
 - g. Templates and patterns.
 - h. Schedules.
 - i. Design calculations.
 - j. Compliance with specified standards.
 - k. Notation of coordination requirements.
 - l. Notation of dimensions established by field measurement.
 - m. Relationship to adjoining construction clearly indicated.
 - n. Seal and signature of professional engineer if specified.
 - o. Wiring Diagrams: Differentiate between manufacturer-installed and field-installed wiring.

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 but no larger than 30 by 40 inches.
 3. Number of Copies: Contractor shall submit shop drawings as follows:
 - a. One hard copy where sheet size exceeds 11 x 17 inches and one electronic copy in PDF format to Architect.
 - b. Architect will retain all hard copies and return electronic copy with redlines and disposition to Contractor.
 - 1) Contractor shall provide and distribute copies of submittals to sub-contractors from returned electronic copy.
 - 2) Contractor shall print and provide one hard copy of all approved shop drawings and submit to Owner for record purposes.
 4. Delegated Design: Where specification sections require signed and sealed shop drawings and/or supporting calculation data by a qualified third party design professional, Architect's review shall be for conformance with design intent only and shall not be interpreted as approval of third party professional's design or calculations. Architect will not stamp such delegated design submittals but will only indicate that the submittal has been reviewed for information only.
- 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 appropriate Specification Section.
 3. Disposition: Maintain sets of approved Samples at Project site, available for quality-control 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.
 4. 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, through Construction Manager, will return submittal with options selected.
 5. 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 three sets of Samples. Architect will retain one Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a Project Record Sample.
 - 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 or List: 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.
 2. Number and name of room or space.
 3. Location within room or space.
 4. Number of Copies: Submit four copies of product schedule or list, unless otherwise indicated. Architect will return two copies.
 - a. Mark up and retain one returned copy as a Project Record Document.
- F. 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.
 4. Number of Copies: Submit three copies of subcontractor list, unless otherwise indicated. Architect will return two copies.
 - a. Mark up and retain one returned copy as a Project Record Document.

2.2 INFORMATION SUBMITTALS

- A. When the following are specified in individual sections, submit them for information only:
 1. Design data
 2. Certificates
 3. Test Reports
 4. Inspection Reports
 5. Manufacturer's instructions
 6. Manufacturer's field reports
 7. Other types indicated.
 8. Installer qualifications:
 9. **DO NOT SUBMIT MSDS SHEETS TO THE ARCHITECT. MSDS SHEETS WILL BE DISCARDED WITHOUT REVIEW. PROVIDE MSDS ONLY FOR CLOSEOUT DOCUMENTS AND OWNER'S INFORMATION.**

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

- A. 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. 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. Contractor submittal stamps with a disposition of "Reviewed" are not acceptable.
 - 1. The contractor's submittal approval stamp shall include the following statement: "I hereby certify that the material(s), equipment and/or products shown and marked in this submittal and proposed to be incorporated into the Work is (are) in strict conformance with the Contract Documents, can be installed in the allocated spaces and comprise(s) no variation thereto, unless specifically noted otherwise." Stamp shall include space for Contractor's signature and date of approval.

3.2 ARCHITECT'S ACTION

- A. General: Architect will not review submittals that do not bear Contractor's approval stamp and will return them without action.
- B. Action Submittals: Architect will review each submittal, make marks to indicate corrections or modifications required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken, as follows:
 - 1. Approved: No Exceptions
 - 2. Approved: Revisions Noted
 - 3. Not Approved: Revise and Resubmit
 - 4. Not Approved
 - 5. C. Partial submittals are not acceptable, will be considered nonresponsive, and will be returned without review.
- C. Submittals not required by the Contract Documents will not be reviewed and may be discarded.

END OF SECTION 01 33 00

SECTION 01 35 14 - LEED-CI 2009 CREDIT SUMMARY

PART 1 - GENERAL

1.1 PROJECT INFORMATION

- A. Project Name: **Discovery I - 1st, 3rd, 4th, 5th Floors Upfit**
- B. City: **Columbia.**
- C. State: **South Carolina.**

1.2 DEFINITIONS

- A. LEED Rating System: LEED-CI 2009 Edition.
- B. Required: Achievement of this credit is essential for certification of this project.
- C. Preferred: Achievement of this credit would be desirable but is not mandatory.
- D. Not Required: Achievement of this credit is not expected or not possible for this project.
- E. See Section 01 35 15 - LEED Certification Procedures, for Contractor's responsibilities.

PART 2 - CREDIT SUMMARY

2.1 CERTIFICATION TO BE ACHIEVED: LEED Silver, requiring minimum of 50 points.

2.2 SUSTAINABLE SITES (SS): 16 Points To Be Achieved.

- A. SS Credit 1 - Required - 2 points - Site Selection.
 - 1. The project is located in a building that meets the criteria for the number of points indicated, using the options for Brownfield Redevelopment and Other Quantifiable Environmental Performance.
- B. SS Credit 2 - Required - 6 points - Development Density and Community Connectivity.
 - 1. The project is on a site that meets the criteria for Option 2, Community Connectivity.
- C. SS Credit 3.1 - Required - 6 points - Alternative Transportation: Public Transportation Access.
 - 1. The project is on a site that meets the criteria for Option 2, Bus Stop Proximity.
- D. SS Credit 3.2 - Required - 2 points - Alternative Transportation: Bicycle Storage & Changing Rooms.
 - 1. Secure bicycle storage and shower and changing facilities are to be provided.
- E. SS Credit 3.3 - Preferred - 2 points - Alternative Transportation: Parking Availability.

2.3 WATER EFFICIENCY (WE): 6 Points To Be Achieved.

- A. WE Prerequisite 1 - Required - No points - Water Use Reduction, 20% Reduction.
- B. WE Credit 1.1 - Required - 6 points - Water Use Reduction, 30% Reduction.

2.4 ENERGY & ATMOSPHERE (EA): 24 Points To Be Achieved.

- A. EA Prerequisite 1 - Required - No points - Fundamental Building Systems Commissioning.
- B. EA Prerequisite 2 - Required - No points - Minimum Energy Performance.

- C. EA Prerequisite 3 - Required - No points - Fundamental Refrigerant Management.
 - 1. Re-Used Equipment: This project includes no re-used equipment that contains refrigerants.
 - D. EA Credit 1.1 - Required - 3 points - Optimize Energy Performance, Lighting Power.
 - E. EA Credit 1.2 - Required - 2 points - Optimize Energy Performance, Lighting Controls.
 - F. EA Credit 1.3 - Required - 5 points - Optimize Energy Performance, HVAC.
 - G. EA Credit 1.4 - Required - 4 points - Optimize Energy Performance, Equipment & Appliances.
 - H. EA Credit 2 - Required - 5 points - Enhanced Commissioning.
 - 1. The commissioning authority's responsibilities with regard to design phase review, review of Contractor's submittals, and post-occupancy review are specified in Section 01 91 14, which is included for Contractor's information only.
 - 2. Contractor's responsibilities for post-occupancy commissioning are specified in Section 01 91 13.
 - 3. Responsibilities for preparation of operation and maintenance manuals for commissioned systems are specified in Section 01 78 00.
 - 4. Responsibilities for demonstrating commissioned systems and conducting training of personnel are specified in Section 01 79 00.
 - I. EA Credit 3 - Required - 5 points - Measurement & Verification.
 - 1. Owner's O&M program addresses incentives for additional improvement.
 - J. EA Credit 4 - Undecided - 5 points - Green Power.
 - 1. The Owner intends to or has already entered into a contract for electricity from renewable sources, but that is not part of the construction contract.
- 2.5 MATERIALS & RESOURCES: 1 Points To Be Achieved.
- A. MR Prerequisite 1 - Required - No points - Storage & Collection of Recyclables.
 - B. MR Credit 1.1 - Preferred - 1 point - Tenant Space, Long Term Commitment.
 - 1.
 - C. MR Credit 2.1 - Required - 1 point - Construction Waste Management, Divert 50% from Disposal.
 - 1. Construction procedures and measurement of diverted waste are specified in Section 01 74 19. This section requires the Contractor to perform the measurement and computation.
 - 2. Waste prevention and disposal procedures specific to certain types of work are specified in many sections.
 - D. MR Credit 2.2 - Preferred - 1 point - Construction Waste Management, Divert 75% from Disposal.
 - 1. Same as for MR Credit 2.1, but increased quantity.
 - E. MR Credit 4.1 - Required - 1 point - Recycled Content: 10% (post-consumer plus 1/2 pre-consumer).
 - 1. The definition of recycled content for the purposes of the contract documents is included in Section 01 60 00; qualifying products do not include plumbing, HVAC, electrical, or communications equipment, piping, conduit, ductwork, or wiring.

2. Contractor's reporting and measurement requirements are specified in Section 01 35 15 and Section 01 60 00; calculation of project totals is not the responsibility of Contractor.
- F. MR Credit 4.2 - Preferred - 1 point - Recycled Content: 20% (post-consumer plus ½ pre-consumer).
1. Same as for MR Credit 4.1, but increased quantity.
- G. MR Credit 5.1 - Required - 1 point - Regional Materials: 20% Manufactured Regionally.
1. For the purposes of the contract documents, the term "regionally-sourced" is used instead of "regional materials" and is defined in Section 01 60 00 in the same way as for this credit.
 2. Contractor's reporting and measurement requirements are specified in Section 01 35 15 and Section 01 60 00; calculation of project totals is not the responsibility of Contractor.
- H. MR Credit 5.2 - Preferred - 1 point - Regional Materials: 10% Extracted and Manufactured Regionally.
1. Same as for MR Credit 5.1, but for an additional 10%.
- 2.6 INDOOR ENVIRONMENTAL QUALITY: 9 Points To Be Achieved.
- A. EQ Prerequisite 1 - Required - No points - Minimum IAQ Performance.
1. The building ventilation has been designed to meet the minimum requirements of ASHRAE 62.1-2004.
- B. EQ Prerequisite 2 - Required - No points - Environmental Tobacco Smoke (ETS) Control.
1. Owner intends to prohibit smoking in the building.
 2. Exterior smoking areas are located at least 25 feet away from entries, outdoor air intakes, and operable windows.
- C. EQ Credit 1 - Required - 1 point - Outdoor Air Delivery Monitoring.
1. CO2 sensing and measurement devices in HVAC system, integrated with HVAC control system, are specified in Section 23 09 13.
- D. EQ Credit 3.1 - Required - 1 point - Construction IAQ Management Plan, During Construction.
1. Good construction procedures intended to prevent future problems are specified in Section 01 57 21.
- E. EQ Credit 3.2 - Required - 1 point - Construction IAQ Management Plan, Before Occupancy.
1. Contractor is required to perform either a full building flush-out or air quality testing prior to occupancy, both of which are specified in Section 01 57 21.
- F. EQ Credit 4.1 - Required - 1 point - Low-Emitting Materials, Adhesives & Sealants.
1. Firestopping sealants; specified in Section 07 84 00.
 2. Architectural joint sealants; specified in Section 07 90 05.
- G. EQ Credit 4.2 - Required - 1 point - Low-Emitting Materials, Paints & Coatings.
1. Paints and stains are specified in Section 09 90 00.
 - a. Water-based paints or solvent-based paints with VOC content meeting the credit criteria are used for all interior opaque applications.
- H. EQ Credit 4.3 - Required - 1 point - Low-Emitting Materials, Flooring Systems.
1. The following products are used in this project and will comply with the specified VOC restrictions:
 - a. Resilient flooring and base; specified in Section 09 65 00.

- b. Resinous flooring, specified in Section 09 67 23.
 - 2. Carpet; specified in Section 09 68 00.
 - 3. Carpet tile; specified in Section 09 68 13.
 - 4. Adhesives used in connection with carpet systems.
 - I. EQ Credit 5 - Preferred - 1 point - Indoor Chemical & Pollutant Source Control.
 - 1. At High Volume Entryways: Permanent grilles or grates to capture dirt, etc., are provided.
 - 2. Rooms Where Hazardous Gases or Chemicals May Be Present: Independent exhaust is provided for each room; this is a design solution involving building construction and HVAC.
 - a. Closers for self-closing doors are specified in Section 08 71 00.
 - b. Gypsum board construction is specified in Section 09 21 16.
 - 3. Chemical Mixing and Drainage: Separate plumbing drains are provided for environmentally appropriate disposal.
 - J. EQ Credit 6.1 - Required - 1 point - Controllability of Systems: Lighting.
 - K. EQ Credit 6.2 - Required - 1 point - Controllability of Systems: Thermal Comfort.
 - 1. HVAC Controls: Individual controls are to be provided for at least 50 percent of occupants in regularly occupied areas.
 - L. EQ Credit 7.1 - Required - 1 point - Thermal Comfort: Design.
 - 1. The overall design solution is implemented in the drawings and many sections of the specifications.
 - M. EQ Credit 7.2 - Required - 1 point - Thermal Comfort: Verification.
- 2.7 INNOVATION & DESIGN PROCESS (ID): 1 Points To Be Achieved.
- A. ID Credit 2 - Required - 1 point - LEED(tm) Accredited Professional.
 - 1. At least one principal participant of the project team has successfully completed the LEED Accredited Professional exam, including:
 - a. Rob Hsin, AIA, LEED AP.
- 2.8 REGIONAL PRIORITY (RP): 2 Points To Be Achieved.
- A. RP Credit 1.1 - Required - 1 point - Region Specific Environmental Priority : Thermal Comfort Region.
 - B. RP Credit 1.2 - Required - 1 point - Region Specific Environmental Priority : Transportation Region.

END OF SECTION

SECTION 01 35 15 - LEED CERTIFICATION PROCEDURES

PART 1 - GENERAL

1.1 PROJECT GOALS

- A. This project has been designed to achieve the LEED Silver (minimum 50 points rating as defined in the LEED(r) Green Building Rating System(tm) for Commercial Interiors, 2009 Edition.
- B. Contractor is not responsible for the application for LEED certification, nor for determination of methods of achieving LEED credits unless specifically so indicated.
- C. Many of the LEED credits can be achieved only through intelligent design of the project and are beyond the control of the Contractor. However, certain credits relate to the products and procedures used for construction. Therefore, the full cooperation of the Contractor and subcontractors is essential to achieving final certification.
- D. Contractor shall familiarize himself with the relevant requirements and provide the necessary information and instruction to all subcontractors and installers.
- E. Since Contractor and subcontractors may not be familiar with LEED requirements, this section includes a summary of the products and procedures intended to achieve LEED credits.
 - 1. Some credits are marked PREREQUISITE; these must be achieved regardless of the level of certification; many are dependent on proper performance by Contractor and subcontractors.
 - 2. Other credits involve quantifying percentages by weight and cost; these require careful record keeping and reporting by the Contractor.
 - 3. See www.usgbc.org for more information.
- F. **Contractor shall be responsible for tracking, documenting, and completing the required LEED template forms relating to construction credits as directed by the LEED Administrator.**

1.2 RELATED REQUIREMENTS

- A. Sections that include requirements intended to achieve LEED credits include, but are not limited to, the following:
- B. Section 01 35 16 - LEED Submittal Forms: Procedures for using the forms.
 - 1. 01 35 16.01 - LEED Material Cost Summary; to report material only cost categories for computations necessary for MR Credits 3, 4.1, 4.2, 5.1, 5.2, and 6.
 - 2. 01 35 16.03 - LEED Metal-Containing Product List; for documentation of steel and other metals used on project; MR Credits 4.1 and 4.2.
 - 3. 01 35 16.04 - LEED New Product Content Form; for content percentages for recycled, rapidly renewable, and certified wood credits, with material cost; MR Credits 4.1, 4.2, and 6; used in conjunction with Wood-Containing and Metal-Containing Product Lists as well as separately.
 - 4. 01 35 16.05 - LEED New Product Source Form; for documenting source of new products; MR Credit 5.1 and 5.2.

5. 01 35 16.07 - LEED Prohibited Content Installer Certification; for each installer to certify compliance with VOC requirements for adhesives and sealants, including duct sealers, and to certify no use of urea-formaldehyde-containing wood products; EQ Credits 4.1 and 4.4.
- C. Section 01 57 21 - Indoor Air Quality Controls:
 1. Contractor's IAQ management plan and construction procedures; EQ Credit 3.1.
 2. Building flush out or air contaminant testing; EQ Credit 3.2.
- D. Section 01 60 00 - Product Requirements: Overall project requirements for:
 1. Recycled content; MR Credits 4.1 and 4.2.
 2. Regionally-sourced products; MR Credits 5.1 and 5.2.
- E. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions: List of product categories having VOC content restrictions, evidence required, and reporting requirements.
- F. Section 01 74 19 - Construction Waste Management and Disposal:
 1. Construction and demolition waste management; MR Credit 2.1 and 2.2.
- G. Section 01 78 00 - Closeout Submittals:
 1. Maintenance and operation manuals for commissioned systems; EA Credit 2.
- H. Section 01 79 00 - Demonstration and Training:
 1. Demonstration of commissioned systems and training of personnel; EA Credit 2.
- I. Section 01 91 13 - General Commissioning Requirements:
 1. Additional commissioning; EA Credit 2.
- J. Section 01 91 14 - Commissioning Authority Responsibilities:
 1. Additional commissioning; EA Credit 2.
- K. Section 07 84 00 - Firestopping: LEED-VOC-compliant firestopping sealants; EQ Credit 4.1.
- L. Section 07 90 05 - Joint Sealers: LEED-VOC-compliant sealants; EQ Credit 4.1.
- M. Section 08 71 00 - Door Hardware:
 1. Door closers at rooms where hazardous gases or chemicals may be present: EQ Credit 5.
- N. Section 09 21 16 - Gypsum Board Assemblies:
 1. Deck-to-deck sealed partitions around certain rooms where hazardous gases or chemicals may be present; EQ Credit 5.
- O. Section 09 68 00 - Carpeting: Carpet complying with CRI Green Label Plus requirements and installation materials complying with CRI Green Label requirements; EQ Credit 4.3.
- P. Section 09 68 13 - Tile Carpeting: Carpet tile complying with CRI Green Label Plus requirements; EQ Credit 4.3.
- Q. Section 09 90 00 - Painting and Coating: LEED-VOC-compliant interior opaque paints and coatings; EQ Credit 4.2.
- R. Section 23 09 13 - Instrumentation and Control Devices for HVAC:
 1. Carbon dioxide monitoring devices for ventilation control; EQ Credit 1.

1.3 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, for additional submittal procedures.
- B. Submit extra copy of LEED submittals and reports directly to LEED Consultant, as well as to Architect, unless otherwise indicated.
- C. LEED Submittal/Report: For each product with the notation "show quantity on LEED submittal or report," submit a report with the following information:
 - 1. Submit with each Application for Payment; update the Report each period with latest period shown separately:
 - 2. Identify each product with:
 - a. Name and manufacturer.
 - b. Specification section number.
 - c. Applicable Credit(s).
 - d. Net weight per unit.
 - e. Quantity installed.
 - f. Material cost per unit.
 - g. Total material cost.
 - 3. Attach evidence of compliance from either the manufacturer or an independent agency.

1.4 INFORMATION SOURCES

- A. American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE); 1791 Tullie Circle, NE, Atlanta, GA 30329. Tel: (404) 636-8400. Fax: (404) 321-5478. www.ashrae.org.
- B. Bay Area Air Quality Management District (BAAQMD); 939 Ellis Street, San Francisco, California 94109. Tel: (415) 771-6000. www.baaqmd.gov.
- C. Center for Resource Solutions (CRS); Presidio Building, 49 P.O. Box 29512, San Francisco, CA 94129. Tel: (415) 561-2100. Fax: (415) 561-2105. www.resource-solutions.org or www.green-e.org.
- D. Green Seal; 1001 Connecticut Avenue, NW, Suite 827, Washington, DC 20036-5525. Tel: (202) 872-6400. Fax: (202) 872-4324. www.greenseal.org.
- E. South Coast Air Quality Management District (SCAQMD); 21865 E. Copley Drive, Diamond Bar, CA 91765. Tel: (909) 396-2000. www.aqmd.gov.
- F. U.S. Green Building Council (USGBC); 1015 18th Street, NW, Suite 805, Washington, DC 20036. Tel: (202) 82-USGBC or (202) 828-7422. Fax: (202) 828-5110. www.usgbc.org.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION - NOT USED

END OF SECTION

SECTION 01 35 16 - LEED SUBMITTAL FORMS

1.1 PURPOSE

- A. These forms are for the Contractor's use in submitting documentation to be used to determine whether particular credits have been achieved. The cooperation of subcontractors, suppliers, and manufacturers is required.
- B. These forms apply to the following LEED Credits:
 - 1. IEQ Credit 4 - Low-Emitting Materials.

1.2 FORMS

- A. 01 61 16.01 - Accessory Material VOC Content Certification Form: Certification by each installer working on project regardless of product type.

1.3 PROCEDURES

- A. All LEED submittal forms are to be submitted by Contractor; certifications are to be made by indicated party.
- B. Where a LEED Submittal is called for, fill out and submit the appropriate form.
 - 1. Fill out one form for each different brand name product and each different manufacturer of a lot of commodity products.
 - 2. Where required attachments are specified, attach the documentation to the back of the form.
- C. Each form must be signed by the entity capable of certifying the information.
 - 1. Certification signatures must be made by an officer of the company.
 - 2. For products, certification must be made by the manufacturer not the supplier.
 - 3. For custom fabricated products, certification by the fabricator is acceptable.
- D. Submit the completed forms in accordance with the requirements of Section 01 33 00 – Submittal Procedures, as information submittals.
 - 1. Give each form a unique submittal number.
 - 2. Do not combine LEED forms with product data or shop drawing submittals.
- E. Submit forms applicable to work for which application for payment is being made, either prior to or concurrent with application for payment; payment will not be made until relevant forms have been submitted.
- F. For work covered by multiple applications for payment, the initial submittal of a LEED form is sufficient for subsequent applications unless the nature of the product has changed.

END OF SECTION

SECTION 01 35 16.07 - LEED PROHIBITED CONTENT INSTALLER CERTIFICATION

1.1 LEED SUBMITTAL FORM

- A. Identification:
1. Project Name: **Discovery I - 1st, 3rd, 4th, 5th Floors Upfit**
 2. Project No.: **H27-6080- CA**
 3. Architect: **Jenkins Peer Architects.**
- B. This form applies to the following LEED credits:
1. Credit IEQ 4.1; VOC content of field-installed adhesives and sealants.
- C. Procedure:
1. Because installers are allowed and directed to choose accessory materials suitable for the applicable installation, each installer of work on this project is required to certify that his/their use of these particular materials complies with the contract documents and to provide documentation showing that the products used do not contain the prohibited content.
 2. Volatile organic compounds (VOCs) are defined by the U.S. EPA and state and local regulations applicable to this project. See Contract Documents for minimum criteria.

1.2 PRODUCT CERTIFICATION

- A. ___ Adhesives: I certify that the installation work of my firm on this project has not required the use of any adhesives.
- B. OR (certify either the above or the below, not both)
- C. ___ Adhesives: I certify that my firm has NOT installed any adhesive with VOC content exceeding that specified in Section 01 60 00 on this project; product data and MSDS sheets for all adhesives used, whether specified or not, are attached.
- D. ___ Joint Sealants: I certify that the installation work of my firm on this project has not required the use of any gunnable or pourable joint sealants.
- E. OR (certify either the above or the below, not both)
- F. ___ Joint Sealants: I certify that my firm has NOT installed any joint sealant with VOC content exceeding that specified in Section 07 90 05 on this project; product data and MSDS sheets for all joint sealants used, whether specified or not, are attached.
- G. CERTIFIED BY: (Installer/Manufacturer/Supplier Firm)
1. Firm Name: _____
 2. Print Name: _____
 3. Signature: _____
 4. Title: _____ (officer of company), Date: _____

END OF SECTION

SECTION 01 40 00 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. This 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 quality-assurance 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.
- C. Related Sections include the following:
 - 1. Division 01 Section "Cutting and Patching" for repair and restoration of construction disturbed by testing and inspecting activities.
 - 2. Divisions 02 through 27 Sections and Drawings for specific test and inspection requirements.

1.2 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 used to verify selections made under sample submittals, to demonstrate aesthetic effects and, where indicated, qualities of materials and execution, and to review construction, coordination, testing, or operation; they are not Samples. Approved mockups establish the standard by which the Work will be judged.
- D. 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 industry standards.
- E. Source Quality-Control Testing: Tests and inspections that are performed at the source, i.e., plant, mill, factory, or shop.

- F. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- G. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- H. 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. Using a term such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to tradespeople of the corresponding generic name.

1.3 CONFLICTING REQUIREMENTS

- A. General: 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 uncertainties and 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.

1.4 SUBMITTALS

- A. Qualification Data: 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.
- B. Reports: Prepare and submit certified written reports that 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.

- C. 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.

1.5 QUALITY ASSURANCE

- A. General: Qualifications paragraphs in this Article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. 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.
- C. 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.
- D. 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.
- E. 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.

1.6 QUALITY CONTROL

- A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing/inspection 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. Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. 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.
 - 1. 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.
 - 2. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
 - 3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.

4. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
 5. 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 Division 01 Section "Submittal Procedures."
- D. 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.
- E. 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.
- F. 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. Security and protection for samples and for testing and inspecting equipment at Project site.
- G. 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.

1.7 SPECIAL TESTS AND INSPECTIONS

- A. Special Tests and Inspections: Owner will engage and pay a qualified testing/inspection agency to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, and as follows:
1. Notifying Architect and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
 2. 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.
 3. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
 4. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
 5. Retesting and reinspecting corrected work.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

- A. 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 modifications 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. Comply with the Contract Document requirements for Division 01 Section "Cutting and Patching."
- 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

SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes requirements for temporary utilities, support facilities, site behavior and security and protection facilities.
- B. Related Sections include the following:
 - 1. Division 01 Section "Summary" for limitations on utility interruptions and other work restrictions.
 - 2. Division 01 Section "Execution Requirements" for progress cleaning requirements.

1.2 USE CHARGES

- A. Water Service: Water from Owner's existing water system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.
- B. Electric Power Service: Electric power from Owner's existing system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

1.3 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.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Portable Chain-Link Fencing: Minimum 2 inch, 9-gage, galvanized steel, chain-link fabric fencing; minimum 6 feet high with galvanized steel pipe posts; minimum 2-3/8 inch OD line posts and 2-7/8 inch OD corner and pull posts, with 1-5/8 inch OD top and bottom rails. Provide galvanized steel bases for supporting posts.
- B. Gypsum Board: Minimum 1/2 inch thick by 48 inches wide by maximum available lengths; regular-type panels with tapered edges. Comply with ASTM C 36/C 36M.
- C. Insulation: Unfaced mineral-fiber blanket, manufactured from glass, slag wool, or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.

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 construction personnel. 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 not less than 1 receptacle on each wall. Furnish room with conference table, chairs, and 4 foot square tack board.
 3. Drinking water and private toilet.
 4. Coffee machine and supplies.
 5. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F.
 6. Lighting fixtures capable of maintaining average illumination of 20 fc 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.

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: Connect to existing service.
1. Arrange with Owner and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- B. Water Service: Use of Owner's existing water service facilities will be permitted, as long as facilities are cleaned and maintained in a condition acceptable to Owner. At Project Acceptance, restore these facilities to condition existing before initial use.
- C. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities. **Use of existing toilet facilities is strictly prohibited.**
- D. 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.

- E. 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.
- F. Electric Power Service: Use of Owner's existing 120 volt electric power service will be permitted, as long as equipment is maintained in a condition acceptable to Owner. Higher power requirements will be furnished by the Contractor.
- G. Lighting: Provide temporary lighting that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.

3.3 SUPPORT FACILITIES INSTALLATION

- A. Parking: Use of Owner existing parking areas for construction personnel will be designated by the Owner.
- B. Project Identification and Temporary Signs: Provide Project identification sign. Install sign where indicated to inform public and individuals seeking entrance to Project. Unauthorized signs are not permitted.
 - 1. Provide two double-faced signs, 4 x 8 feet exterior grade plywood. The Architect will coordinate the design and the signage with the Owner and Contractor.
 - 2. Provide temporary, directional signs for construction personnel and visitors.
 - 3. Maintain and touchup signs so they are legible at all times.
- C. Waste Disposal Facilities: Comply with requirements specified in Division 01 Section "Construction Waste Management."
- D. 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.
- E. Existing Elevator Use: Use of Owner's designated elevators will be permitted, as long as elevators are cleaned and maintained in a condition acceptable to Owner. At Project Acceptance, restore elevators to condition existing before initial use, including replacing worn cables, guide shoes, and similar items of limited life.
 - 1. Do not load elevators beyond their rated weight capacity.
 - 2. Provide protective coverings, barriers, devices, signs, or other procedures to protect elevator car and entrance doors and frame. If, despite such protection, elevators become damaged, engage elevator Installer to restore damaged work so no evidence remains of correction work. Return items that cannot be refinished in field to the shop, make required repairs and refinish entire unit, or provide new units as required.
- F. Existing Stair Usage: Use of Owner's existing stairs will be permitted, as long as stairs are cleaned and maintained in a condition acceptable to Owner. At Project Acceptance, restore stairs to condition existing before initial use.
 - 1. Provide protective coverings, barriers, devices, signs, or other procedures to protect stairs and to maintain means of egress. If, despite such protection, stairs become damaged, restore damaged areas so no evidence remains of correction work.

- G. Temporary Use of Permanent Stairs: Cover finished, permanent stairs with protective covering of plywood or similar material so finishes will be undamaged at time of acceptance.

3.4 SITE BEHAVIOR

- A. All construction personnel shall be respectful of all members of the University community. Any incidents of disrespect, verbal abuse, threatening statements, unwelcome comments, unwelcome interaction or any form of harassment from any construction personnel toward any member of University community is strictly prohibited. Any such act shall constitute sufficient cause for the University to remove any individual permanently from the project and all University property. In addition, any of the Contractor(s) project personnel who ignore or refuse to take action on any requirements of the contract documents or ignore or refuse to take immediate action to correct any endangerment to the health and safety of the public (as solely determined by the University) shall be permanently removed from the project and University property. If in the sole determination of the University it is in the best interest of the project and the University to have any of the Contractor(s) personnel removed from the project, then the Contractor shall do so upon request by the University. Such actions taken by the University shall not constitute grounds for a delay claim. The University will not be responsible for any delays caused to the project due to any individual being removed from the project by the University.

3.5 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Temporary Partitions: Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate areas occupied by Owner from fumes and noise.
 - 1. Construct dustproof partitions with gypsum wallboard with joints taped on occupied side, and fire-retardant plywood on construction operations side.
 - 2. Construct dustproof partitions with 2 layers of 3 mil polyethylene sheet on each side. Cover floor with 2 layers of 3 mil polyethylene sheet, extending sheets 18 inches up the sidewalls. Overlap and tape full length of joints. Cover floor with fire-retardant plywood.
 - 3. Insulate partitions to provide noise protection to occupied areas.
 - 4. Seal joints and perimeter. Equip partitions with dustproof doors and security locks.
 - 5. Protect air-handling equipment.
 - 6. Weather strip openings.
 - 7. Provide walk-off mats at each entrance through temporary partition.
- B. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241.
 - 1. Smoking is prohibited in all areas.
 - 2. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.

3.6 OPERATION, TERMINATION, AND REMOVAL

- A. 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.
 2. At Substantial Completion, clean and renovate permanent facilities used during construction period. Comply with final cleaning requirements specified in Division 01 Section "Closeout Procedures."

END OF SECTION

DISCOVERY UPFIT - SITE ACCESS & LAYDOWN DIAGRAM



NOTES AND REQUIREMENTS::

1. G.C shall confine all storage, unloading, onsite parking, temporary facilities etc. activities and uses to the laydown area shown above unless advance written authorization for exceptions from USC facilities is granted
2. Street access to the laydown area and work access to the building shall be as indicated by black arrows above. Pedestrian access between the Discovery parking garage, Discovery plaza and surrounding streets and sidewalks shall be maintained and/or accomodated at all times. (Partially indicated by dashed arrow above) G.C. shall be responsible for protection measures to ensure pedestrian safety.

SECTION 01 57 21 - INDOOR AIR QUALITY CONTROLS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Construction procedures to promote adequate indoor air quality after construction.
- B. Building flush-out after construction and before occupancy.
- C. Testing indoor air quality before commencement of construction; existing building areas only.
- D. Testing indoor air quality after completion of construction.

1.2 PROJECT GOALS

- A. See Section 01 35 15 - LEED Certification Procedures, for overall project goals relating to environment and energy.
- B. Dust and Airborne Particulates: Prevent deposition of dust and other particulates in HVAC ducts and equipment.
 - 1. Cleaning of ductwork is not contemplated under this Contract.
 - 2. Contractor shall bear the cost of cleaning required due to failure to protect ducts and equipment from construction dust.
 - 3. Establish condition of existing ducts and equipment prior to start of alterations.
- C. Airborne Contaminants: Procedures and products have been specified to minimize indoor air pollutants.
 - 1. Furnish products meeting the specifications.
 - 2. Avoid construction practices that could result in contamination of installed products leading to indoor air pollution.
- D. Ventilation: HVAC system has been designed to achieve the minimum requirements for ventilation specified in ASHRAE 62.1.

1.3 RELATED REQUIREMENTS

- A. Section 01 35 15 - LEED Certification Procedures: LEED credits relating to indoor air quality.
- B. Section 01 40 00 - Quality Requirements: Testing and inspection services.

1.4 REFERENCE STANDARDS

- A. ASHRAE Std 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
- B. ASHRAE Std 62.1 - Ventilation For Acceptable Indoor Air Quality.
- C. SMACNA (OCC) - IAQ Guideline for Occupied Buildings Under Construction.

1.5 DEFINITIONS

- A. Adsorptive Materials: Gypsum board, acoustical ceiling tile and panels, carpet and carpet tile, fabrics, fibrous insulation, and other similar products.
- B. Contaminants: Gases, vapors, regulated pollutants, airborne mold and mildew, and the like, as specified.

- C. Particulates: Dust, dirt, and other airborne solid matter.
- D. Wet Work: Concrete, plaster, coatings, and other products that emit water vapor or volatile organic compounds during installation, drying, or curing.

1.6 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. LEED Submittals: Submit all submittals required in this section in accordance with procedures specified in Section 01 35 15.
- C. Indoor Air Quality Management Plan: Describe in detail measures to be taken to promote adequate indoor air quality upon completion; use SMACNA IAQ Guidelines for Occupied Buildings Under Construction as a guide.
 - 1. Submit not less than 60 days after signing of the Owner-Contractor Agreement.
 - 2. Identify potential sources of odor and dust.
 - 3. Identify construction activities likely to produce odor or dust.
 - 4. Identify areas of project potentially affected, especially occupied areas.
 - 5. Evaluate potential problems by severity and describe methods of control.
 - 6. Describe construction ventilation to be provided, including type and duration of ventilation, use of permanent HVAC systems, types of filters and schedule for replacement of filters.
 - 7. Describe cleaning and dust control procedures.
- D. Interior Finishes Installation Schedule: Identify each interior finish that either generates odors, moisture, or vapors or is susceptible to adsorption of odors and vapors, and indicate air handling zone, sequence of application, and curing times.
- E. Duct and Terminal Unit Inspection Report.
- F. Air Contaminant Test Plan: Identify:
 - 1. Testing agency qualifications.
 - 2. Locations and scheduling of air sampling.
 - 3. Test procedures, in detail.
 - 4. Test instruments and apparatus.
 - 5. Sampling methods.
- G. Air Contaminant Test Reports: Show:
 - 1. Location where each sample was taken, and time.
 - 2. Test values for each air sample; average the values of each set of 3.
 - 3. HVAC operating conditions.
 - 4. Certification of test equipment calibration.
 - 5. Other conditions or discrepancies that might have influenced results.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Low VOC Materials: See Section 01 61 16.
- B. Auxiliary Air Filters: MERV of 8, minimum, when tested in accordance with ASHRAE 52.2.

PART 3 - EXECUTION

3.1 CONSTRUCTION PROCEDURES

- A. Prevent the absorption of moisture and humidity by adsorptive materials by:
 - 1. Sequencing the delivery of such materials so that they are not present in the building until wet work is completed and dry.
 - 2. Delivery and storage of such materials in fully sealed moisture-impermeable packaging.
 - 3. Provide sufficient ventilation for drying within reasonable time frame.
- B. Begin construction ventilation when building is substantially enclosed.
- C. When working in a portion of an occupied building, prevent movement of air from construction area to occupied area.
- D. Do not store construction materials or waste in mechanical or electrical rooms.
- E. Prior to use of return air ductwork without intake filters clean up and remove dust and debris generated by construction activities.
 - 1. Inspect duct intakes, return air grilles, and terminal units for dust.
 - 2. Clean plenum spaces, including top sides of lay-in ceilings, outsides of ducts, tops of pipes and conduit.
 - 3. Clean tops of doors and frames.
 - 4. Clean mechanical and electrical rooms, including tops of pipes, ducts, and conduit, equipment, and supports.
 - 5. Clean return plenums of air handling units.
 - 6. Remove intake filters last, after cleaning is complete.
- F. Do not perform dusty or dirty work after starting use of return air ducts without intake filters.
- G. Use other relevant recommendations of SMACNA IAQ Guideline for Occupied Buildings Under Construction for avoiding unnecessary contamination due to construction procedures.

3.2 BUILDING FLUSH-OUT

- A. Contractor's Option: Either full continuous flush-out OR satisfactory air contaminant testing is required, not both.
- B. Perform building flush-out before occupancy.
- C. Do not start flush-out until:
 - 1. All construction is complete.
 - 2. HVAC systems have been tested, adjusted, and balanced for proper operation.
 - 3. Inspection of inside of return air ducts and terminal units confirms that cleaning is not necessary.
 - 4. New HVAC filtration media have been installed.
- D. Building Flush-Out: Operate all ventilation systems at normal flow rates with 100 percent outside air until a total air volume of 14,000 cubic feet per square foot of floor area has been supplied.
 - 1. Obtain Owner's concurrence that construction is complete enough before beginning flush-out.

2. Maintain interior temperature of at least 60 degrees F and interior relative humidity no higher than 60 percent.
 3. If additional construction involving materials that produce particulates or any of the specified contaminants is conducted during flush-out, start flush-out over.
 4. If interior spaces must be occupied prior to completion of the flush-out, supply a minimum of 25 percent of the total air volume prior to occupancy, and:
 - a. Begin ventilation at least three hours prior to daily occupancy.
 - b. Continue ventilation during all occupied periods.
 - c. Provide minimum outside air volume of 0.30 cfm per square foot or design minimum outside air rate, whichever is greater.
- E. Install new HVAC filtration media after completion of flush-out and before occupancy or further testing.

3.3 AIR CONTAMINANT TESTING

- A. Contractor's Option: Either full continuous flush-out OR satisfactory air contaminant testing is required, not both.
- B. Perform air contaminant testing before starting construction, as base line for evaluation of post-construction testing.
- C. Perform air contaminant testing before occupancy.
- D. Do not start air contaminant testing until:
1. All construction is complete, including interior finishes.
 2. HVAC systems have been tested, adjusted, and balanced for proper operation.
 3. New HVAC filtration media have been installed.
- E. Indoor Air Samples: Collect from spaces representative of occupied areas:
1. Collect samples while operable windows and exterior doors are closed, HVAC system is running normally as if occupied, with design minimum outdoor air, but with the building unoccupied.
 2. Collect samples from spaces in each contiguous floor area in each air handler zone, but not less than one sample per 25,000 square feet; take samples from areas having the least ventilation and those having the greatest presumed source strength.
 3. Collect samples from height from 36 inches to 72 inches above floor.
 4. Collect samples from same locations on 3 consecutive days during normal business hours; average the results of each set of 3 samples.
 5. Exception: Areas with normal very high outside air ventilation rates, such as laboratories, do not need to be tested.
 6. When retesting the same building areas, take samples from at least the same locations as in first test.
- F. Outdoor Air Samples: Collect samples at outside air intake of each air handler at the same time as indoor samples are taken.
- G. Analyze air samples and submit report.
- H. Air Contaminant Concentration Determination and Limits:
1. Carbon Monoxide: Not more than 9 parts per million and not more than 2 parts per million higher than outdoor air.

2. Airborne Mold and Mildew: Measure in relation to outside air; not higher than outside air.
3. Formaldehyde: Not more than 50 parts per billion.
4. Formaldehyde: Measure in micrograms per cubic meter, in relation to outside air; not more than 20 micrograms per cubic meter higher than outside air.
5. Total Volatile Organic Compounds (TVOC): Not more than 500 micrograms per cubic meter.
6. Total Volatile Organic Compounds (TVOC): Measure in micrograms per cubic meter, in relation to outside air; not more than 200 micrograms per cubic meter higher than outside air.
7. Particulates (PM10): Not more than 50 micrograms per cubic meter.
8. Total Particulates (PM): Measure in micrograms per cubic meter, in relation to outside air; not more than 20 micrograms per cubic meter higher than outside air.

END OF SECTION

SECTION 01 60 00 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. This 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; product substitutions; and comparable products.
- B. Related Sections include the following:
 - 1. Division 01 Section "Allowances" for products selected under an allowance.
 - 2. Division 01 Section "Closeout Procedures" for submitting warranties for Contract closeout.
 - 3. Divisions 02 through 27 Sections for specific requirements for warranties on products and installations specified to be warranted.

1.2 DEFINITIONS

- A. Products: Items purchased 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, or where indicated as a product substitution, 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. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
- C. Basis-of-Design Product Specification: Where a specific manufacturer's product is named and accompanied by the words "basis of design," 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 other named manufacturers.

1.3 SUBMITTALS

- A. Product List: Submit a list, in tabular form, showing specified products. Include generic names of products required. Include manufacturer's name and proprietary product names for each product.
 - 1. Coordinate product list with Contractor's Construction Schedule and the Submittals Schedule.
 - 2. Form: Tabulate information for each product under the following column headings:
 - a. Specification Section number and title.
 - b. Generic name used in the Contract Documents.
 - c. Proprietary name, model number, and similar designations.

- d. Manufacturer's name and address.
 - e. Supplier's name and address.
 - f. Installer's name and address.
 - g. Projected delivery date or time span of delivery period.
 - h. Identification of items that require early submittal approval for scheduled delivery date.
3. Initial Submittal: Within 14 days after date of commencement of the Work, submit 3 copies of initial product list. Include a written explanation for omissions of data and for variations from Contract requirements.
 - a. At Contractor's option, initial submittal may be limited to product selections and designations that must be established early in Contract period.
 4. Completed List: Within 30 days after date of commencement of the Work, submit 3 copies of completed product list. Include a written explanation for omissions of data and for variations from Contract requirements.
 5. Architect's Action: Architect will respond in writing to Contractor within 10 days of receipt of completed product list. Architect's response will include a list of unacceptable product selections and a brief explanation of reasons for this action. Architect's response, or lack of response, does not constitute a waiver of requirement to comply with the Contract Documents.
- B. Substitutions: Proposed products shall be manufactured of the same material/gauges or higher quality material and meet or exceed all specification requirements including, but not limited to, structure, dimension, function, appearance, energy usage, photometry, etc. without deviation. Substitutions will not be considered without providing the Architect with all necessary data requested such as, but not limited to, certified engineering drawings, material certifications of equal or better consistence, details, samples, mock-up(s) and test data. Substitutions must be approved by the Architect at least 10 days prior to bid. No substitutions will be allowed after the project bid date.
1. Substitution Request Form: Use Form approved by the Architect.
- C. Basis-of-Design Product Specification Submittal: Comply with requirements in Division 01 Section "Submittal Procedures." Show compliance with requirements.
- D. **Intent: The intent of all materials is that they match existing color, finish, etc. Where applicable, Contractor shall verify materials and finish match existing prior to submitting to Architect for approval.**

1.4 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, product selected shall be compatible with products specified.
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.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft. 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 ensure compliance with the Contract Documents and to ensure 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 products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
 - 3. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
 - 4. Protect stored products from damage and liquids from freezing.
 - 5. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.6 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: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
 - 2. Special Warranty: Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final 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 appropriate form properly executed.
 - 3. Refer to Divisions 02 through 10 Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Division 01 Section "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, that 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.
- B. Product Selection Procedures:
1. Product: Where Specifications name a single product and manufacturer, provide the named product that complies with requirements.
 2. Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed that complies with requirements.
 3. Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements.
 4. Basis-of-Design Product: Where Specifications name a product and include a list of manufacturers, provide the specified 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 provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product by the other named manufacturers.
 5. Visual Matching Specification: Where Specifications require matching an established Sample, select a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
 - a. If no product available within specified category matches and complies with other specified requirements, comply with provisions in Part 2 "Product Substitutions" Article for proposal of product.
 6. Visual Selection Specification: Where Specifications include the phrase "as selected from manufacturer's colors, patterns, textures" or a similar phrase, select a product that complies with other specified requirements.
 - a. Full Range: Where Specifications include the phrase "full range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 PRODUCT SUBSTITUTIONS

- A. 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:
1. 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.
 2. Requested substitution does not require extensive revisions to the Contract Documents.
 3. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 4. Substitution request is fully documented and properly submitted.
 5. Requested substitution will not adversely affect Contractor's Construction Schedule.
 6. Requested substitution has received necessary approvals of authorities having jurisdiction.
 7. Requested substitution is compatible with other portions of the Work.
 8. Requested substitution has been coordinated with other portions of the Work.
 9. Requested substitution provides specified warranty.

2.3 COMPARABLE PRODUCTS

- A. Conditions: Architect will consider Contractor's request for comparable product 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:
1. Evidence that the proposed product does not require extensive 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

SECTION 01 61 16 - VOLATILE ORGANIC COMPOUND (VOC) CONTENT RESTRICTIONS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. VOC restrictions for product categories listed below under "DEFINITIONS."
- B. All products of each category that are installed in the project must comply; Owner's project goals do not allow for partial compliance.

1.2 RELATED REQUIREMENTS

- A. Section 01 35 15 - LEED Certification Procedures.
- B. Section 01 40 00 - Quality Requirements: Procedures for testing and certifications.
- C. Section 01 57 21 - Indoor Air Quality Controls: Procedures and testing; LEED requirements.
- D. Section 01 60 00 - Product Requirements: Fundamental product requirements, substitutions and product options, delivery, storage, and handling.
- E. Section 01 61 16.01 - Accessory Material VOC Content Certification Form.

1.3 DEFINITIONS

- A. VOC-Restricted Products: All products of each of the following categories when installed or applied on-site in the building interior:
 - 1. Adhesives, sealants, and sealer coatings.
 - 2. Carpet.
 - 3. Resilient floor coverings.
 - 4. Paints and coatings.
 - 5. Gypsum board.
- B. Interior of Building: Anywhere inside the exterior weather barrier.
- C. Adhesives: All gunnable, trowelable, liquid-applied, and aerosol adhesives, whether specified or not; including flooring adhesives, resilient base adhesives, and pipe jointing adhesives.
- D. Sealants: All gunnable, trowelable, and liquid-applied joint sealants and sealant primers, whether specified or not; including firestopping sealants and duct joint sealers.

1.4 REFERENCE STANDARDS

- A. CAL (CHPS LEM) - Low-Emitting Materials Product List; California Collaborative for High Performance Schools (CHPS).
- B. CAL (VOC) - Standard Practice for the Testing of Volatile Organic Emissions From Various Sources Using Small-Scale Environmental Chambers (including Addendum 2004-01); State of California Department of Health Services.
- C. CRI (GLP) - Green Label Plus Carpet Testing Program - Approved Products; Carpet and Rug Institute.
- D. GEI (SCH) - GREENGUARD "Children and Schools" Certified Products; GREENGUARD Environmental Institute.

- E. GreenSeal GS-36 - Commercial Adhesives; Green Seal, Inc..
- F. SCAQMD 1168 - South Coast Air Quality Management District Rule No.1168; www.aqmd.gov.
- G. SCS (CPD) - SCS Certified Products; Scientific Certification Systems.

1.5 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Evidence of Compliance: Submit for each different product in each applicable category.
 - 1. Identify evidence submittals with the words "LEED Report".
- C. Product Data: For each VOC-restricted product used in the project, submit product data showing compliance, except when another type of evidence of compliance is required.
- D. Installer Certifications for Accessory Materials: Require each installer of any type of product (not just the products for which VOC restrictions are specified) to certify that either 1) no adhesives, joint sealants, paints, coatings, or composite wood or agrifiber products have been used in the installation of his products, or 2) that such products used comply with these requirements.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. All VOC-Restricted Products: Provide products having VOC content of types and volume not greater than those specified in State of California Department of Health Services Standard Practice for the Testing of Volatile Organic Emissions From Various Sources Using Small-Scale Environmental Chambers.
 - 1. Evidence of Compliance: Acceptable types of evidence are:
 - a. Current GREENGUARD Children & Schools certification; www.greenguard.org.
 - b. Current Carpet and Rug Institute Green Label Plus certification; www.carpet-rug.org.
 - c. Current SCS Floorscore certification; www.scs-certified.com.
 - d. Current SCS Indoor Advantage Gold certification; www.scs-certified.com.
 - e. Product listing in the CHPS Low-Emitting Materials Product List at www.chps.net/manual/lem_table.htm.
 - f. Current certification by any other agencies acceptable to CHPS.
 - g. Report of laboratory testing performed in accordance with CHPS requirements for getting a product listed in the Low-Emitting Materials Product List; report must include laboratory's statement that the product meets the specified criteria.
 - 2. Product data submittals showing VOC content are NOT acceptable forms of evidence.
- B. Adhesives and Joint Sealants: Provide only products having volatile organic compound (VOC) content not greater than required by South Coast Air Quality Management District Rule No.1168.

1. Evidence of Compliance: Acceptable types of evidence are:
 - a. Report of laboratory testing performed in accordance with requirements.
 - b. Published product data showing compliance with requirements.
- C. Aerosol Adhesives: Provide only products having volatile organic compound (VOC) content not greater than required by GreenSeal GS-36.
 1. Evidence of Compliance: Acceptable types of evidence are:
 - a. Current GreenSeal Certification.
 - b. Published product data showing compliance with requirements.
- D. Paints and Coatings: Provide products having VOC content as specified in Section 09 90 00.
- E. Carpet, Carpet Cushion, and Adhesive: Provide products having VOC content as specified in Section 09 68 00.
- F. Carpet Tile and Adhesive: Provide products having VOC content as specified in Section 09 68 13.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

- A. Owner reserves the right to reject non-compliant products, whether installed or not, and require their removal and replacement with compliant products at no extra cost to Owner.
- B. All additional costs to restore indoor air quality due to installation of non-compliant products will be borne by Contractor.

END OF SECTION

SECTION 01 61 16.01 - ACCESSORY MATERIAL VOC CONTENT CERTIFICATION FORM

1.1 FORM

A. Identification:

1. Project Name: Discovery One Upfit
2. Project No.: H27-6080-LC
3. Architect: Jenkins Peer Architects

B. Use of This Form:

1. Because installers are allowed and directed to choose accessory materials suitable for the applicable installation, there is a possibility that such accessory materials might contain VOC content in excess of that permitted, especially where such materials have not been explicitly specified.
2. Contractor is required to obtain and submit this form from each installer of work on this project.
3. For each product category listed, circle the correct words in brackets: either [HAS] or [HAS NOT].
4. If any of these accessory materials has been used, attach to this form product data and MSDS sheet for each such product.

C. VOC content restrictions are specified in Section 01 61 16.

2.1 PRODUCT CERTIFICATION

A. I certify that the installation work of my firm on this project:

1. [HAS] [HAS NOT] required the use of any ADHESIVES.
2. [HAS] [HAS NOT] required the use of any JOINT SEALANTS.
3. [HAS] [HAS NOT] required the use of any PAINTS OR COATINGS.
4. [HAS] [HAS NOT] required the use of any COMPOSITE WOOD or AGRIFIBER PRODUCTS.

B. Product data and MSDS sheets are attached.

3.1 CERTIFIED BY: (Installer/Manufacturer/Supplier Firm)

A. Firm Name: _____

B. Print Name: _____

C. Signature: _____

D. Title: _____ (officer of company)

E. Date: _____

END OF SECTION

SECTION 01 70 00 - EXECUTION REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes general procedural requirements governing execution of the Work including, but not limited to, the following:
 - 1. General installation of products.
 - 2. Progress cleaning.
 - 3. Protection of installed construction.
 - 4. Correction of the Work.
- B. Related Sections include the following:
 - 1. Division 01 Section "Cutting and Patching" for procedural requirements for cutting and patching necessary for the installation or performance of other components of the Work.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Existing Conditions: The existence and location of construction indicated as existing are not guaranteed. Before beginning work, investigate and verify the existence and location of mechanical and electrical systems and other construction affecting the Work.
- B. Acceptance of Conditions: 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. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
 - 2. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 - 3. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 - 4. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. 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.
- B. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

- C. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect. Include a detailed description of problem encountered, together with recommendations for changing the Contract Documents.

3.3 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 8 feet in spaces without a suspended ceiling.
- 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 Project Acceptance.
- 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. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.
- F. 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.
- G. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work.
 - 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.
- H. 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.
- I. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.4 OWNER-INSTALLED PRODUCTS

- A. Site Access: Provide access to Project site for Owner's construction forces.

- B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction forces.
 - 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 forces at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction forces if portions of the Work depend on Owner's construction.

3.5 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of materials lawfully.
 - 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
- B. 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.
- C. 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.
- D. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
 - 1. Bottom Tracks: All construction debris, dust, garbage etc. shall be removed from bottom tracks of steel stud walls prior to drywall installation.
- E. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Project Acceptance.
- F. Waste Disposal: Washing waste materials down sewers or into waterways will not be permitted.
- G. 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 Project Acceptance.
- H. 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.
- I. 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.

3.6 STARTING AND ADJUSTING

- A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- B. Adjust operating components for proper operation without binding. Adjust equipment for proper operation.
- 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: If a factory-authorized service representative is required to inspect field-assembled components and equipment installation, comply with qualification requirements in Division 1 Section "Quality Requirements."

3.7 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Project Acceptance.
- B. Comply with manufacturer's written instructions for temperature and relative humidity.

3.8 CORRECTION OF THE WORK

- A. Repair or remove and replace defective construction. Restore damaged substrates and finishes. Comply with requirements in Division 1 Section "Cutting and Patching."
 - 1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.
- B. Restore permanent facilities used during construction to their specified condition.
- C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.
- D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.
- E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION

SECTION 01 73 10 - CUTTING AND PATCHING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes procedural requirements for cutting and patching.
- B. Related Sections include the following:
 - 1. Division 02 Section "Demolition" for demolition of selected portions of the building.
 - 2. Divisions 02 through 27 Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.

1.2 QUALITY ASSURANCE

- A. Miscellaneous Elements: Do not cut and patch miscellaneous elements or related 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.
- B. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces 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.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections.
- B. In-Place Materials: Use materials 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 match the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.
 - 1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with in-place finishes or primers.
 - 2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Temporary Support: Provide temporary support of Work to be cut.
- B. 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.

- C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
- D. 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 prevent interruption to occupied areas.

3.3 PERFORMANCE

- A. 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. 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 as small as possible, neatly to 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. 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.
 - 4. Proceed with patching after construction operations requiring cutting are complete.
- C. 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 possible. Provide materials and comply with installation requirements specified in other Sections.
 - 1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate 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 eliminate 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, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.

4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
- D. Cleaning: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.

END OF SECTION

SECTION 01 74 19 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 WASTE MANAGEMENT REQUIREMENTS

- A. Owner requires that this project generate the least amount of trash and waste possible.
- B. Employ processes that ensure the generation of as little waste as possible due to error, poor planning, breakage, mishandling, contamination, or other factors.
- C. Minimize trash/waste disposal in landfills; reuse, salvage, or recycle as much waste as economically feasible.
- D. Owner may decide to pay for additional recycling, salvage, and/or reuse based on Landfill Alternatives Proposal specified below.
- E. Required Recycling, Salvage, and Reuse: The following may not be disposed of in landfills or by incineration:
 - 1. Aluminum and plastic beverage containers.
 - 2. Corrugated cardboard.
 - 3. Wood pallets.
 - 4. Clean dimensional wood: May be used as blocking or furring.
 - 5. Metals, including packaging banding, metal studs, sheet metal, structural steel, piping, door frames, and other items made of steel, iron, galvanized steel, stainless steel, aluminum, copper, zinc, lead, brass, and bronze.
- F. LEED Certification for this project is dependent on diversion of 50 percent, by weight, of potential landfill trash/waste by recycling and/or salvage.
- G. Contractor shall submit periodic Waste Disposal Reports; all landfill disposal, incineration, recycling, salvage, and reuse must be reported regardless of to whom the cost or savings accrues; use the same units of measure on all reports.
- H. Contractor shall develop and follow a Waste Management Plan designed to implement these requirements.
- I. Methods of trash/waste disposal that are not acceptable are:
 - 1. Burning on the project site.
 - 2. Burying on the project site.
 - 3. Dumping or burying on other property, public or private.
 - 4. Other illegal dumping or burying.
- J. Regulatory Requirements: Contractor is responsible for knowing and complying with regulatory requirements, including but not limited to Federal, state and local requirements, pertaining to legal disposal of all construction and demolition waste materials.

1.2 RELATED REQUIREMENTS

- A. Section 01 10 00 - Summary: List of items to be salvaged from the existing building for relocation in project or for Owner.

1.3 DEFINITIONS

- A. Clean: Untreated and unpainted; not contaminated with oils, solvents, caulk, or the like.

- B. Construction and Demolition Waste: Solid wastes typically including building materials, packaging, trash, debris, and rubble resulting from construction, remodeling, repair and demolition operations.
- C. Hazardous: Exhibiting the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity or reactivity.
- D. Nonhazardous: Exhibiting none of the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity, or reactivity.
- E. Nontoxic: Neither immediately poisonous to humans nor poisonous after a long period of exposure.
- F. Recyclable: The ability of a product or material to be recovered at the end of its life cycle and remanufactured into a new product for reuse by others.
- G. Recycle: To remove a waste material from the project site to another site for remanufacture into a new product for reuse by others.
- H. Recycling: The process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for the purpose of using the altered form. Recycling does not include burning, incinerating, or thermally destroying waste.
- I. Return: To give back reusable items or unused products to vendors for credit.
- J. Reuse: To reuse a construction waste material in some manner on the project site.
- K. Salvage: To remove a waste material from the project site to another site for resale or reuse by others.
- L. Sediment: Soil and other debris that has been eroded and transported by storm or well production run-off water.
- M. Source Separation: The act of keeping different types of waste materials separate beginning from the first time they become waste.
- N. Toxic: Poisonous to humans either immediately or after a long period of exposure.
- O. Trash: Any product or material unable to be reused, returned, recycled, or salvaged.
- P. Waste: Extra material or material that has reached the end of its useful life in its intended use. Waste includes salvageable, returnable, recyclable, and reusable material.

1.4 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. LEED Submittals: Submit Waste Management Plan in accordance with procedures specified in Section 01 35 15.
- C. Landfill Alternatives Proposal: Within 10 calendar days after receipt of Notice of Award of Bid, or prior to any trash or waste removal, whichever occurs sooner, submit a projection of trash/waste that will require disposal and alternatives to landfilling, with net costs.
 - 1. Submit to Architect for Owner's review and approval.
 - 2. If Owner wishes to implement any cost alternatives, the Contract Sum will be adjusted as specified elsewhere.

3. Include an analysis of trash/waste to be generated and landfill options as specified for Waste Management Plan described below.
 4. Describe as many alternatives to landfilling as possible:
 - a. List each material proposed to be salvaged, reused, or recycled.
 - b. List the proposed local market for each material.
 - c. State the estimated net cost resulting from each alternative, after subtracting revenue from sale of recycled or salvaged materials and landfill tipping fees saved due to diversion of materials from the landfill.
 5. Provide alternatives to landfilling for at least the following materials:
 - a. Gypsum drywall.
 - b. Paint.
- D. Once Owner has determined which of the landfill alternatives addressed in the Proposal above are acceptable, prepare and submit Waste Management Plan; submit within 10 calendar days after notification by Architect.
- E. Waste Management Plan: Include the following information:
1. Analysis of the trash and waste projected to be generated during the entire project construction cycle, including types and quantities.
 2. Landfill Options: The name, address, and telephone number of the landfill(s) where trash/waste will be disposed of, the applicable landfill tipping fee(s), and the projected cost of disposing of all project trash/waste in the landfill(s).
 3. Landfill Alternatives: List all waste materials that will be diverted from landfills by reuse, salvage, or recycling.
 4. Meetings: Describe regular meetings to be held to address waste prevention, reduction, recycling, salvage, reuse, and disposal.
 5. Materials Handling Procedures: Describe the means by which materials to be diverted from landfills will be protected from contamination and prepared for acceptance by designated facilities; include separation procedures for recyclables, storage, and packaging.
 6. Transportation: Identify the destination and means of transportation of materials to be recycled; i.e. whether materials will be site-separated and self-hauled to designated centers, or whether mixed materials will be collected by a waste hauler.
- F. Waste Disposal Reports: Submit at specified intervals, with details of quantities of trash and waste, means of disposal or reuse, and costs; show both totals to date and since last report.
1. Submit updated Report with each Application for Progress Payment; failure to submit Report will delay payment.
 2. Submit Report on a form acceptable to Owner.
 3. Landfill Disposal: Include the following information:
 - a. Identification of material.
 - b. Amount, in tons or cubic yards, of trash/waste material from the project disposed of in landfills.
 - c. State the identity of landfills, total amount of tipping fees paid to landfill, and total disposal cost.
 - d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
 4. Incinerator Disposal: Include the following information:
 - a. Identification of material.

- b. Amount, in tons or cubic yards, of trash/waste material from the project delivered to incinerators.
 - c. State the identity of incinerators, total amount of fees paid to incinerator, and total disposal cost.
 - d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
5. Recycled and Salvaged Materials: Include the following information for each:
 - a. Identification of material, including those retrieved by installer for use on other projects.
 - b. Amount, in tons or cubic yards, date removed from the project site, and receiving party.
 - c. Transportation cost, amount paid or received for the material, and the net total cost or savings of salvage or recycling each material.
 - d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
 - e. Certification by receiving party that materials will not be disposed of in landfills or by incineration.
6. Material Reused on Project: Include the following information for each:
 - a. Identification of material and how it was used in the project.
 - b. Amount, in tons or cubic yards.
 - c. Include weight tickets as evidence of quantity.
7. Other Disposal Methods: Include information similar to that described above, as appropriate to disposal method.

PART 2 - PRODUCTS

2.1 PRODUCT SUBSTITUTIONS

- A. See Section 01 60 00 - Product Requirements for substitution submission procedures.
- B. For each proposed product substitution, submit the following information in addition to requirements specified in Section 01 60 00:
 1. Relative amount of waste produced, compared to specified product.
 2. Cost savings on waste disposal, compared to specified product, to be deducted from the Contract Sum.
 3. Proposed disposal method for waste product.
 4. Markets for recycled waste product.

PART 3 - EXECUTION

3.1 WASTE MANAGEMENT PROCEDURES

- A. See Section 01 10 00 for list of items to be salvaged from the existing building for relocation in project or for Owner.

3.2 WASTE MANAGEMENT PLAN IMPLEMENTATION

- A. Manager: Designate an on-site person or persons responsible for instructing workers and overseeing and documenting results of the Waste Management Plan.
- B. Communication: Distribute copies of the Waste Management Plan to job site foreman, each subcontractor, Owner, and Architect.

- C. Instruction: Provide on-site instruction of appropriate separation, handling, and recycling, salvage, reuse, and return methods to be used by all parties at the appropriate stages of the project.
- D. Meetings: Discuss trash/waste management goals and issues at project meetings.
 - 1. Pre-bid meeting.
 - 2. Pre-construction meeting.
 - 3. Regular job-site meetings.
- E. Facilities: Provide specific facilities for separation and storage of materials for recycling, salvage, reuse, return, and trash disposal, for use by all contractors and installers.
 - 1. As a minimum, provide:
 - a. Separate area for storage of materials to be reused on-site, such as wood cut-offs for blocking.
 - b. Separate dumpsters for each category of recyclable.
 - c. Recycling bins at worker lunch area.
 - 2. Provide containers as required.
 - 3. Provide adequate space for pick-up and delivery and convenience to subcontractors.
 - 4. Keep recycling and trash/waste bin areas neat and clean and clearly marked in order to avoid contamination of materials.
- F. Hazardous Wastes: Separate, store, and dispose of hazardous wastes according to applicable regulations.
- G. Recycling: Separate, store, protect, and handle at the site identified recyclable waste products in order to prevent contamination of materials and to maximize recyclability of identified materials. Arrange for timely pickups from the site or deliveries to recycling facility in order to prevent contamination of recyclable materials.
- H. Reuse of Materials On-Site: Set aside, sort, and protect separated products in preparation for reuse.
- I. Salvage: Set aside, sort, and protect products to be salvaged for reuse off-site.

END OF SECTION

SECTION 01 77 00 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
 - 1. Inspection procedures.
 - 2. Warranties.
 - 3. Final cleaning.
- B. Related Sections include the following:
 - 1. Division 01 Section "Execution Requirements" for progress cleaning of Project site.
 - 2. Division 01 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
 - 3. Divisions 02 through 27 Sections for specific closeout and special cleaning requirements for the Work in those Sections.

1.2 SUBSTANTIAL COMPLETION

- A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.
 - 1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
 - 2. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 - 3. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 - 4. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
 - 5. Submit test/adjust/balance records.
 - 6. Complete final cleaning requirements, including touchup painting.
 - 7. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- B. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Occupancy 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.

1.3 FINAL COMPLETION

- A. Preliminary Procedures: Before requesting final inspection for determining date of Final Completion, complete the following:

1. Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
 2. Prepare and submit Project Record Documents, operation and maintenance manuals.
 3. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
 4. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
- B. Inspection: Submit a written request for final inspection for acceptance. 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.

1.4 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Preparation: Submit three copies 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, 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.

1.5 WARRANTIES

- A. Submittal Time: 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.
- B. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.
1. Bind warranties and bonds in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11 inch 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.

- C. 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: Provide 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 portion of Project:
 - a. Clean exposed interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances.
 - b. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.
 - c. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
 - d. Remove labels that are not permanent.
 - e. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
 - 1) Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.
 - f. Replace parts subject to unusual operating conditions.
 - g. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 - h. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
 - i. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
 - j. Leave Project clean and ready for occupancy.

END OF SECTION

SECTION 01 78 00 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Project Record Documents.
- B. Operation and Maintenance Data.

1.2 RELATED REQUIREMENTS

- A. Section 01 30 00 - Administrative Requirements: Submittals procedures, shop drawings, product data, and samples.
- B. Individual Product Sections: Specific requirements for operation and maintenance data.

1.3 SUBMITTALS

- A. Project Record Documents: Submit documents to Architect with claim for final Application for Payment.
- B. Operation and Maintenance Data:
 - 1. Submit two copies of preliminary draft or proposed formats and outlines of contents before start of Work. Architect will review draft and return one copy with comments.
 - 2. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit completed documents within ten days after acceptance.
 - 3. Submit one copy of completed documents 15 days prior to final inspection. This copy will be reviewed and returned after final inspection, with Architect comments. Revise content of all document sets as required prior to final submission.
 - 4. Submit two sets of revised final documents in final form within 10 days after final inspection.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 PROJECT RECORD DOCUMENTS

- A. Maintain on site one set of the following record documents; record actual revisions to the Work:
 - 1. Drawings.
 - 2. Addenda.
 - 3. Change Orders and other modifications to the Contract.
- B. Ensure entries are complete and accurate, enabling future reference by Owner.
- C. Store record documents separate from documents used for construction.
- D. Record information concurrent with construction progress.
- E. Record Drawings: Legibly mark each item to record actual construction including:
 - 1. Field changes of dimension and detail.
 - 2. Details not on original Contract drawings.

3.2 OPERATION AND MAINTENANCE DATA

- A. For Each Product or System: List names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.
- B. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.
- C. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.
- D. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

3.3 OPERATION AND MAINTENANCE DATA FOR MATERIALS AND FINISHES

- A. For Each Product, Applied Material, and Finish:
 - 1. Paint: Along with manufacturer information, provide color name, number and paint mix formula for each paint used.
- B. Instructions for Care and Maintenance: Manufacturer's recommendations for cleaning agents and methods, precautions against detrimental cleaning agents and methods, and recommended schedule for cleaning and maintenance.

3.4 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS

- A. For Each Item of Equipment and Each System:
 - 1. Description of unit or system, and component parts.
 - 2. Identify function, normal operating characteristics, and limiting conditions.
 - 3. Include performance curves, with engineering data and tests.
 - 4. Complete nomenclature and model number of replaceable parts.
- B. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications; by label machine.
- C. Include color coded wiring diagrams as installed.
- D. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
- E. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and trouble shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- F. Provide servicing and lubrication schedule, and list of lubricants required.
- G. Include manufacturer's printed operation and maintenance instructions.
- H. Include sequence of operation by controls manufacturer.
- I. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.

J. Additional Requirements: As specified in individual product specification sections.

3.5 OPERATION AND MAINTENANCE MANUALS

- A. Prepare instructions and data by personnel experienced in maintenance and operation of described products.
- B. Prepare data in the form of an instructional manual.
- C. Binders: Commercial quality, 8-1/2 by 11 inch three D side ring binders with durable plastic covers; 2 inch maximum ring size. When multiple binders are used, correlate data into related consistent groupings.
- D. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents.
- E. Provide tabbed dividers for each separate product and system, with typed description of product and major component parts of equipment.
- F. Text: Manufacturer's printed data, or typewritten data on 24 pound paper.
- G. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
- H. Contents: Prepare a Table of Contents for each volume, with each product or system description identified, in three parts as follows:
 - 1. Part 1: Directory, listing names, addresses, and telephone numbers of Architect, Contractor, Subcontractors, suppliers of finish materials and major equipment suppliers.
 - 2. Part 2: Operation and maintenance instructions, arranged by system and subdivided by specification section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Identify the following:
 - a. Significant design criteria.
 - b. List of equipment.
 - c. Parts list for each component.
 - d. Operating instructions.
 - e. Maintenance instructions for equipment and systems.
 - f. Maintenance instructions for special finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents.
 - 3. Part 3: Project documents and certificates, including the following:
 - a. Shop drawings and product data.
 - b. Certificates.

END OF SECTION

SECTION 01 78 13 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for Project Record Documents, including the following:
 - 1. Record Drawings.
 - 2. Record Specifications.
 - 3. Record Product Data.
- B. Related Sections include the following:
 - 1. Division 01 Section "Closeout Procedures" for general closeout procedures.

1.2 SUBMITTALS

- A. Record Drawings: Comply with the following:
 - 1. Contractor shall provide record drawings in REVIT to the Architect and Owner.
- B. Record Specifications: Submit one copy of Project's Specifications, including addenda and contract modifications. Specifications shall be submitted in digital format.
- C. Record Product Data: Submit one copy of each Product Data submittal.
 - 1. Where Record Product Data is required as part of operation and maintenance manuals, submit marked-up Product Data as an insert in manual instead of submittal as Record Product Data.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

- A. Record Prints: Maintain one set of blue- or black-line white prints of the Contract Drawings and Shop Drawings.
 - 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 prepare the 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 understandable drawing technique.
 - c. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.
 - 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. Revisions to routing of piping and conduits.
 - d. Revisions to electrical circuitry.
 - e. Duct size and routing.
 - f. Locations of concealed internal utilities.
 - g. Changes made by Change Order or Construction Change Directive.
 - h. Changes made following Architect's written orders.

- i. Details not on the original Contract Drawings.
 - j. Field records for variable and concealed conditions.
 - k. Record information on the Work that is shown only schematically.
 3. Mark the Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. If Shop Drawings are marked, show cross-reference on the Contract Drawings.
 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. 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. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
 3. For each principal product, indicate whether Record Product Data has been submitted in operation and maintenance manuals instead of submitted as Record Product Data.
 4. Note related Change Orders, Record Product Data, and Record Drawings where applicable.

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.

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 modifications to Project Record Documents as they occur; do not wait until the end of Project.
- B. Maintenance of Record Documents and Samples: Store Record Documents and Samples 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

SECTION 01 79 00 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 SUMMARY

- A. Demonstration of products and systems to be commissioned and where indicated in specific specification sections.
- B. Training of Owner personnel in operation and maintenance is required for:
 - 1. HVAC systems and equipment.
 - 2. Electrical systems and equipment.
- C. Training of Owner personnel in care, cleaning, maintenance, and repair is required for:
 - 1. Finishes, including flooring, wall finishes, ceiling finishes.
 - 2. Fixtures and fittings.

1.2 RELATED REQUIREMENTS

- A. Section 01 78 00 - Operation and Maintenance Data: Operation and maintenance manuals.
- B. Section 01 91 13 - General Commissioning Requirements: Additional requirements applicable to demonstration and training.
- C. Other Specification Sections: Additional requirements for demonstration and training.

1.3 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, for submittal procedures; except:
 - 1. Make all submittals specified in this section, and elsewhere where indicated for commissioning purposes, directly to the Commissioning Authority.
 - 2. Submit one copy to the Commissioning Authority, not to be returned.
 - 3. Make commissioning submittals on time schedule specified by Commissioning Authority.
 - 4. Submittals indicated as "Draft" are intended for the use of the Commissioning Authority in preparation of overall Training Plan; submit in editable electronic format, Microsoft Word 2003 preferred.
- B. Training Plan: Owner will designate personnel to be trained; tailor training to needs and skill-level of attendees.
 - 1. Submit to Architect for transmittal to Owner.
 - 2. Submit not less than four weeks prior to start of training.
 - 3. Revise and resubmit until acceptable.
 - 4. Provide an overall schedule showing all training sessions.
 - 5. Include at least the following for each training session:
 - a. Identification, date, time, and duration.
 - b. Description of products and/or systems to be covered.
 - c. Name of firm and person conducting training; include qualifications.
 - d. Intended audience, such as job description.
 - e. Objectives of training and suggested methods of ensuring adequate training.
 - f. Methods to be used, such as classroom lecture, live demonstrations, hands-on, etc.
 - g. Media to be used, such a slides, hand-outs, etc.
 - h. Training equipment required, such as projector, projection screen, etc., to be provided by Contractor.

- C. Training Manuals: Provide training manual for each attendee; allow for minimum of two attendees per training session.
 - 1. Include applicable portion of O&M manuals.
 - 2. Include copies of all hand-outs, slides, overheads, video presentations, etc., that are not included in O&M manuals.
 - 3. Provide one extra copy of each training manual to be included with operation and maintenance data.
- D. Training Reports:
 - 1. Identification of each training session, date, time, and duration.
 - 2. Sign-in sheet showing names and job titles of attendees.
 - 3. List of attendee questions and written answers given, including copies of and references to supporting documentation required for clarification; include answers to questions that could not be answered in original training session.
 - 4. Include Commissioning Authority's formal acceptance of training session.

1.4 QUALITY ASSURANCE

- A. Instructor Qualifications: Familiar with design, operation, maintenance and troubleshooting of the relevant products and systems.
 - 1. Provide as instructors the most qualified trainer of those contractors and/or installers who actually supplied and installed the systems and equipment.
 - 2. Where a single person is not familiar with all aspects, provide specialists with necessary qualifications.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 DEMONSTRATION - GENERAL

- A. Demonstrations conducted during system start-up do not qualify as demonstrations for the purposes of this section, unless approved in advance by Owner.
- B. Demonstrations conducted during Functional Testing need not be repeated unless Owner personnel training is specified.
- C. Demonstration may be combined with Owner personnel training if applicable.
- D. Operating Equipment and Systems: Demonstrate operation in all modes, including start-up, shut-down, seasonal changeover, emergency conditions, and troubleshooting, and maintenance procedures, including scheduled and preventive maintenance.
 - 1. Perform demonstrations not less than two weeks prior to Substantial Completion.
 - 2. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.
- E. Non-Operating Products: Demonstrate cleaning, scheduled and preventive maintenance, and repair procedures.
 - 1. Perform demonstrations not less than two weeks prior to Substantial Completion.

3.2 TRAINING - GENERAL

- A. Commissioning Authority will prepare the Training Plan based on draft plans submitted.
- B. Conduct training on-site unless otherwise indicated.
- C. Owner will provide classroom and seating at no cost to Contractor.
- D. Do not start training until Functional Testing is complete, unless otherwise specified or approved by the Commissioning Authority.
- E. Provide training in minimum two hour segments.
- F. The Commissioning Authority is responsible for determining that the training was satisfactorily completed and will provide approval forms.
- G. Training schedule will be subject to availability of Owner's personnel to be trained; re-schedule training sessions as required by Owner; once schedule has been approved by Owner failure to conduct sessions according to schedule will be cause for Owner to charge Contractor for personnel "show-up" time.
- H. Review of Facility Policy on Operation and Maintenance Data: During training discuss:
 - 1. The location of the O&M manuals and procedures for use and preservation; backup copies.
 - 2. Typical contents and organization of all manuals, including explanatory information, system narratives, and product specific information.
 - 3. Typical uses of the O&M manuals.
- I. Product- and System-Specific Training:
 - 1. Review the applicable O&M manuals.
 - 2. For systems, provide an overview of system operation, design parameters and constraints, and operational strategies.
 - 3. Review instructions for proper operation in all modes, including start-up, shut-down, seasonal changeover and emergency procedures, and for maintenance, including preventative maintenance.
 - 4. Provide hands-on training on all operational modes possible and preventive maintenance.
 - 5. Emphasize safe and proper operating requirements; discuss relevant health and safety issues and emergency procedures.
 - 6. Discuss common troubleshooting problems and solutions.
 - 7. Discuss any peculiarities of equipment installation or operation.
 - 8. Discuss warranties and guarantees, including procedures necessary to avoid voiding coverage.
 - 9. Review recommended tools and spare parts inventory suggestions of manufacturers.
 - 10. Review spare parts and tools required to be furnished by Contractor.
 - 11. Review spare parts suppliers and sources and procurement procedures.
- J. Be prepared to answer questions raised by training attendees; if unable to answer during training session, provide written response within three days.

END OF SECTION

SECTION 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Commissioning is intended to achieve the following specific objectives; this section specifies the Contractor's responsibilities for commissioning:
 - 1. Verify that the work is installed in accordance with the Contract Documents and the manufacturer's recommendations and instructions, and that it receives adequate operational checkout prior to startup: Startup reports and Prefunctional Checklists executed by Contractor are utilized to achieve this.
 - 2. Verify and document that functional performance is in accordance with the Contract Documents: Functional Tests executed by Contractor and witnessed by the Commissioning Authority are utilized to achieve this.
 - 3. Verify that operation and maintenance manuals submitted to Owner are complete: Detailed operation and maintenance (O&M) data submittals by Contractor are utilized to achieve this.
 - 4. Verify that the Owner's operating personnel are adequately trained: Formal training conducted by Contractor is utilized to achieve this.
- B. Commissioning, including Functional Tests, O&M documentation review, and training, is to occur after startup and initial checkout and be completed before Substantial Completion
- C. The Commissioning Authority directs and coordinates all commissioning activities; this section describes some but not all of the Commissioning Authority's responsibilities.
- D. The Commissioning Authority is employed by Owner.

1.2 SCOPE OF COMMISSIONING

- A. The following are to be commissioned:
- B. HVAC System, including:
 - 1. Major and minor equipment items.
 - 2. Piping systems and equipment.
 - 3. Ductwork and accessories.
 - 4. Vibration control devices.
 - 5. Variable frequency drives.
- C. Special Ventilation:
 - 1. Fume hoods.
 - 2. Laboratory pressurization.
- D. Electrical Systems:
 - 1. Power quality.
 - 2. Lighting controls other than manual switches.
- E. Other equipment and systems explicitly identified elsewhere in Contract Documents as requiring commissioning.

1.3 RELATED REQUIREMENTS

- A. Section 01 35 15 - LEED Certification Procedures: LEED credits relating to commissioning.

- B. Section 01 57 21 - Indoor Air Quality Controls: Precautions and procedures; smoking room testing; building flush-out.
- C. Section 01 78 00 - Operation and Maintenance Data: Scope and procedures for operation and maintenance manuals and project record documents.
- D. Section 01 79 00 - Demonstration and Training: Scope and procedures for Owner personnel training.
- E. Section 01 91 14 - Commissioning Authority Responsibilities.

1.4 REFERENCE STANDARDS

- A. PEI (Samples) - Sample Forms for Prefunctional Checklists and Functional Performance Tests; Portland Energy Conservation, Inc.; located at <http://www.peci.org/library/mcpgs.htm>.

1.5 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, for submittal procedures; except:
 - 1. Make all submittals specified in this section, and elsewhere where indicated for commissioning purposes, directly to the Commissioning Authority, unless they require review by Architect; in that case, submit to Architect first.
 - 2. Submit one copy to the Commissioning Authority, not to be returned.
 - 3. Make commissioning submittals on time schedule specified by Commissioning Authority.
 - 4. Submittals indicated as "Draft" are intended for the use of the Commissioning Authority in preparation of Prefunctional Checklists or Functional Test requirements; submit in editable electronic format, Microsoft Word 2003 preferred.
 - 5. As soon as possible after submittals made to Architect are approved, submit copy of approved submittal to the Commissioning Authority.
 - 6. LEED Submittals: Submit approved submittals in accordance with procedures specified in Section 01 35 15.
- B. Manufacturers' Instructions: Submit copies of all manufacturer-provided instructions that are shipped with the equipment as soon as the equipment is delivered.
- C. Product Data: If submittals to Architect do not include the following, submit copies as soon as possible:
 - 1. Manufacturer's product data, cut sheets, and shop drawings.
 - 2. Manufacturer's installation instructions.
 - 3. Startup, operating, and troubleshooting procedures.
 - 4. Fan and pump curves.
 - 5. Factory test reports.
 - 6. Warranty information, including details of Owner's responsibilities in regard to keeping warranties in force.
- D. Startup Plans and Reports.
- E. Completed Prefunctional Checklists.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

- A. Provide all standard testing equipment required to perform startup and initial checkout and required Functional Testing; unless otherwise noted such testing equipment will NOT become the property of Owner.
- B. Calibration Tolerances: Provide testing equipment of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified. If not otherwise noted, the following minimum requirements apply:
 - 1. Temperature Sensors and Digital Thermometers: Certified calibration within past year to accuracy of 0.5 degree F and resolution of plus/minus 0.1 degree F.
 - 2. Pressure Sensors: Accuracy of plus/minus 2.0 percent of the value range being measured (not full range of meter), calibrated within the last year.
 - 3. Calibration: According to the manufacturer's recommended intervals and when dropped or damaged; affix calibration tags or keep certificates readily available for inspection.
- C. Equipment-Specific Tools: Where special testing equipment, tools and instruments are specific to a piece of equipment, are only available from the vendor, and are required in order to accomplish startup or Functional Testing, provide such equipment, tools, and instruments as part of the work at no extra cost to Owner; such equipment, tools, and instruments are to become the property of Owner.
- D. Dataloggers: Independent equipment and software for monitoring flows, currents, status, pressures, etc. of equipment.
 - 1. Dataloggers required to for Functional Tests will be provided by the Commissioning Authority and will not become the property of Owner.

PART 3 - EXECUTION

3.1 COMMISSIONING PLAN

- A. Commissioning Authority has prepared the Commissioning Plan.
 - 1. Attend meetings called by the Commissioning Authority for purposes of completing the commissioning plan.
 - 2. Require attendance and participation of relevant subcontractors, installers, suppliers, and manufacturer representatives.
- B. Contractor is responsible for compliance with the Commissioning Plan.
- C. Commissioning Plan: The commissioning schedule, procedures, and coordination requirements for all parties in the commissioning process.
- D. Commissioning Schedule:
 - 1. Submit anticipated dates of startup of each item of equipment and system to Commissioning Authority within 60 days after award of Contract.
 - 2. Re-submit anticipated startup dates monthly, but not less than 4 weeks prior to startup.
 - 3. Prefunctional Checklists and Functional Tests are to be performed in sequence from components, to subsystems, to systems.
 - 4. Provide sufficient notice to Commissioning Authority for delivery of relevant Checklists and Functional Test procedures, to avoid delay.

3.2 DOCUMENTATION IDENTIFICATION SYSTEM

- A. Give each submitted form or report a unique identification; use the following scheme.
- B. Type of Document: Use the following prefixes:
 - 1. Startup Plan: SP-.
 - 2. Startup Report: SR-.
 - 3. Prefunctional Checklist: PC-.
 - 4. Functional Test Procedure: FTP-.
 - 5. Functional Test Report: FTR-.
- C. System Type: Use the first 4 digits from CSI/CSC MasterFormat, 2004 Edition, that are applicable to the system; for example:
 - 1. 2300: HVAC system as a whole.
 - 2. 2320: HVAC Piping and Pumps.
 - 3. 2330: HVAC Air Distribution.
- D. Component Number: Assign numbers sequentially, using 1, 2, or 3 digits as required to accommodate the number of units in the system.
- E. Test, Revision, or Submittal Number: Number each successive iteration sequentially, starting with 1.
- F. Example: PC-2320-001.2 would be the Prefunctional Checklist for equipment item 1 in the HVAC piping system, probably a pump; this is the second, revised submittal of this checklist.

3.3 STARTUP PLANS AND REPORTS

- A. Startup Plans: For each item of equipment and system for which the manufacturer provides a startup plan, submit the plan not less than 8 weeks prior to startup.
- B. Startup Reports: For each item of equipment and system for which the manufacturer provides a startup checklist (or startup plan or field checkout sheet), document compliance by submitting the completed startup checklist prior to startup, signed and dated by responsible entity.
- C. Submit directly to the Commissioning Authority.

3.4 PREFUNCTIONAL CHECKLISTS

- A. A Prefunctional Checklist is required to be filled out for each item of equipment or other assembly specified to be commissioned.
 - 1. No sampling of identical or near-identical items is allowed.
 - 2. These checklists do not replace manufacturers' recommended startup checklists, regardless of apparent redundancy.
 - 3. Prefunctional Checklist forms will not be complete until after award of the contract; the following types of information will be gathered via the completed Checklist forms:
 - a. Certification by installing contractor that the unit is properly installed, started up, and operating and ready for Functional Testing.
 - b. Confirmation of receipt of each shop drawing and commissioning submittal specified, itemized by unit.
 - c. Manufacturer, model number, and relevant capacity information; list information "as specified," "as submitted," and "as installed."
 - d. Serial number of installed unit.

- e. List of inspections to be conducted to document proper installation prior to startup and Functional Testing; these will be primarily static inspections and procedures; for equipment and systems may include normal manufacturer's start-up checklist items and minor testing.
 - f. Sensor and actuator calibration information.
 4. Samples of Prefunctional Checklist forms that indicate anticipated level of detail can be found at <http://www.peci.org/library/mcpgs.htm>.
- B. Contractor is responsible for filling out Prefunctional Checklists, after completion of installation and before startup; witnessing by the Commissioning Authority is not required unless otherwise specified.
1. Each line item without deficiency is to be witnessed, initialed, and dated by the actual witness; checklists are not complete until all line items are initialed and dated complete without deficiencies.
 2. Checklists with incomplete items may be submitted for approval provided the Contractor attests that incomplete items do not preclude the performance of safe and reliable Functional Testing; re-submission of the Checklist is required upon completion of remaining items.
 3. Individual Checklists may contain line items that are the responsibility of more than one installer; Contractor shall assign responsibility to appropriate installers or subcontractors, with identification recorded on the form.
 4. If any Checklist line item is not relevant, record reasons on the form.
 5. Contractor may independently perform startup inspections and/or tests, at his option.
 6. Regardless of these reporting requirements, Contractor is responsible for correct startup and operation.
 7. Submit completed Checklists to Commissioning Authority within two days of completion.
- C. Commissioning Authority is responsible for furnishing the Prefunctional Checklists to Contractor.
1. Initial Drafts: Contractor is responsible for initial draft of Prefunctional Checklist where so indicated in the Contract Documents.
 2. Provide all additional information requested by Commissioning Authority to aid in preparation of checklists, such as shop drawing submittals, manufacturers' startup checklists, and O&M data.
 3. Commissioning Authority may add any relevant items deemed necessary regardless of whether they are explicitly mentioned in the Contract Documents or not.
 4. When asked to review the proposed Checklists, do so in a timely manner.
- D. Commissioning Authority Witnessing: Required for:
1. Each piece of primary equipment, unless sampling of multiple similar units is allowed by the commissioning plan.
 2. A sampling of non-primary equipment, as allowed by the commissioning plan.
- E. Deficiencies: Correct deficiencies and re-inspect or re-test, as applicable, at no extra cost to Owner.
1. If difficulty in correction would delay progress, report deficiency to the Commissioning Authority immediately.

3.5 FUNCTIONAL TESTS

- A. A Functional Test is required for each item of equipment, system, or other assembly specified to be commissioned, unless sampling of multiple identical or near-identical units is allowed by the final test procedures.
- B. Contractor is responsible for execution of required Functional Tests, after completion of Prefunctional Checklist and before closeout.
- C. Commissioning Authority is responsible for witnessing and reporting results of Functional Tests, including preparation and completion of forms for that purpose.
- D. Contractor is responsible for correction of deficiencies and re-testing at no extra cost to Owner; if a deficiency is not corrected and re-tested immediately, the Commissioning Authority will document the deficiency and the Contractor's stated intentions regarding correction.
 - 1. Deficiencies are any condition in the installation or function of a component, piece of equipment or system that is not in compliance with the Contract Documents or does not perform properly.
 - 2. When the deficiency has been corrected, the Contractor completes the form certifying that the item is ready to be re-tested and returns the form to the Commissioning Authority; the Commissioning Authority will reschedule the test and the Contractor shall re-test.
 - 3. Identical or Near-Identical Items: If 10 percent, or three, whichever is greater, of identical or near-identical items fail to perform due to material or manufacturing defect, all items will be considered defective; provide a proposal for correction within 2 weeks after notification of defect, including provision for testing sample installations prior to replacement of all items.
 - 4. Contractor shall bear the cost of Owner and Commissioning Authority personnel time witnessing re-testing.
 - 5. Contractor shall bear the cost of Owner and Commissioning Authority personnel time witnessing re-testing if the test failed due to failure to execute the relevant Prefunctional Checklist correctly; if the test failed for reasons that would not have been identified in the Prefunctional Checklist process, Contractor shall bear the cost of the second and subsequent re-tests.
- E. Functional Test Procedures:
 - 1. Some test procedures are included in the Contract Documents; where Functional Test procedures are not included in the Contract Documents, test procedures will be determined by the Commissioning Authority with input by and coordination with Contractor.
 - 2. Examples of Functional Testing:
 - a. Test the dynamic function and operation of equipment and systems (rather than just components) using manual (direct observation) or monitoring methods under full operation (e.g., the chiller pump is tested interactively with the chiller functions to see if the pump ramps up and down to maintain the differential pressure setpoint).
 - b. Systems are tested under various modes, such as during low cooling or heating loads, high loads, component failures, unoccupied, varying outside air temperatures, fire alarm, power failure, etc.
 - c. Systems are run through all the HVAC control system's sequences of operation and components are verified to be responding as the sequence's state.

- d. Traditional air or water test and balancing (TAB) is not Functional Testing; spot checking of TAB by demonstration to the Commissioning Authority is Functional Testing.
 3. Samples of Functional Test forms that indicate anticipated level of detail can be found at <http://www.peci.org/library/mcpgs.htm>.
- F. Deferred Functional Tests: Some tests may need to be performed later, after substantial completion, due to partial occupancy, equipment, seasonal requirements, design or other site conditions; performance of these tests remains the Contractor's responsibility regardless of timing.

3.6 SENSOR AND ACTUATOR CALIBRATION

- A. Calibrate all field-installed temperature, relative humidity, carbon monoxide, carbon dioxide, and pressure sensors and gages, and all actuators (dampers and valves) on this piece of equipment shall be calibrated. Sensors installed in the unit at the factory with calibration certification provided need not be field calibrated.
- B. Calibrate using the methods described below; alternate methods may be used, if approved by Owner beforehand. See PART 2 for test instrument requirements. Record methods used on the relevant Prefunctional Checklist or other suitable forms, documenting initial, intermediate and final results.
- C. All Sensors:
 1. Verify that sensor location is appropriate and away from potential causes of erratic operation.
 2. Verify that sensors with shielded cable are grounded only at one end.
 3. For sensor pairs that are used to determine a temperature or pressure difference, for temperature make sure they are reading within 0.2 degree F of each other, and for pressure, within tolerance equal to 2 percent of the reading, of each other.
 4. Tolerances for critical applications may be tighter.
- D. Sensors Without Transmitters - Standard Application:
 1. Make a reading with a calibrated test instrument within 6 inches of the site sensor.
 2. Verify that the sensor reading, via the permanent thermostat, gage or building automation system, is within the tolerances in the table below of the instrument-measured value.
 3. If not, install offset, calibrate or replace sensor.
- E. Sensors With Transmitters - Standard Application.
 1. Disconnect sensor.
 2. Connect a signal generator in place of sensor.
 3. Connect ammeter in series between transmitter and building automation system control panel.
 4. Using manufacturer's resistance-temperature data, simulate minimum desired temperature.
 5. Adjust transmitter potentiometer zero until 4 mA is read by the ammeter.
 6. Repeat for the maximum temperature matching 20 mA to the potentiometer span or maximum and verify at the building automation system.
 7. Record all values and recalibrate controller as necessary to conform with specified control ramps, reset schedules, proportional relationship, reset relationship and P/I reaction.
 8. Reconnect sensor.
 9. Make a reading with a calibrated test instrument within 6 inches of the site sensor.

10. Verify that the sensor reading, via the permanent thermostat, gage or building automation system, is within the tolerances in the table below of the instrument-measured value.
 11. If not, replace sensor and repeat.
 12. For pressure sensors, perform a similar process with a suitable signal generator.
- F. Sensor Tolerances for Standard Applications: Plus/minus the following maximums:
1. Watthour, Voltage, Amperage: 1 percent of design.
 2. Pressure, Air, Water, Gas: 3 percent of design.
 3. Air Temperatures (Outside Air, Space Air, Duct Air): 0.4 degrees F.
 4. Relative Humidity: 4 percent of design.
 5. Barometric Pressure: 0.1 inch of Hg.
 6. Flow Rate, Air: 10 percent of design.
 7. Flow Rate, Water: 4 percent of design.
 8. AHU Wet Bulb and Dew Point: 2.0 degrees F.
- G. Critical Applications: For some applications more rigorous calibration techniques may be required for selected sensors. Describe any such methods used on an attached sheet.
- H. Valve/Damper Stroke Setup and Check:
1. For all valve/damper actuator positions checked, verify the actual position against the control system readout.
 2. Set pump/fan to normal operating mode.
 3. Command valve/damper closed; visually verify that valve/damper is closed and adjust output zero signal as required.
 4. Command valve/damper to open; verify position is full open and adjust output signal as required.
 5. Command valve/damper to a few intermediate positions.
 6. If actual valve/damper position does not reasonably correspond, replace actuator or add pilot positioner (for pneumatics).
- I. Isolation Valve or System Valve Leak Check: For valves not associated with coils.
1. With full pressure in the system, command valve closed.
 2. Use an ultra-sonic flow meter to detect flow or leakage.

3.7 TEST PROCEDURES - GENERAL

- A. Provide skilled technicians to execute starting of equipment and to execute the Functional Tests. Ensure that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments and problem-solving.
- B. Provide all necessary materials and system modifications required to produce the flows, pressures, temperatures, and conditions necessary to execute the test according to the specified conditions. At completion of the test, return all affected equipment and systems to their pre-test condition.
- C. Sampling: Where Functional Testing of fewer than the total number of multiple identical or near-identical items is explicitly permitted, perform sampling as follows:
1. Identical Units: Defined as units with same application and sequence of operation; only minor size or capacity difference.
 2. Sampling is not allowed for:
 - a. Major equipment.

- b. Life-safety-critical equipment.
 - c. Prefunctional Checklist execution.
 3. XX = the percent of the group of identical equipment to be included in each sample; defined for specific type of equipment.
 4. YY = the percent of the sample that if failed will require another sample to be tested; defined for specific type of equipment.
 5. Randomly test at least XX percent of each group of identical equipment, but not less than three units. This constitutes the "first sample."
 6. If YY percent of the units in the first sample fail, test another XX percent of the remaining identical units.
 7. If YY percent of the units in the second sample fail, test all remaining identical units.
 8. If frequent failures occur, resulting in more troubleshooting than testing, the Commissioning Authority may stop the testing and require Contractor to perform and document a checkout of the remaining units prior to continuing testing.
- D. Manual Testing: Use hand-held instruments, immediate control system readouts, or direct observation to verify performance (contrasted to analyzing monitored data taken over time to make the "observation").
- E. Simulating Conditions: Artificially create the necessary condition for the purpose of testing the response of a system; for example apply hot air to a space sensor using a hair dryer to see the response in a VAV box.
- F. Simulating Signals: Disconnect the sensor and use a signal generator to send an amperage, resistance or pressure to the transducer and control system to simulate the sensor value.
- G. Over-Writing Values: Change the sensor value known to the control system in the control system to see the response of the system; for example, change the outside air temperature value from 50 degrees F to 75 degrees F to verify economizer operation.
- H. Indirect Indicators: Remote indicators of a response or condition, such as a reading from a control system screen reporting a damper to be 100 percent closed, are considered indirect indicators.
- I. Monitoring: Record parameters (flow, current, status, pressure, etc.) of equipment operation using dataloggers or the trending capabilities of the relevant control systems; where monitoring of specific points is called for in Functional Test Procedures:
1. All points that are monitored by the relevant control system shall be trended by Contractor; at the Commissioning Authority's request, Contractor shall trend up to 20 percent more points than specified at no extra charge.
 2. Other points will be monitored by the Commissioning Authority using dataloggers.
 3. At the option of the Commissioning Authority, some control system monitoring may be replaced with datalogger monitoring.
 4. Provide hard copies of monitored data in columnar format with time down left column and at least 5 columns of point values on same page.
 5. Graphical output is desirable and is required for all output if the system can produce it.
 6. Monitoring may be used to augment manual testing.

3.8 OPERATION AND MAINTENANCE MANUALS

- A. See Section 01 78 00 for additional requirements.

- B. Add design intent documentation furnished by Architect to manuals prior to submission to Owner.
- C. Submit manuals related to items that were commissioned to Commissioning Authority for review; make changes recommended by Commissioning Authority.
- D. Commissioning Authority will add commissioning records to manuals after submission to Owner.

END OF SECTION

SECTION 01 91 14 - COMMISSIONING AUTHORITY RESPONSIBILITIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Commissioning is intended to achieve the following specific objectives; this section covers the Commissioning Authority's responsibilities for commissioning:
 - 1. Verify that the work is installed in accordance with the Contract Documents and the manufacturer's recommendations and instructions, and that it receives adequate operational checkout prior to startup: Startup reports and Prefunctional Checklists are utilized to achieve this.
 - 2. Verify and document that functional performance is in accordance with the Contract Documents: Functional Tests performed by Contractor and witnessed by the Commissioning Authority are utilized to achieve this.
 - 3. Verify that operation and maintenance manuals submitted to Owner are complete: Detailed O&M data submittals are specified.
 - 4. Verify that the Owner's operating personnel are adequately trained: Formal training conducted by Contractor is specified.
- B. Commissioning, including Functional Tests, O&M documentation review, and training, is to occur after startup and initial checkout and be completed before Substantial Completion.
- C. Coordinate and direct all the commissioning activities in a logical, sequential and efficient manner using consistent protocols and forms, centralized documentation, clear and regular communications and consultations with all necessary parties, frequently updated timelines and schedules and technical expertise.
- D. The Commissioning Authority is to be employed by Owner.

1.2 SCOPE OF COMMISSIONING

- A. The following are to be commissioned:
- B. Other equipment and systems explicitly identified elsewhere in Contract Documents as requiring commissioning.

1.3 REFERENCE STANDARDS

- A. ASHRAE Guideline 1 - The HVAC Commissioning Process
- B. PECCI (MCP) - Model Commissioning Plan; Portland Energy Conservation, Inc.; located at <http://www.peci.org/library/mcpgs.htm>.

1.4 SUBMITTALS

- A. Commissioning Plan:
 - 1. Submit preliminary draft for review by Owner and Architect within 30 days after commencement of Commissioning Authority contract.
 - 2. Submit revised draft to be included in the construction contract documents, not less than 4 weeks prior to bid date.
 - 3. Submit final plan not more than 90 days after commencement of construction, for issuance to all parties.

- B. List of Prefunctional Checklists to be developed:
 - 1. Submit preliminary list at start of construction documents phase or within 30 days after commencement of contract, whichever is later.
 - 2. Submit revised list not less than 6 weeks prior to bid date, for inclusion in the construction contract documents.
 - 3. Submit final list not more than 60 days after start of construction.
- C. Prefunctional Checklists:
 - 1. Submit preliminary draft at start of construction documents phase or within 30 days after commencement of contract, whichever is later.
 - 2. Submit revised draft for review by Owner and Architect not less than 6 weeks prior to bid date, for inclusion in the construction contract documents.
 - 3. Submit final draft to Contractor not less than 4 weeks prior to startup of particular items to be commissioned.
- D. List of Functional Test procedures to be developed:
 - 1. Submit preliminary list at start of construction documents phase or within 30 days after commencement of contract, whichever is later.
 - 2. Submit revised list not less than 6 weeks prior to bid date, for inclusion in the Contract Documents; this is intended to be a list of titles, not full description of the tests.
 - 3. Submit final list not more than 60 days after start of construction.
- E. Functional Test Procedures:
 - 1. Submit preliminary draft at start of construction documents phase or within 30 days after commencement of contract, whichever is later.
 - 2. Submit revised draft for review by Owner and Architect not less than 6 weeks prior to bid date, for inclusion in the construction contract documents.
 - 3. Submit final draft to Contractor not less than 4 weeks prior to startup of particular items to be commissioned.
- F. Training Plan.
- G. Commissioning Record: Submit to Contractor for inclusion with O&M manuals.
- H. Final Commissioning Report: Submit to Owner.
- I. Recommissioning Manual: Submit within 60 days after receipt of Owner's instructions to proceed with preparation.
- J. LEED Reports: Submit Final Commissioning Report and Recommissioning Manual in accordance with procedures specified in Section 01 35 15.

PART 2 PRODUCTS

2.1 DOCUMENTATION IDENTIFICATION SYSTEM

- A. Give each submitted form or report a unique identification; use the following scheme.
- B. Type of Document: Use the following prefixes:
 - 1. Commissioning Plan: CP-
 - 2. Prefunctional Checklist: PC-
 - 3. Functional Test Procedure: FTP-

4. Functional Test Report: FTR-
 5. Commissioning Report: CR-
- C. System Type: Use the first 4 digits from CSI/CSC MasterFormat, 2004 Edition, that are applicable to the system; for example:
1. 2300: HVAC system as a whole.
 2. 2320: HVAC Piping and Pumps.
 3. 2330: HVAC Air Distribution.
- D. Component Number: Assign numbers sequentially, using 1, 2, or 3 digits as required to accommodate the number of units in the system.
- E. Test, Revision, or Submittal Number: Number each successive iteration sequentially, starting with 1.
- F. Example: PC-2320-001.2 would be the Prefunctional Checklist for equipment item 1 in the HVAC piping system, probably a pump; this is the second, revised submittal of this checklist.

PART 3 - EXECUTION

3.1 COMMISSIONING PLAN

- A. Prepare and maintain the Commissioning Plan, covering commissioning schedule, Prefunctional Checklist and Functional Test procedures, coordination requirements, and forms to be used, for all parties in the commissioning process.
1. Call and chair meetings of the Commissioning Team when appropriate.
 2. Give Contractor sufficient notice for scheduling commissioning activities.
 3. Develop a comprehensive start-up and initial systems checkout plan with cooperation of Contractor and subcontractors.
 4. The PECCI Model Commissioning Plan may be used as a guide for the Commissioning Plan.
 5. ASHRAE Guideline 1 may be used as a guide for the Commissioning Plan.
 6. Avoid replication of information included in the construction contract documents to the greatest extent possible.
- B. Basis of Design Documentation: Detailed documentation of the functional requirements of the project; descriptions of the systems, components, and methods chosen to meet the design intent; assumptions underlying the design intent.
1. Prepared By: Architect.
 2. Copy to be furnished to Commissioning Authority for use in preparation of the commissioning plan.
- C. Review the construction contract documents for Contractor submittals of draft checklists, draft test procedures, manufacturer startup procedures, and other information intended for the use of the Commissioning Authority in preparing the Commissioning Plan.
- D. Commissioning Schedule:
1. Coordinate with Contractor anticipated dates of startup of each item of equipment and system.
 2. Contractor's scheduling responsibilities are specified in the construction contract documents.
 3. Revise and re-issue schedule monthly.

4. Prefunctional Checklists and Functional Tests are to be performed in sequence from components, to subsystems, to systems.
 5. Deliver relevant Prefunctional Checklists and Functional Test Procedures to Contractor in time to avoid delay.
- E. Commissioning Team: Project manager or other designated person of:
1. Commissioning Authority.

3.2 CONSTRUCTION CONTRACT DOCUMENTS

- A. General Commissioning Specifications: Architect has prepared general commissioning specifications for inclusion in the construction contract documents; review and submit comments to Owner.
1. These specifications include:
 - a. Procedures applicable to all types of items to be commissioned.
 - b. General commissioning procedures for HVAC.
 - c. General commissioning procedures for electrical.
 2. Prepare specifications for any of the following that would be recommended, for incorporation into the construction contract documents by Architect:
 - a. Additional Contractor submittals needed for purposes of commissioning, such as startup procedures, draft test procedures, draft training plans, etc.
 - b. Additional Owner personnel training.
 - c. Additional operation or maintenance data that should be submitted.
- B. Prefunctional Checklists: Develop detailed Checklists for each item to be commissioned.
1. List of Checklists to be Developed: Prepare and maintain a detailed list of titles, not full text.
 2. The Checklist forms are intended to be part of the Contractor's Contract Documents.
- C. Functional Testing: Develop detailed procedures for each item to be commissioned; submit for review by Owner and Architect.
1. List of Test Procedures to be Developed: Prepare and maintain a detailed list of titles, not full text.
 2. The forms the Commissioning Authority will use to report Functional Test results are not intended to be part of Contractor's Contract Documents, but the Functional Test Procedures that must be executed by the Contractor must be made part of the Contract Documents, by modification if necessary.
- D. Develop any other reporting forms Contractor will be required to use; if they are likely to require a substantially different amount of work than the Contractor can reasonably anticipate, they must be included in the construction contract documents.
- E. If any part of the documents described above have not been developed by the bid date, coordinate with Architect the issuance of modifications to the construction contract documents

3.3 PREFUNCTIONAL CHECKLISTS

- A. Prefunctional Checklists - Content: Prepare forms for Contractor's use, in sufficient detail to document that the work has been installed in accordance with the Contract Documents and the manufacturer's recommendations and instructions, and that it receives adequate operational checkout prior to startup.
1. Prepare separate Checklists for each type of equipment, system, or other assembly, customized to the item.
 2. Identify each Checklist by using the contract documents identification number or name, if any; if none, create unique identifiers for each Checklist; do not rely on Contractor to number checklists.
 3. Multiple identical or near-identical items may appear on a single Checklist provided there is space to record all required data for each separately; label each set of data uniquely.
 4. Include space to record manufacturer name, model number, serial number, capacity and other relevant characteristics, and accessories and other features as applicable; include space to record "as specified", "as submitted", and "as installed" data.
 5. Include space to record whether or not the required submittals have been received; list each separate type of submittal.
 6. Include line items for each physical inspection to be performed.
 7. Include line items for each operational inspection to be performed, such as checking switch operation, fan rotation, valve and damper stroke, and measuring actual electrical loads.
 8. Include separate section for sensors and actuators, with space for documenting actual physical location and calibration measurements; provide a separate generic calibration checklist identified wherever referenced.
 9. Include spaces to record that related Checklists for related work upon which this work depends have been completed.
- B. Prefunctional Checklists - Format:
1. Provide a cover sheet showing name of equipment item or system, documentation identification number (see Documentation Identification Scheme), names of accessory components involved, and identification of related checklists.
 2. Include on cover sheet space for Contractor's use in attesting to completeness; provide spaces for the signatures of the general contractor and each subcontractor or other entity responsible, customized to the project and the type of item.
 3. Include on the cover sheet, above the signature block, the following statement: "The work referenced in this Checklist and other work integral to or dependent on this work is complete and ready for functional testing. The checklist items are complete and have been checked off only by parties having direct knowledge of the event." Include two checkboxes:
 - a. "This Checklist is submitted for approval with no exceptions."
 - b. "This Checklist is submitted for approval, subject to the attached list of outstanding items, none of which preclude the performance of safe and reliable functional tests. A statement of completion will be submitted upon completion of the outstanding items."
 4. Use a consistent, tabular format for all Checklists, with one line per checklist activity.
 5. For each line item, provide space for initials and date, and identification of the subcontractor or other entity responsible.

3.4 FUNCTIONAL TEST PROCEDURES

- A. Develop test procedures in sufficient detail to show that functional performance is in accordance with the Contract Documents and shows proper operation through all modes of operation where there is a different system response, including seasonal, unoccupied, warm-up, cool-down, part-and full-load.
 - 1. Obtain assistance and review by installing subcontractors.
 - 2. Itemize each test sequence in step-by-step order, with acceptance criteria for each step and for the test as a whole.
 - 3. Include test setup instructions, description of tools and apparatus, special cautions, and.
 - 4. Avoid procedures that would void or otherwise limit warranties; review with Contractor prior to execution.
 - 5. For HVAC systems, procedures may include energy management control system trending, stand-alone datalogger monitoring or manual functional testing.
 - 6. Obtain explicit approval of Contractor in regard to feasibility and safety prior to execution.
- B. Functional Test Report Forms: Prepare forms in advance of testing, using a consistent format; include all test procedure information given to Contractor and:
 - 1. Report Identifier (see Documentation Identification Scheme).
 - 2. Test prerequisites.
 - 3. Formulas to be used in calculations.
 - 4. Yes/No check boxes for each step of test.
 - 5. Space to record results, document deficiencies, and make recommendations.
 - 6. Signature and date block for Commissioning Authority.
- C. Functional Test Prerequisites: Include space to verify all of the following items on each Functional Test Report Form, unless truly inapplicable:
 - 1. All related equipment has been started up and start-up reports and Prefunctional Checklists submitted and approved ready for Functional Testing.
 - a. For hydronic systems, check that:
 - 1) Piping system flushing is complete and required report approved.
 - 2) Water treatment system is complete and operational.
 - 3) Test and balance (TAB) is complete and approved.
 - 2. All control system functions for this and all interlocking systems are programmed and operable in accordance with the Contract Documents, including final set points and schedules with debugging, loop tuning and sensor calibrations completed, with space for signature of controls installer.
 - 3. Incomplete items identified by Architect during closeout inspections have been corrected or completed.
 - 4. Safeties and operating ranges have been reviewed.
 - 5. A copy of the specified sequence of operation is attached.
 - 6. A copy of applicable schedules and setpoints is attached.
 - 7. A copy of the specified Functional Test Procedures is attached.
 - 8. The Functional Test Procedures have been reviewed and approved by the applicable installer.
 - 9. Vibration control report approved (if required).
 - 10. False loading equipment, system and procedures ready.
 - 11. Sufficient clearance around equipment for servicing.

12. Original values of pre-test setpoints that need to be changed to accommodate testing have been recorded, with a check box provided to verify return to original values (include control parameters, limits, delays, lockouts, schedules, etc.).
13. Any other items on the Prefunctional Checklist or Start-up Reports that need to be re-verified.

3.5 CONSTRUCTION PHASE

- A. Coordinate the commissioning work with Contractor, ensure that commissioning activities are being incorporated into the master schedule.
- B. Perform site visits, as necessary, to observe component and system installations. Attend planning and job-site meetings to obtain information on construction progress. Review Contractor's meeting minutes for issues relating to the commissioning process. Assist in resolving discrepancies.
- C. Commissioning Kick-Off Meeting: Plan and conduct a meeting early in the construction phase to review commissioning activities and responsibilities with all parties involved. Require attendance by all members of the Commissioning Team.
- D. Conduct periodic meetings as necessary to coordinate, resolve planning issues, and aid in resolution of deficiencies, minimizing the time spent by Contractor and Owner personnel; hold meetings at least monthly.
- E. Submit periodic progress reports to Owner and Contractor.
- F. Review Contractor shop drawing submittals applicable to systems being commissioned for compliance with commissioning needs; verify that Owner's responsibilities are clearly defined in warranties.
- G. Review and approve submittals directly related to commissioning.
- H. Deliver Prefunctional Checklists and Functional Test procedures to Contractor.
- I. Verify satisfactory completion of Prefunctional Checklists by Contractor by reviewing checklists and by site observation and spot checking; provide formal approval when satisfactory.
- J. Verify startup of all systems by reviewing start-up reports and by site observation; provide formal approval when satisfactory.
- K. Coordinate, witness and approve Functional Tests performed by Contractor. Coordinate retesting until satisfactory performance is achieved.
- L. HVAC Commissioning:
 1. Gather and review the control sequences and interlocks and work with Contractor and design engineers until sufficient clarity has been obtained, in writing, to be able to prepare detailed Functional Test procedures.
 2. Witness all or part of HVAC piping test and flushing procedures, sufficient to be confident that proper procedures were followed; document testing and include documentation in O&M manuals.

3. Witness all or part of duct testing and cleaning procedures, sufficient to be confident that proper procedures were followed; document testing and include documentation in O&M manuals.
 4. Review TAB Plan prepared by Contractor.
 5. Before TAB is executed, witness sufficient Functional Testing of the control system to approve it to be used for TAB.
 6. Verify air and water systems balancing by spot testing, by reviewing completed reports, and by site observation; provide formal approval when satisfactory.
 7. Analyze trend logs and monitoring data to verify performance.
- M. Witness and document testing of systems and components over which the Commissioning Authority does not have direct control, such as smoke control systems, tests contracted directly by Owner, and tests by manufacturer's personnel; include documentation in O&M manuals.
- N. When Functional Testing for specific systems or equipment is specified to be performed by the Commissioning Authority rather than the Contractor, perform such testing without assistance of Contractor.
- O. Maintain a master deficiency and resolution log and a separate testing record. Provide written progress and test reports with recommended actions.
- P. O&M Data: Review submitted operation and maintenance data for completeness; provide formal approval if satisfactory.
- Q. Notify Contractor and Owner of deficiencies in procedures or results; suggest solutions.

3.6 TRAINING

- A. Training Plan: Prepare a comprehensive Training Plan, incorporating draft training plans submitted by Contractor.
1. Include a 8 hour session by the HVAC design engineer covering the overall HVAC system and equipment design concepts, with one-line schematic drawings.
 2. Include a 8 hour session by the Commissioning Authority on the use of the blank Prefunctional Checklists and Functional Test report forms for re-commissioning purposes.
 3. Establish criteria for determining satisfactory completion of training.
- B. Verify that training was satisfactorily completed; provide formal approval if satisfactory.

3.7 CLOSEOUT

- A. Commissioning Record: Use the same format and organization as specified for the O&M manuals.
1. Include the Final Commissioning Plan and Final Report.
 2. For each product or system and equipment item, include the following organized as indicated, with separator tabs:
 - a. Design intent documentation, furnished by Architect or others.
 - b. Detailed operational sequences.
 - c. Startup plan and approved startup reports.
 - d. Filled out Prefunctional Checklists.
 - e. Filled out Functional Test reports; trend logs and monitoring reports and analysis; other verification documentation.
 - f. Training plan and training records.

SECTION 01 91 15 ELECTRICAL COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes requirements for commissioning the building systems and their subsystems and equipment. This Section supplements the general requirements specified in Division 1 Section "General Commissioning Requirements."
- B. Related Sections include the following:
 - 1. Division 1 Sections "General Commissioning Requirements" and "System Commissioning Requirements" for general requirements for commissioning processes that apply to this Section.

1.2 DEFINITIONS

- A. BoD: Basis of Design.
- B. CxA: Commissioning Authority.
- C. OPR: Owner's Project Requirements.
- D. Systems, Subsystems, and Equipment: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, and equipment.
- E. TAB: Testing, Adjusting, and Balancing.

1.3 SYSTEMS TO BE COMMISSIONED

- A. The following systems are to be commissioned for this project:
 - 1. Lighting Controls

1.4 COMMISSIONING TEAM

- A. Members Appointed by Contractor(s): Individuals, each having authority to act on behalf of the entity he or she represents, explicitly organized to implement the commissioning process through coordinated actions. The commissioning team shall consist of, but not be limited to, representatives of Contractor, including Project superintendent and subcontractors, installers, suppliers, and specialists deemed appropriate by the CxA.
- B. Members Appointed by Owner:
 - 1. CxA: The designated person, company, or entity that plans, schedules, and coordinates the commissioning team to implement the commissioning process. Owner will engage the CxA under a separate contract.
 - 2. Representatives of the facility user and operation and maintenance personnel.
 - 3. Architect and engineering design professionals.

1.5 CONTRACTOR'S RESPONSIBILITIES

- A. Electrical subcontractor shall assign representatives with expertise and authority to act on behalf of the Contractor/Subcontractor and schedule them to participate in and perform commissioning team activities including, but not limited to, the following:
 - 1. Work with the CxA to identify schedule requirements for all commissioning activities, and incorporate these activities into the overall project schedule, to ensure all required commissioning scope is properly completed prior to Occupancy.
 - 2. Participate in commissioning meetings.
 - 3. Certify that Work is complete and systems are operational according to the Contract Documents, including calibration of instrumentation and controls.
 - 4. Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system and equipment installation, recommend and implement corrective action.
 - 5. Participate in procedures meeting for testing.

6. Provide schedule for operation and maintenance data submittals, equipment startup, and testing to CxA for incorporation into the commissioning plan. Update schedule on a weekly basis throughout the construction period.
7. Provide updated As-Built and Project Record Documents to the CxA on a daily basis.
8. Gather and submit operation and maintenance data for systems, subsystems, and equipment to the CxA, as specified in Division 1 Section "Operation and Maintenance Data," within 45 days of submittal approval.
9. Provide technicians who are familiar with the construction and operation of installed systems and who shall participate in functional performance testing of installed systems, subsystems, and equipment.
10. Complete construction checklists, provided by the CxA, for all commissioned equipment.
11. Develop and coordinate an overall training program, including manufacturer training, classroom training, and field demonstration training sessions.
12. Provide qualified instructors to perform training sessions for Owner's operation and maintenance personnel.
13. Provide personnel to assist or perform seasonal or deferred testing as defined under other sections of the Specifications.

1.6 COMMISSIONING DOCUMENTATION

- A. Index of Commissioning Documents: CxA shall prepare an index to include storage location of each document.
- B. OPR: A written document, prepared by Owner, that details the functional requirements of Project and expectations of how it will be used and operated. This document includes Project and design goals, measurable performance criteria, budgets, schedules, success criteria, and supporting information.
- C. BoD Document: A document, prepared by Architect, that records concepts, calculations, decisions, and product selections used to meet the OPR and to satisfy applicable regulatory requirements, standards, and guidelines. The document includes both narrative descriptions and lists of individual items that support the design process.
- D. Commissioning Plan: A document, prepared by CxA, that outlines the process, organization, reporting, and documentation requirements of the commissioning process, and shall include, but is not limited to the following:
 1. Plan for delivery and review of submittals, systems manuals, and other documents and reports. Identification of the relationship of these documents to other functions and a detailed description of submittals that are required to support the commissioning processes.
 2. Description of the organization, layout, and content of commissioning documentation (including systems manual) and a detailed description of documents to be provided along with identification of responsible parties.
 3. Identification of systems and equipment to be commissioned.
 4. Description of testing procedures along with identification of parties involved in performing and verifying tests.
 5. Identification of items that must be completed before the next operation can proceed.
 6. Description of responsibilities of commissioning team members.
 7. Description of observations to be made.
 8. Description of requirements for operation and maintenance training, including required training materials.
 9. Description of expected performance for systems, subsystems, equipment, and controls.
 10. Process for completing prestart and startup checklists for systems, subsystems, and equipment to be verified and tested.

11. Step-by-step procedures for testing systems, subsystems, and equipment with descriptions for methods of verifying relevant data, recording the results obtained, and listing parties involved in performing and verifying tests.
- E. Construction Checklists and Functional Performance Test Procedures: CxA shall develop construction checklists and functional performance test procedures for each system, subsystem, or equipment including interfaces and interlocks, and include a separate entry, with space for comments, for each item to be tested. Provide space for testing personnel to sign off on each checklist. Specific checklist and test procedure content requirements are specified in Division 1 Section "System Commissioning Requirements." Each checklist, regardless of system, subsystem, or equipment being tested, shall include, but not be limited to, the following:
 1. Name and identification code of tested item.
 2. Test number.
 3. Time and date of test.
 4. Indication of whether the record is for a first test or retest following correction of a problem or issue.
 5. Dated signatures of the person performing test and of the witness, if applicable.
 6. Individuals present for test.
 7. Deficiencies.
 8. Issue number, if any, generated as the result of test.
 - F. Certificate of Readiness: Certificate of Readiness shall be signed by Contractor, Subcontractor(s), Installer(s), and CxA certifying that systems, subsystems, equipment, and associated controls are ready for testing. Completed construction checklists signed by the responsible parties shall accompany this certificate.
 - G. Test Reports: CxA shall record test data, observations, and measurements on test procedures and test logs. Photographs, forms, and other means appropriate for the application shall be included with data. CxA shall compile test reports and include them in systems manual and commissioning report.
 - H. Corrective Action Documents: CxA shall document corrective action taken for systems and equipment that fail tests. Include required modifications to systems and equipment and revisions to test procedures, if any. Retest systems and equipment requiring corrective action and document retest results.
 - I. Issues Log: CxA shall prepare and maintain an issues log that describes design, installation, and performance issues that are at variance with the OPR, BoD, and Contract Documents. Identify and track issues as they are encountered, documenting the status of unresolved and resolved issues.
 - J. Coordination drawings: Contractor shall prepare coordination drawings showing coordination between trades for all above-ceiling areas, sleeves, and mechanical and electrical equipment rooms. Contractor shall conduct a review meeting with the commissioning team of the coordination drawings prior to commencing any rough-in of commissioned systems, and any comments by the commissioning team shall be addressed and incorporated in the coordination drawings prior to rough-in.
 - K. Reporting: CxA shall distribute commissioning field reports, periodically updated issues logs, test results, and other documents generated by the CxA to the commissioning team. All information will be copied to the Owner's representatives. The Contractor shall respond to all items noted in each commissioning field report within seven (7) days. The response shall note the intended action or response by the Contractor, and indicate a date for correction or resolution of the issue.
 - L. Scheduling: The Contractor shall incorporate key commissioning activities and milestones into the overall construction schedule to ensure that commissioning can be successfully completed prior to Substantial Completion. The CxA will provide input to the Contractor as to activity

durations, sequences, and logic ties, and other activities required to completed as prerequisites to commissioning process activities.

- M. Commissioning Meetings: CxA shall conduct periodic commissioning meetings of the commissioning team to review the issues log, progress on the commissioning plan, to discuss scheduling conflicts, and to discuss upcoming commissioning process activities.
- N. Pretesting Meetings: CxA shall conduct pretest meetings of the commissioning team to review startup reports, pretest inspection results, testing procedures, testing personnel and instrumentation requirements, and manufacturers' authorized service representative services for each system, subsystem, equipment, and component to be tested.
- O. Testing Coordination: Contractor shall coordinate sequence of testing 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, and to ensure all testing activities can be completed prior to Occupancy, including allowance for time to correct any deficiencies.
- P. Manufacturers' Field Services: Contractor shall coordinate services of manufacturers' field services. Contractor shall give CxA at least seven days notice prior to any special testing or startup services by manufacturers.
- Q. Coordination among subcontractors: Contractor shall maintain a master file of construction checklists, startup reports, manufacturer field tests, and other related information. The General Contractor shall be responsible for distributing construction checklists to all necessary subcontractors. The General Contractor shall ensure proper completion of each checklist by each subcontractor, collect completed checklists, and notify the CxA upon completion by all involved subs for each checklist.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 BASIC COMMISSIONING PROCESS

- A. The following outlines the basic process of commissioning.
 - 1. Commissioning during construction begins with a scoping meeting conducted by the CxA where the commissioning process is reviewed with the commissioning team members.
 - 2. Additional meetings will be required throughout construction, scheduled by the CxA with necessary parties attending, to plan, scope, coordinate, schedule future activities and resolve problems.
 - 3. CxA maintains and distributes a Master Issues Log to track all deficiencies through to resolution.
 - 3. Equipment documentation is submitted to the CxA during normal submittals, including detailed start-up procedures.
 - 4. The CxA works with the Contractor in developing startup plans and startup documentation formats, including providing the Contractor with construction checklists to be completed, during the startup process.
 - 5. In general, the checkout and performance verification proceeds from simple to complex; from component level to equipment to systems and intersystem levels with construction checklists being completed before functional testing.
 - 6. The Contractor and Subcontractors, under their own direction, execute and document the construction checklists and perform startup and initial checkout. The CxA documents that the checklists and startup were completed according to the approved plans. This may include the CxA witnessing start-up of selected equipment.

7. The CxA develops specific equipment and system functional performance test procedures. The Contractor reviews the procedures.
8. The functional test procedures are executed by the Contractor, under the direction of, and documented by the CxA.
9. Items of non-compliance in material, installation or setup are corrected at the Contractor's expense and the system retested.
10. The CxA reviews the O&M documentation for completeness.
11. Commissioning is completed before Substantial Completion.
12. The CxA reviews, pre-approves and coordinates the training provided by the Contractor and verifies that it was completed.
13. Deferred and seasonal testing is conducted by the Contractor, as specified or required, under the direction of the CxA. The CxA coordinates the scheduling through the Contractor.
14. The CxA performs post-occupancy evaluations after approximately two months and ten months of occupancy to identify any issues or deficiencies. Deficiencies shall be addressed by the Contractor prior to expiration of any warranties.

3.2 OPERATION AND MAINTENANCE TRAINING REQUIREMENTS

- A. Training Preparation Conference: Before operation and maintenance training, CxA shall convene a training preparation conference to include Owner's operation and maintenance personnel, Contractor, and subcontractors. In addition to requirements specified in Division 1 Section "Demonstration and Training," perform the following:
 1. Review the OPR and BoD.
 2. Review installed systems, subsystems, and equipment.
 3. Review instructor qualifications.
 4. Review instructional methods and procedures.
 5. Review training module outlines and contents.
 6. Review course materials (including operation and maintenance manuals).
 7. Inspect and discuss locations and other facilities required for instruction.
 8. Review and finalize training schedule and verify availability of educational materials, instructors, audiovisual equipment, and facilities needed to avoid delays.
 9. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.
- B. Training Modules: The commissioning team shall jointly develop an instruction program that includes individual training modules for each system, subsystem, and equipment as specified in Division 1 Section "Demonstration and Training."

3.3 CONTRACTOR'S RESPONSIBILITIES

- A. The following responsibilities are in addition to those specified in Division 1 Section "General Commissioning Requirements."
- B. Electrical Subcontractor:
 1. With the Mechanical and Plumbing Subcontractor, coordinate installations and connections between and among electrical, plumbing and HVAC systems, subsystems, and equipment.
 2. Participate in functional performance testing of electrical systems, with vendors and subcontractors for each system tested.

3.4 COMMISSIONING DOCUMENTATION

- A. The following are in addition to documentation specified in Division 1 Section "General Commissioning Requirements."

- B. BoD HVAC: Owner will provide BoD-HVAC documents, prepared by Architect and approved by Owner, to the CxA and Contractor for use in developing the commissioning plan, systems manual, and operation and maintenance training plan.
- C. Construction Checklists and Functional Performance Test Procedures: CxA shall develop construction checklists and functional performance test procedures for all commissioned systems, subsystems, and equipment, including interfaces and interlocks with other systems. CxA shall prepare separate checklists for each mode of operation and provide space to indicate whether the mode under test responded as required. In addition to the requirements specified in Division 1 Section "General Commissioning Requirements," checklists shall include, but not be limited to, the following:
 - 1. Calibration of sensors and sensor function.
 - 2. Testing conditions under which test was conducted, including (as applicable) ambient conditions, set points, override conditions, and status and operating conditions that impact the results of test.
 - 3. Control sequences.
 - 4. Strength of control signal for each set point at specified conditions.
 - 5. Responses to control signals at specified conditions.
 - 6. Sequence of response(s) to control signals at specified conditions.
 - 7. Electrical demand or power input at specified conditions.
 - 8. Power quality and related measurements.
 - 9. Expected performance of systems, subsystems, and equipment at each step of test.
 - 10. Narrative description of observed performance of systems, subsystems, and equipment. Notation to indicate whether the observed performance at each step meets the expected results.
 - 11. Interaction of auxiliary equipment and interfaces with other systems.
 - 12. Issues log.

3.5 TESTING PREPARATION

- A. The Electrical Subcontractor shall complete the following prerequisites for Testing:
 - 1. Certify that electrical systems, subsystems, and equipment have been completed, calibrated, and started; are operating according to the OPR, BoD, and Contract Documents; and that Certificates of Readiness are signed and submitted.
 - 2. Submit results and reports from all manufacturer startup or special field-testing services within seven days of completion.
 - 3. Complete all construction checklists and correct any deficiencies prior to functional testing.
 - 4. Perform preliminary check of systems and intersystem performance after approval of construction checklists for systems, subsystems, and equipment.
 - 5. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shut down, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).
 - 6. Verify each operating cycle after it has been running for a specified period and is operating in a steady-state condition.
 - 7. Observe and verify the position of each device and interlock identified on checklists. Sign off each item as acceptable, or failed. Repeat this test for each operating cycle that applies to system being tested.
 - 8. Annotate checklist or data sheet when a deficiency is observed.
 - 9. Verify proper responses of monitoring and control system controllers and sensors to include the following:
 - a. For each controller or sensor, record the indicated monitoring and control system reading and the test instrument reading. If initial test indicates that the test reading

is outside of the control range of the installed device, check calibration of the installed device and adjust as required. Retest malfunctioning devices and record results on checklist or data sheet.

- b. Report deficiencies and prepare an issues log entry.

3.6 CONSTRUCTION CHECKLIST VERIFICATION

- A. Contractors shall notify the CxA when prefunctional checklists for a particular system have been completed, in preparation for system functional testing.
- B. The CxA will review the completed checklists for completeness.
- C. The CxA will field-verify random samples of the contractor-completed checklists. The sampling rate will be defined in the Commissioning Plan.
- D. The commissioning plan will define failure criteria for each component. Based on the random sampling, the CxA will determine if the prefunctional construction checklists for each system have been properly and completely filled out by the installing contractors. Any items noted as deficient during field-verification will be reported to the Commissioning Team. Any components that are found to exceed the failure criteria established in the commissioning plan will require that the Contractor recheck all checklists prior to proceeding.
- E. Efforts required by the CxA to recheck failed checklists, or to field-verify additional components beyond the initial sampling plan caused by improper completion of the checklists by the Contractor, shall be billed to the Owner on an hourly basis. The Contractor shall reimburse the Owner for these efforts.
- F. All checklists associated with each functional performance test procedure shall be completed and approved by the CxA prior to functional performance testings.

3.7 TESTING

- A. Functional Performance Tests of systems and intersystem performance shall be completed after construction checklists for systems, subsystems, and equipment have been approved.
- B. Functional Performance Testing will be done under the direction of the CxA. The responsible subcontractors and vendor representatives shall operate and manipulate equipment and controls as directed.
- C. Perform tests using design conditions whenever possible.
 1. Simulate conditions by imposing an artificial load when it is not practical to test under design conditions and when written approval for simulated conditions is received from CxA. Before simulating conditions, calibrate testing instruments. Set and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.
 2. Alter set points when simulating conditions is not practical and when written approval is received from CxA.
 3. Alter sensor values with a signal generator when design or simulating conditions and altering set points are not practical. Do not use sensor to act as signal generator to simulate conditions or override values.
- D. Scope of Lighting System Testing:
 1. Test for proper control of interior and exterior lighting controls via switches, occupancy sensors, daylight sensors, photocells, or other controls.
- E. Detailed Testing Procedures: CxA, with commissioning team, shall prepare detailed testing plans, procedures, and checklists for all commissioned systems, subsystems, and equipment.
- F. Deferred Testing:
 1. If tests cannot be completed because of a deficiency outside the scope of the system, the deficiency shall be documented and reported to Owner. Deficiencies shall be resolved and corrected by appropriate parties and test rescheduled.
 2. Initial testing shall be performed with simulated loads where necessary, based on seasonal conditions. Contractor shall provide personnel to assist CxA with completion of

testing after occupancy, when seasonal conditions permit actual performance under summer and winter design conditions.

G. Testing Reports:

1. Reports shall include measured data, data sheets, and a comprehensive summary describing the operation of systems at the time of testing.
2. Include data sheets for each controller to verify proper operation of the control system, the system it serves, the service it provides, and its location. For each controller, provide space for recording its readout, the reading at the controller's sensor(s), plus comments. Provide space for testing personnel to sign off on each data sheet.
3. Prepare a preliminary test report. Deficiencies will be evaluated by Architect to determine corrective action. Deficiencies shall be corrected and test repeated.
4. If it is determined that the system is constructed according to the Contract Documents, Owner will decide whether modifications required to bring the performance of the system to the OPR and BoD documents shall be implemented or if tests will be accepted as submitted. If corrective Work is performed, Owner will decide if tests shall be repeated and a revised report submitted.

END OF SECTION 01 91 15

SECTION 019116 - MECHANICAL COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes requirements for commissioning the building systems and their subsystems and equipment. This Section supplements the general requirements specified in Division 1 Section "General Commissioning Requirements."
- B. Related Sections include the following:
 - 1. Division 1 Sections "General Commissioning Requirements" and "System Commissioning Requirements" for general requirements for commissioning processes that apply to this Section.

1.2 DEFINITIONS

- A. BoD: Basis of Design.
- B. CxA: Commissioning Authority.
- C. OPR: Owner's Project Requirements.
- D. Systems, Subsystems, and Equipment: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, and equipment.
- E. TAB: Testing, Adjusting, and Balancing.

1.3 SYSTEMS TO BE COMMISSIONED

- A. The following systems are to be commissioned for this project:
 - 1. HVAC
 - a. Air Handling Units
 - b. Air Terminal Units
 - c. Building Automation System, including interfaces with other systems
 - d. Ductwork, dampers, grilles, diffusers, and sheetmetal accessories
 - e. Exhaust Fans
 - f. Piping, valves, and hydronic accessories
 - g. Pumps
 - h. Terminal Equipment (Fan Coils, AC Units, Unit Heaters, fans, etc.)
 - 2. Plumbing
 - a. Domestic Water Heater

1.4 COMMISSIONING TEAM

- A. Members Appointed by Contractor(s): Individuals, each having authority to act on behalf of the entity he or she represents, explicitly organized to implement the commissioning process through coordinated actions. The commissioning team shall consist of, but not be limited to, representatives of Contractor, including Project superintendent and subcontractors, installers, suppliers, and specialists deemed appropriate by the CxA.
- B. Members Appointed by Owner:

1. CxA: The designated person, company, or entity that plans, schedules, and coordinates the commissioning team to implement the commissioning process. Owner will engage the CxA under a separate contract.
2. Representatives of the facility user and operation and maintenance personnel.
3. Architect and engineering design professionals.

1.5 CONTRACTOR'S RESPONSIBILITIES

- A. Contractor and HVAC, Electrical, Plumbing, and Fire Protection subcontractors shall assign representatives with expertise and authority to act on behalf of the Contractor/Subcontractor and schedule them to participate in and perform commissioning team activities including, but not limited to, the following:
1. Work with the CxA to identify schedule requirements for all commissioning activities, and incorporate these activities into the overall project schedule, to ensure all required commissioning scope is properly completed prior to Occupancy.
 2. Participate in commissioning meetings.
 3. Certify that Work is complete and systems are operational according to the Contract Documents, including calibration of instrumentation and controls.
 4. Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system and equipment installation, recommend and implement corrective action.
 5. Participate in procedures meeting for testing.
 6. Provide schedule for operation and maintenance data submittals, equipment startup, and testing to CxA for incorporation into the commissioning plan. Update schedule on a weekly basis throughout the construction period.
 7. Provide updated As-Built and Project Record Documents to the CxA on a daily basis.
 8. Gather and submit operation and maintenance data for systems, subsystems, and equipment to the CxA, as specified in Division 1 Section "Operation and Maintenance Data," within 45 days of submittal approval.
 9. Provide technicians who are familiar with the construction and operation of installed systems and who shall participate in functional performance testing of installed systems, subsystems, and equipment.
 10. Complete construction checklists, provided by the CxA, for all commissioned equipment.
 11. Develop and coordinate an overall training program, including manufacturer training, classroom training, and field demonstration training sessions.
 12. Provide qualified instructors to perform training sessions for Owner's operation and maintenance personnel.
 13. Participate in final review at acceptance meeting.
 14. Provide personnel to assist or perform seasonal or deferred testing as defined under other sections of the Specifications.

1.6 COMMISSIONING DOCUMENTATION

- A. Index of Commissioning Documents: CxA shall prepare an index to include storage location of each document.
- B. OPR: A written document, prepared by Owner, that details the functional requirements of Project and expectations of how it will be used and operated. This document includes Project

and design goals, measurable performance criteria, budgets, schedules, success criteria, and supporting information.

- C. **BoD Document:** A document, prepared by Architect, that records concepts, calculations, decisions, and product selections used to meet the OPR and to satisfy applicable regulatory requirements, standards, and guidelines. The document includes both narrative descriptions and lists of individual items that support the design process.
- D. **Commissioning Plan:** A document, prepared by CxA, that outlines the process, organization, reporting, and documentation requirements of the commissioning process, and shall include, but is not limited to the following:
 - 1. Plan for delivery and review of submittals, systems manuals, and other documents and reports. Identification of the relationship of these documents to other functions and a detailed description of submittals that are required to support the commissioning processes.
 - 2. Description of the organization, layout, and content of commissioning documentation (including systems manual) and a detailed description of documents to be provided along with identification of responsible parties.
 - 3. Identification of systems and equipment to be commissioned.
 - 4. Description of testing procedures along with identification of parties involved in performing and verifying tests.
 - 5. Identification of items that must be completed before the next operation can proceed.
 - 6. Description of responsibilities of commissioning team members.
 - 7. Description of observations to be made.
 - 8. Description of requirements for operation and maintenance training, including required training materials.
 - 9. Description of expected performance for systems, subsystems, equipment, and controls.
 - 10. Process for completing prestart and startup checklists for systems, subsystems, and equipment to be verified and tested.
 - 11. Step-by-step procedures for testing systems, subsystems, and equipment with descriptions for methods of verifying relevant data, recording the results obtained, and listing parties involved in performing and verifying tests.
- E. **Construction Checklists and Functional Performance Test Procedures:** CxA shall develop construction checklists and functional performance test procedures for each system, subsystem, or equipment including interfaces and interlocks, and include a separate entry, with space for comments, for each item to be tested. Provide space for testing personnel to sign off on each checklist. Specific checklist and test procedure content requirements are specified in Division 1 Section "System Commissioning Requirements." Each checklist, regardless of system, subsystem, or equipment being tested, shall include, but not be limited to, the following:
 - 1. Name and identification code of tested item.
 - 2. Test number.
 - 3. Time and date of test.
 - 4. Indication of whether the record is for a first test or retest following correction of a problem or issue.
 - 5. Dated signatures of the person performing test and of the witness, if applicable.
 - 6. Individuals present for test.
 - 7. Deficiencies.
 - 8. Issue number, if any, generated as the result of test.

- F. Certificate of Readiness: Certificate of Readiness shall be signed by Contractor, Subcontractor(s), Installer(s), and CxA certifying that systems, subsystems, equipment, and associated controls are ready for testing. Completed construction checklists signed by the responsible parties shall accompany this certificate.
- G. Test Reports: CxA shall record test data, observations, and measurements on test procedures and test logs. Photographs, forms, and other means appropriate for the application shall be included with data. CxA shall compile test reports and include them in systems manual and commissioning report.
- H. Corrective Action Documents: CxA shall document corrective action taken for systems and equipment that fail tests. Include required modifications to systems and equipment and revisions to test procedures, if any. Retest systems and equipment requiring corrective action and document retest results.
- I. Issues Log: CxA shall prepare and maintain an issues log that describes design, installation, and performance issues that are at variance with the OPR, BoD, and Contract Documents. Identify and track issues as they are encountered, documenting the status of unresolved and resolved issues.

1.7 COORDINATION

- A. Coordination drawings: Contractor shall prepare coordination drawings showing coordination between trades for all above-ceiling areas, sleeves, and mechanical and electrical equipment rooms. Contractor shall conduct a review meeting with the commissioning team of the coordination drawings prior to commencing any rough-in of commissioned systems, and any comments by the commissioning team shall be addressed and incorporated in the coordination drawings prior to rough-in.
- B. Reporting: CxA shall distribute commissioning field reports, periodically updated issues logs, test results, and other documents generated by the CxA to the commissioning team. All information will be copied to the Owner's representatives. The Contractor shall respond to all items noted in each commissioning field report within seven (7) days. The response shall note the intended action or response by the Contractor, and indicate a date for correction or resolution of the issue.
- C. Scheduling: The Contractor shall incorporate key commissioning activities and milestones into the overall construction schedule to ensure that commissioning can be successfully completed prior to Substantial Completion. The CxA will provide input to the Contractor as to activity durations, sequences, and logic ties, and other activities required to be completed as prerequisites to commissioning process activities.
- D. Commissioning Meetings: CxA shall conduct periodic commissioning meetings of the commissioning team to review the issues log, progress on the commissioning plan, to discuss scheduling conflicts, and to discuss upcoming commissioning process activities.
- E. Pretesting Meetings: CxA shall conduct pretest meetings of the commissioning team to review startup reports, pretest inspection results, testing procedures, testing personnel and instrumentation requirements, and manufacturers' authorized service representative services for each system, subsystem, equipment, and component to be tested.
- F. Testing Coordination: Contractor shall coordinate sequence of testing 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,

and to ensure all testing activities can be completed prior to Occupancy, including allowance for time to correct any deficiencies.

- G. **Manufacturers' Field Services:** Contractor shall coordinate services of manufacturers' field services. Contractor shall give CxA at least seven days notice prior to any special testing or startup services by manufacturers.
- H. **Coordination among subcontractors:** Contractor shall maintain a master file of construction checklists, startup reports, manufacturer field tests, and other related information. The General Contractor shall be responsible for distributing construction checklists to all necessary subcontractors. The General Contractor shall ensure proper completion of each checklist by each subcontractor, collect completed checklists, and notify the CxA upon completion by all involved subs for each checklist.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 BASIC COMMISSIONING PROCESS

- A. The following outlines the basic process of commissioning.
 - 1. Commissioning during construction begins with a scoping meeting conducted by the CxA where the commissioning process is reviewed with the commissioning team members.
 - 2. Additional meetings will be required throughout construction, scheduled by the CxA with necessary parties attending, to plan, scope, coordinate, schedule future activities and resolve problems.
 - 3. CxA maintains and distributes a Master Issues Log to track all deficiencies through to resolution.
 - 3. Equipment documentation is submitted to the CxA during normal submittals, including detailed start-up procedures.
 - 4. The CxA works with the Contractor in developing startup plans and startup documentation formats, including providing the Contractor with construction checklists to be completed, during the startup process.
 - 5. In general, the checkout and performance verification proceeds from simple to complex; from component level to equipment to systems and intersystem levels with construction checklists being completed before functional testing.
 - 6. The Contractor and Subcontractors, under their own direction, execute and document the construction checklists and perform startup and initial checkout. The CxA documents that the checklists and startup were completed according to the approved plans. This may include the CxA witnessing start-up of selected equipment.
 - 7. The CxA develops specific equipment and system functional performance test procedures. The Contractor reviews the procedures.
 - 8. The functional test procedures are executed by the Contractor, under the direction of, and documented by the CxA.
 - 9. Items of non-compliance in material, installation or setup are corrected at the Contractor's expense and the system retested.
 - 10. The CxA reviews the O&M documentation for completeness.
 - 11. Commissioning is completed before Substantial Completion.
 - 12. The CxA reviews, pre-approves and coordinates the training provided by the Contractor and verifies that it was completed.

13. Deferred and seasonal testing is conducted by the Contractor, as specified or required, under the direction of the CxA. The CxA coordinates the scheduling through the Contractor.
14. The CxA performs post-occupancy evaluations after approximately two months and ten months of occupancy to identify any issues or deficiencies. Deficiencies shall be addressed by the Contractor prior to expiration of any warranties.

3.2 OPERATION AND MAINTENANCE TRAINING REQUIREMENTS

- A. Training Preparation Conference: Before operation and maintenance training, CxA shall convene a training preparation conference to include Owner's operation and maintenance personnel, Contractor, and subcontractors. In addition to requirements specified in Division 1 Section "Demonstration and Training," perform the following:
 1. Review the OPR and BoD.
 2. Review installed systems, subsystems, and equipment.
 3. Review instructor qualifications.
 4. Review instructional methods and procedures.
 5. Review training module outlines and contents.
 6. Review course materials (including operation and maintenance manuals).
 7. Inspect and discuss locations and other facilities required for instruction.
 8. Review and finalize training schedule and verify availability of educational materials, instructors, audiovisual equipment, and facilities needed to avoid delays.
 9. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.
- B. Training Modules: The commissioning team shall jointly develop an instruction program that includes individual training modules for each system, subsystem, and equipment as specified in Division 1 Section "Demonstration and Training."

3.3 CONTRACTOR'S RESPONSIBILITIES

- A. The following responsibilities are in addition to those specified in Division 1 Section "General Commissioning Requirements."
- B. Mechanical subcontractor:
 1. Attend procedures meeting for TAB Work.
 2. Certify that TAB Work is complete.
 3. Attend coordination meeting between HVAC Instrumentation and Control and TAB subcontractors.
- C. HVAC Instrumentation and Control Subcontractor:
 1. With the CxA, review control designs for compliance with the OPR and BoD, controllability with respect to actual equipment to be installed, and recommend adjustments to control designs and sequence of operation descriptions.
 2. Attend coordination meeting between CxA and TAB subcontractor to review plan for using controls system in TAB effort.
 3. Provide calibration procedures and documentation that all components of the Building Automation System including control sensors, meters, damper actuators, valve actuators, etc. are properly calibrated and reading accurately. Where manufacturer's calibrations

are used, the BAS contractor shall demonstrate that manufacturer's calibration provides an accurate reading.

4. Initiate trending for each system monitored by the BAS as requested by the CxA. Retrieve trending data and forward to CxA at intervals requested.

D. TAB Subcontractor:

1. Contract Documents Review: With the CxA, review the Contract Documents before developing TAB procedures.
 - a. Verify the following:
 - 1) Accessibility of equipment and components required for TAB Work.
 - 2) Adequate number and placement of duct balancing dampers to allow proper balancing while minimizing sound levels in occupied spaces.
 - 3) Adequate number and placement of balancing valves to allow proper balancing and recording of water flow.
 - 4) Adequate number and placement of test ports and test instrumentation to allow reading and compilation of system and equipment performance data needed to conduct both TAB and commissioning testing.
 - 5) Air and water flow rates have been specified and compared to central equipment output capacities.
 - b. Identify discontinuities and omissions in the Contract Documents.
 - c. This review of the Contract Documents by the TAB Subcontractor satisfies requirements for a design review report as specified in Division 15 Section "Testing, Adjusting, and Balancing."
2. Additional Responsibilities:
 - a. Participate in functional performance testing.
 - b. Complete construction checklists where indicated as needing TAB measurements such as motor voltage, current, etc.
 - c. Perform calibration checks of all sensors and gauges as defined in the construction checklists.

E. Plumbing Subcontractor:

1. With the Mechanical and Electrical Subcontractor, coordinate installations and connections between and among electrical, HVAC and plumbing systems, subsystems, and equipment.
2. Participate in functional performance testing of plumbing systems, with vendors and subcontractors for each system tested.

3.4 COMMISSIONING DOCUMENTATION

- A. The following are in addition to documentation specified in Division 1 Section "General Commissioning Requirements."
- B. BoD HVAC: Owner will provide BoD-HVAC documents, prepared by Architect and approved by Owner, to the CxA and Contractor for use in developing the commissioning plan, systems manual, and operation and maintenance training plan.
- C. Construction Checklists and Functional Performance Test Procedures: CxA shall develop construction checklists and functional performance test procedures for all commissioned systems, subsystems, and equipment, including interfaces and interlocks with other systems. CxA shall prepare separate checklists for each mode of operation and provide space to indicate

whether the mode under test responded as required. In addition to the requirements specified in Division 1 Section "General Commissioning Requirements," checklists shall include, but not be limited to, the following:

1. Calibration of sensors and sensor function.
2. Testing conditions under which test was conducted, including (as applicable) ambient conditions, set points, override conditions, and status and operating conditions that impact the results of test.
3. Control sequences.
4. Strength of control signal for each set point at specified conditions.
5. Responses to control signals at specified conditions.
6. Sequence of response(s) to control signals at specified conditions.
7. Electrical demand or power input at specified conditions.
8. Power quality and related measurements.
9. Expected performance of systems, subsystems, and equipment at each step of test.
10. Narrative description of observed performance of systems, subsystems, and equipment. Notation to indicate whether the observed performance at each step meets the expected results.
11. Interaction of auxiliary equipment and interfaces with other systems.
12. Issues log.

3.5 TESTING PREPARATION

A. The Mechanical Subcontractor shall complete the following prerequisites for Testing:

1. Certify that HVAC systems, subsystems, and equipment have been completed, calibrated, and started; are operating according to the OPR, BoD, and Contract Documents; and that Certificates of Readiness are signed and submitted.
2. Submit results and reports from all manufacturer startup or special field-testing services within seven days of completion.
3. Pipe cleaning, flushing, hydrostatic tests, and chemical treatment requirements are specified in Division 15 piping Sections. HVAC subcontractor shall prepare pipe system cleaning, flushing, and hydrostatic testing. CxA shall review and comment on plan and final reports. Plan shall include the following:
 - a. Sequence of testing and testing procedures for each section of pipe to be tested, identified by pipe zone or sector identification marker. Markers shall be keyed Drawings for each pipe sector showing the physical location of each designated pipe test section. Drawings keyed to pipe zones or sectors shall be formatted to allow each section of piping to be physically located and identified when referred to in pipe system cleaning, flushing, hydrostatic testing, and chemical treatment plan.
 - b. Description of equipment for flushing operations.
 - c. Minimum flushing water velocity.
 - d. Tracking checklist for managing and ensuring that all pipe sections have been cleaned, flushed, hydrostatically tested, and chemically treated.
4. Certify that HVAC instrumentation and control systems have been completed and calibrated; are operating according to the OPR, BoD, and Contract Documents; and that pretest set points have been recorded.
5. Certify that TAB procedures have been completed, and that TAB reports have been submitted, discrepancies corrected, and corrective work approved.
6. Complete all construction checklists and correct any deficiencies prior to functional testing.

7. Perform preliminary check of systems and intersystem performance after approval of construction checklists for systems, subsystems, and equipment.
8. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shut down, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).
9. Verify each operating cycle after it has been running for a specified period and is operating in a steady-state condition.
10. Observe and verify the position of each device and interlock identified on checklists. Sign off each item as acceptable, or failed. Repeat this test for each operating cycle that applies to system being tested.
11. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.
12. Annotate checklist or data sheet when a deficiency is observed.
13. Verify equipment interface with monitoring and control system and TAB criteria; include the following:
 - a. Supply and return flow rates for VAV and constant volume systems in each operational mode.
 - b. Operation of terminal units in both heating and cooling cycles.
 - c. Minimum outdoor-air intake in each operational mode and at minimum and maximum airflows.
 - d. Building pressurization.
 - e. Total exhaust airflow and total outdoor-air intake.
 - f. Operation of indoor-air-quality monitoring systems.
14. Verify proper responses of monitoring and control system controllers and sensors to include the following:
 - a. For each controller or sensor, record the indicated monitoring and control system reading and the test instrument reading. If initial test indicates that the test reading is outside of the control range of the installed device, check calibration of the installed device and adjust as required. Retest malfunctioning devices and record results on checklist or data sheet.
 - b. Report deficiencies and prepare an issues log entry.

3.6 CONSTRUCTION CHECKLIST VERIFICATION

- A. Contractors shall notify the CxA when prefunctional checklists for a particular system have been completed, in preparation for system functional testing.
- B. The CxA will review the completed checklists for completeness.
- C. The CxA will field-verify random samples of the contractor-completed checklists. The sampling rate will be defined in the Commissioning Plan.
- D. The commissioning plan will define failure criteria for each component. Based on the random sampling, the CxA will determine if the prefunctional construction checklists for each system have been properly and completely filled out by the installing contractors. Any items noted as deficient during field-verification will be reported to the Commissioning Team. Any components that are found to exceed the failure criteria established in the commissioning plan will require that the Contractor recheck all checklists prior to proceeding.
- E. Efforts required by the CxA to recheck failed checklists, or to field-verify additional components beyond the initial sampling plan caused by improper completion of the checklists

by the Contractor, shall be billed to the Owner on an hourly basis. The Contractor shall reimburse the Owner for these efforts.

- F. All checklists associated with each functional performance test procedure shall be completed and approved by the CxA prior to functional performance testings.

3.7 TAB VERIFICATION

- A. TAB subcontractor shall coordinate with CxA for work required in Division 15 Section "Testing, Adjusting, and Balancing." TAB subcontractor shall copy CxA with required reports, sample forms, checklists, and certificates.
- B. Contractor, HVAC subcontractor, and CxA shall witness TAB Work.
- C. TAB Preparation:
 - 1. TAB subcontractor shall provide CxA with data required for "Pre-Field TAB Engineering Reports" specified in Division 15 Section "Testing, Adjusting, and Balancing."
 - a. CxA shall use this data to certify that prestart and startup activities have been completed for systems, subsystems, and equipment installation.
- D. Ductwork Air Leakage Testing (if applicable):
 - 1. Architect will identify, for HVAC subcontractor and CxA, portions of duct systems to have ductwork air leakage testing. Ductwork air leakage testing shall be performed according to Division 15 Section "Metal Ducts," and shall be witnessed by the CxA.
 - 2. On approval of preliminary ductwork air leakage testing report, the CxA shall coordinate verification testing of ductwork air leakage testing. Verification testing shall include random retests of portions of duct section tests, reported in preliminary ductwork air leakage testing report. The HVAC subcontractor shall perform tests using the same instrumentation (by model and serial number) as for original testing; the CxA shall witness verification testing.
- E. Verification of Final TAB Report:
 - 1. CxA shall select, at random, 10 percent of report for field verification.
 - 2. CxA shall notify TAB subcontractor ten days in advance of the date of field verification; however, notice shall not include data points to be verified. The TAB subcontractor shall use the same instruments (by model and serial number) that were used when original data were collected.
 - 3. Failure of an item is defined as follows:
 - a. For all readings other than sound, a deviation of more than 10 percent.
 - 4. Failure of more than 10 percent of selected items shall result in rejection of final TAB report.
- F. If deficiencies are identified during verification testing, CxA shall notify the HVAC subcontractor and Architect, and shall take action to remedy the deficiency. Architect shall review final tabulated checklists and data sheets to determine if verification is complete and that system is operating according to the Contract Documents.
- G. CxA shall verify that TAB Work has been successfully completed.

3.8 TESTING

- A. Functional Performance Tests of systems and intersystem performance shall be completed after construction checklists for systems, subsystems, and equipment have been approved.
- B. Functional Performance Testing will be done under the direction of the CxA. The responsible subcontractors and vendor representatives shall operate and manipulate equipment and controls as directed.
- C. Perform tests using design conditions whenever possible.
 - 1. Simulate conditions by imposing an artificial load when it is not practical to test under design conditions and when written approval for simulated conditions is received from CxA. Before simulating conditions, calibrate testing instruments. Set and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.
 - 2. Alter set points when simulating conditions is not practical and when written approval is received from CxA.
 - 3. Alter sensor values with a signal generator when design or simulating conditions and altering set points are not practical. Do not use sensor to act as signal generator to simulate conditions or override values.
- D. Scope of HVAC System Testing:
 - 1. Testing scope shall include entire HVAC installation, from central equipment for heat generation and refrigeration through distribution systems to each conditioned space. It shall include measuring capacities and effectiveness of operational and control functions.
 - 2. Test all operating modes, interlocks, control responses, responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.
 - 3. Initiate and retrieve trend data for all data points, for first four weeks following successful testing.
- E. Scope of Plumbing System Testing:
 - 1. Testing scope shall include central equipment for water heating through distribution systems to each fixture. It shall include measuring capacities and effectiveness of operational and control functions.
 - 2. Test all operating modes, interlocks, control responses, responses to abnormal or emergency conditions, and verify proper response of system controllers and sensors.
 - 3. Verify interfaces with the Building Automation System are correct and operational.
- F. Detailed Testing Procedures: CxA, with commissioning team, shall prepare detailed testing plans, procedures, and checklists for all commissioned systems, subsystems, and equipment.
- G. Deferred Testing:
 - 1. If tests cannot be completed because of a deficiency outside the scope of the system, the deficiency shall be documented and reported to Owner. Deficiencies shall be resolved and corrected by appropriate parties and test rescheduled.
 - 2. Initial testing shall be performed with simulated loads where necessary, based on seasonal conditions. Contractor shall provide personnel to assist CxA with completion of testing after occupancy, when seasonal conditions permit actual performance under summer and winter design conditions.

H. Testing Reports:

1. Reports shall include measured data, data sheets, and a comprehensive summary describing the operation of systems at the time of testing.
2. Include data sheets for each controller to verify proper operation of the control system, the system it serves, the service it provides, and its location. For each controller, provide space for recording its readout, the reading at the controller's sensor(s), plus comments. Provide space for testing personnel to sign off on each data sheet.
3. Prepare a preliminary test report. Deficiencies will be evaluated by Architect to determine corrective action. Deficiencies shall be corrected and test repeated.
4. If it is determined that the system is constructed according to the Contract Documents, Owner will decide whether modifications required to bring the performance of the system to the OPR and BoD documents shall be implemented or if tests will be accepted as submitted. If corrective Work is performed, Owner will decide if tests shall be repeated and a revised report submitted.

END OF SECTION 019116

SECTION 02 41 00 - DEMOLITION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Selective demolition of building elements for alteration purposes.

1.2 RELATED REQUIREMENTS

- A. Section 01 10 00 - Summary: Limitations on Contractor's use of site and premises.
- B. Section 01 73 10 - Cutting and Patching: Cutting and patching of existing construction.

PART 2 - PRODUCTS -- NOT USED

PART 3 - EXECUTION

3.1 GENERAL PROCEDURES AND PROJECT CONDITIONS

- A. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
 - 1. Obtain required permits.
 - 2. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
 - 3. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
 - 4. Do not close or obstruct roadways or sidewalks without permit.
 - 5. Conduct operations to minimize obstruction of public and private entrances and exits; do not obstruct required exits at any time; protect persons using entrances and exits from removal operations.
- B. Do not begin removal until receipt of notification to proceed from Owner.
- C. **Use of exterior chutes is not permitted.**

3.2 SELECTIVE DEMOLITION FOR ALTERATIONS

- A. Drawings showing existing construction and utilities are based on casual field observation only.
 - 1. Verify that construction and utility arrangements are as shown.
 - 2. Report discrepancies to Architect before disturbing existing installation.
 - 3. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.
- B. Separate areas in which demolition is being conducted from other areas that are still occupied.
 - 1. Provide, erect, and maintain temporary dustproof partitions of construction specified in Section 01 50 00 in locations indicated on drawings.
- C. Remove existing work as indicated and as required to accomplish new work.
 - 1. Remove items indicated on drawings.

D. Protect existing work to remain.

1. Perform cutting to accomplish removals neatly and as specified for cutting new work.
2. Repair adjacent construction and finishes damaged during removal work.
3. Patch as specified for patching new work.

3.3 DEBRIS AND WASTE REMOVAL

- A. Remove debris, junk, and trash from site.

END OF SECTION

SECTION 03 54 00 - CAST UNDERLAYMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Liquid-applied self-leveling floor underlayment.
 - 1. Use cementitious type at existing concrete slabs as required.

1.2 RELATED REQUIREMENTS

- A. Section 02 41 00 - Demolition: Alteration project procedures; selective demolition for remodeling.

1.3 REFERENCE STANDARDS

- A. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens).
- B. ASTM C348 - Standard Test Method for Flexural Strength of Hydraulic-Cement Mortars.
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

1.4 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Provide manufacturer's data sheets documenting physical characteristics and product limitations of underlayment materials. Include information on mixing instructions.
- C. Manufacturer's Instructions: Indicate mix instructions.
- D. Certificate: Certify that products meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

- A. Applicator Qualifications: Company specializing in performing the work of this section with minimum 3 years of experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Keep dry and protect from direct sun exposure, freezing, and ambient temperature greater than 105 degrees F.

1.7 FIELD CONDITIONS

- A. Do not install underlayment until floor penetrations and peripheral work are complete.
- B. Maintain minimum ambient temperatures of 50 degrees F 24 hours before, during and 72 hours after installation of underlayment.
- C. During the curing process, ventilate spaces to remove excess moisture.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Cementitious Underlayment:
 - 1. Ardex, Inc.; Product Ardex 15.
 - 2. Dayton Superior Corporation.; Product LevelLayer I www.daytonsuperior.com.
 - 3. Degussa Building Systems; Product Sonoflow.
 - 4. Dependable Chemical Co., Inc.; Product Skimflow: www.floorprep.com.
 - 5. W.R. Meadows, Inc; Floor-Top STG: www.wrmeadows.com.
- B. Substitutions: See Section 01 60 00 - Product Requirements.

2.2 MATERIALS

- A. Cementitious Underlayment: Blended cement mix, that when mixed with water in accordance with manufacturer's directions will produce self-leveling underlayment with the following properties:
 - 1. Compressive Strength: Minimum 4000 psi after 28 days, tested per ASTM C109/C109M.
 - 2. Flexural Strength: Minimum 1000 psi after 28 days, tested per ASTM C348.
 - 3. Density: 125 lb/cu ft, nominal.
 - 4. Final Set Time: 1-1/2 to 2 hours, maximum.
 - 5. Thickness: As required to obtain level surface.
 - 6. Surface Burning Characteristics: Flame spread/Smoke developed index of 0/0 in accordance with ASTM E84.
- B. Water: Potable and not detrimental to underlayment mix materials.
- C. Primer: Manufacturer's recommended type.
- D. Joint and Crack Filler: Latex based filler, as recommended by manufacturer.

2.3 MIXING

- A. Site mix materials in accordance with manufacturer's instructions.
- B. Mix to self-leveling consistency without over-watering.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that substrate surfaces are clean, dry, unfrozen, do not contain petroleum bi-products, or other compounds detrimental to underlayment material bond to substrate.

3.2 PREPARATION

- A. Concrete: Mechanically prepare steel troweled concrete to create a textured surface necessary to achieve the best bond; acceptable methods include bead blasting and scarifying. Do not use acid etching.
- B. Remove substrate surface irregularities. Fill voids and deck joints with filler. Finish smooth.
- C. Vacuum clean surfaces.

- D. Prime substrate in accordance with manufacturer's instructions. Allow to dry.
- E. Close floor openings.

3.3 APPLICATION

- A. General: Mix and apply underlayment components according to manufacturer's written instructions.
 - 1. Close areas to traffic during underlayment application and for time period after application recommended in writing by manufacturer.
 - 2. Coordinate application of components to provide optimum underlayment-to-substrate and intercoat adhesion.
 - 3. At substrate expansion, isolation, and other moving joints, allow joint of same width to continue through underlayment.
- B. Apply primer over prepared substrate at manufacturer's recommended spreading rate.
- C. Apply underlayment to produce uniform, level surface.
 - 1. Feather edges to match adjacent floor elevations.
- D. Cure underlayment according to manufacturer's written instructions. Prevent contamination during application and curing processes.
- E. Do not install floor coverings over underlayment until after time period recommended in writing by underlayment manufacturer.
- F. Remove and replace underlayment areas that evidence lack of bond with substrate, including areas that emit a "hollow" sound when tapped.

3.4 CURING

- A. Once underlayment starts to set, prohibit foot traffic until final set has been reached.
- B. Air cure in accordance with manufacturer's instructions.

3.5 PROTECTION

- A. Protect against direct sunlight, heat, and wind; prevent rapid drying to avoid shrinkage and cracking.

END OF SECTION

SECTION 05 50 00 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Shop fabricated steel items.

1.2 REFERENCE STANDARDS

- A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
- B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- C. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- D. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
- E. ASTM A325M - Standard Specification for Structural Bolts, Steel, Heat Treated 830 MPa Tensile Strength (Metric).
- F. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; American Welding Society.
- G. AWS D1.1/D1.1M - Structural Welding Code - Steel; American Welding Society.
- H. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); Society for Protective Coatings.

1.3 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
 - 1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.

PART 2 - PRODUCTS

2.1 MATERIALS - STEEL

- A. Steel Sections: ASTM A36/A36M.
- B. Bolts, Nuts, and Washers: ASTM A325 (ASTM A325M), Type 1, galvanized to ASTM A153/A153M where connecting galvanized components.
- C. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
- D. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.2 FABRICATION

- A. Fabricate items with joints tightly fitted and secured.
- B. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
- C. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.3 FABRICATED ITEMS

- A. Ledge Angles and Shelf Angles Not Attached to Structural Framing: For support of metal decking; galvanized finish.

2.4 FINISHES - STEEL

- A. Galvanizing of Non-structural Items: Galvanize after fabrication to ASTM A123/A123M requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.

3.2 INSTALLATION

- A. Install items plumb and level, accurately fitted, free from distortion or defects.
- B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- C. Obtain approval prior to site cutting or making adjustments not scheduled.

3.3 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch.
- C. Maximum Out-of-Position: 1/4 inch.

END OF SECTION

SECTION 06 10 00 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Roofing nailers.
- B. Preservative treated wood materials.
- C. Fire retardant treated wood materials.
- D. Wood nailers and curbs for items installed on roof.
- E. Concealed wood blocking, nailers, grounds and supports.

1.2 REFERENCE STANDARDS

- A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- C. AWWA U1 - Use Category System: User Specification for Treated Wood; American Wood Protection Association.
- D. PS 20 - American Softwood Lumber Standard; National Institute of Standards and Technology (Department of Commerce).
- E. SPIB (GR) - Grading Rules; Southern Pine Inspection Bureau, Inc..

1.3 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Provide technical data on wood preservative materials.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.
- B. Fire Retardant Treated Wood: Prevent exposure to precipitation during shipping, storage, or installation.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
 - 1. Species: Southern Pine, unless otherwise indicated.
 - 2. If no species is specified, provide any species graded by the agency specified; if no grading agency is specified, provide lumber graded by any grading agency meeting the specified requirements.
 - 3. Grading Agency: Any grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee (www.alsc.org) and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.

- B. Lumber fabricated from old growth timber is not permitted.

2.2 DIMENSION LUMBER

- A. Grading Agency: Southern Pine Inspection Bureau, Inc. (SPIB).
- B. Sizes: Nominal sizes as indicated on drawings, S4S.
- C. Moisture Content: S-dry or MC19.
- D. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
 - 1. Lumber: S4S, No. 2 or Standard Grade.

2.3 ACCESSORIES

- A. Fasteners and Anchors:
 - 1. Metal and Finish: Hot-dipped galvanized steel per ASTM A 153/A 153M.

2.4 FACTORY WOOD TREATMENT

- A. Treated Lumber and Plywood: Comply with requirements of AWPA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.
 - 1. Fire-Retardant Treated Wood: Mark each piece of wood with producer's stamp indicating compliance with specified requirements.
 - 2. Preservative-Treated Wood: Provide lumber and plywood marked or stamped by an ALSC-accredited testing agency, certifying level and type of treatment in accordance with AWPA standards.
- B. Fire Retardant Treatment:
 - 1. Manufacturers:
 - a. Arch Wood Protection, Inc: www.wolmanizedwood.com.
 - b. Hoover Treated Wood Products, Inc: www.frtw.com.
 - c. Osmose, Inc: www.osmose.com.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
 - 2. Interior Type A: AWPA U1, Use Category UCFA, Commodity Specification H, low temperature (low hygroscopic) type, chemically treated and pressure impregnated; capable of providing a maximum flame spread rating of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes.
 - a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
 - b. Treat rough carpentry items in accordance with code requirements.
 - c. Do not use treated wood in applications exposed to weather or where the wood may become wet.
 - d. Provide fire treated, preservative treated lumber where indicated or required.
- C. Preservative Treatment:
 - 1. Manufacturers:
 - a. Arch Wood Protection, Inc: www.wolmanizedwood.com.
 - b. Viance, LLC: www.treatedwood.com.

- c. Osmose, Inc: www.osmose.com.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
- D. Preservative Pressure Treatment of Lumber Above Grade: AWPA U1, Use Category UC3B, Commodity Specification A using waterborne preservative to 0.25 lb/cu ft retention.
- 1. Kiln dry lumber after treatment to maximum moisture content of 19 percent.
 - 2. Treat lumber in contact with roofing or flashing.
 - 3. Treat lumber in contact with masonry or concrete.

PART 3 - EXECUTION

3.1 INSTALLATION - GENERAL

- A. Select material sizes to minimize waste.
- B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.
- C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

3.2 BLOCKING, NAILERS, AND SUPPORTS

- A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.
- B. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.
- C. Specifically, provide the following non-structural framing and blocking:
 - 1. Cabinets and shelf supports.
 - 2. Wall-mounted door stops.

3.3 ROOF-RELATED CARPENTRY

- A. Coordinate installation of roofing carpentry with deck construction, framing of roof openings, and mechanical equipment installation.
- B. Provide wood curbs at roof openings as required at for new mechanical equipment installations.

3.4 SITE APPLIED WOOD TREATMENT

- A. Apply preservative treatment compatible with factory applied treatment at site-sawn cuts, complying with manufacturer's instructions.
- B. Allow preservative to dry prior to erecting members.

END OF SECTION

SECTION 06 41 00 - ARCHITECTURAL WOOD CASEWORK

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Specially fabricated cabinet units.
- B. Cabinet hardware.
- C. Preparation for installing utilities.

1.2 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Support framing, grounds, and concealed blocking.
- B. Section 12 36 00 - Countertops.
- C. Section 09 21 16 - Gypsum Board Assemblies: Cabinet substrate.

1.3 REFERENCE STANDARDS

- A. AWI (QCP) - Quality Certification Program, www.awiqcp.org.
- B. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards.
- C. GSA CID A-A-1936 - Adhesive, Contact, Neoprene Rubber; Federal Specifications and Standards.
- D. NEMA LD 3 - High-Pressure Decorative Laminates; National Electrical Manufacturers Association.

1.4 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
 - 1. Minimum Scale of Detail Drawings: 1-1/2 inch to 1 foot.
 - 2. Provide the information required by AWI/AWMAC/WI Architectural Woodwork Standards.
- C. Product Data: For panel products, high-pressure decorative laminate, adhesive for bonding plastic laminate, cabinet hardware and accessories and finishing materials and processes.
- D. Samples: Submit two samples, 8 x 10 inches in size, illustrating plastic laminate finish. Submit finish samples of panel products for casework and lumber products at the same time for comparison.
- E. Samples: Submit actual sample items of proposed pulls and hinges, demonstrating hardware design, quality, and finish.

1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.
 - 1. Accredited participant in the specified certification program prior to the commencement of fabrication and throughout the duration of the project.

- B. Quality Certification: Provide AWI Quality Certification Program inspection report and quality certification of completed work.
 - 1. Provide labels or certificates indicating that the work complies with requirements of AWS Grade or Grades specified.
 - 2. Prior to delivery to the site provide shop drawings with certification labels.
 - 3. Provide labels on each product when required by certification program.
 - 4. Upon completion of installation provide certificate certifying that the installation and products meet the specified requirements.
 - 5. Arrange and pay for inspections required for certification.
 - 6. Replace, repair, or rework all work for which certification is refused.

1.6 MOCK-UP

- A. Provide mock-up of typical base cabinet and wall cabinet, including hardware, finishes, and plumbing accessories.
- B. Locate where directed.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect units from moisture damage.

1.8 FIELD CONDITIONS

- A. During and after installation of custom cabinets, maintain temperature and humidity conditions in building spaces at same levels planned for occupancy.

PART 2 - PRODUCTS

2.1 CABINETS

- A. Quality Grade: Unless otherwise indicated provide products of quality specified by AWI//AWMAC/WI Architectural Woodwork Standards for Grades as indicated.
- B. Plastic Laminate Faced Cabinets: Premium grade.
- C. Cabinets:
 - 1. Finish - Exposed Exterior Surfaces: Decorative laminate as scheduled.
 - 2. Finish - Semi-exposed Surfaced: Melamine.
 - 3. Adjustable Shelf Loading: 50 lbs. per sq. ft..
 - 4. Cabinet Style: Flush overlay.

2.2 WOOD-BASED COMPONENTS

- A. Wood fabricated from old growth timber is not permitted.
- B. Hardwood Edgebanding: Use premium grade solid hardwood edgebanding at front edge of all exposed and semi-exposed shelves.

2.3 PANEL MATERIALS

- A. Veneer Core Plywood: HPVA HP-1, made with adhesive containing no urea formaldehyde.
- B. Hardwood Edgebanding: Use solid hardwood edgebanding, 0.020 inches thick, matching species, color, grain, and grade for exposed portions of cabinetry.

2.4 LAMINATE MATERIALS

A. Manufacturers:

1. Formica Corporation: www.formica.com.
2. Panolam Industries International, Inc\Nevamar: www.nevamar.com.
3. Wilsonart International, Inc: www.wilsonart.com.
4. Substitutions: See Section 01 60 00 - Product Requirements.

B. High Pressure Decorative Laminate (HPDL): NEMA LD 3, types as recommended for specific applications and as follows:

1. Vertical Surfaces: VGS, 0.028 inch nominal thickness, through color, colors as scheduled, finish as scheduled.
2. Laminate Backer: BKL, 0.020 inch nominal thickness, undecorated; for application to concealed backside of panels faced with high pressure decorative laminate.

2.5 ACCESSORIES

A. Adhesive: GSA CID A-A-1936 contact adhesive.

B. Fasteners: Size and type to suit application.

C. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application .

D. Grommets for Cable Passage through Countertops: 1-1/4-inch or 2-inch as required OD, color as selected, molded-plastic grommets and matching plastic caps with slot for wire passage.

2.6 HARDWARE

A. General Requirements: The products of the following manufacturers are used herein and the accompanying abbreviations for the company name are used at the product designation.

B. Hardware Finish: US26 (Bright Chrome) for plastic laminate finish

C. Manufacturers:

1. BA - Baldwin Hardware Mfg. Corp.
2. BL - Julius Blum Mfg.
3. BO - Bommer Spring Hinge Co., Inc.
4. GA - Garcy Corporation
5. GRA - Grass America
6. HA - Hager Hinge Co.
7. HE - Hettich
8. HF - Hafele
9. IV - The H. B. Ives Co.
10. KV - Knappe and Vogt
11. McK - McKinney Sales Co.
12. NCL - National Cabinet Locks
13. ST - Stanley Hardware

D. Hinges and Baseplates:

1. For 3/4 inch thick doors: Julius Blum 170 degree opening hinge, Product Number 71.6550 used in conjunction with baseplate 175H9100, zinc die cast, two-piece, wing type. Mount baseplate with two 5mm system screws and one #7 wood screw (3 screws total each baseplate) or approved equals by Grass America, Salice or approved equal.

2. Number of hinges per door shall depend on weight and size of door. Following information is only a guideline and it is the responsibility of the contractor to ensure that a sufficient number of hinges are installed to prevent sagging or binding.
3.

Number of Hinges	Door Height	Door Weight
a. 2	Less than 36 inches	Less than 15 lbs.
b. 3	Less than 66 inches	Less than 30 lbs.
c. 4	Less than 84 inches	Less than 45 lbs.
d. 5	Less than 96 inches	Less than 60 lbs.

E. Pulls:

1. For doors and drawers:
 - a. No. 346120 as manufactured by ST satin chrome plated wire pull.
 - b. Equals as manufactured by BA or BL.

F. Drawer Slides (Light/Medium Duty Drawers - 24 inches wide or less):

1. No. 8405 as manufactured by KV full extension 1 inch over travel.
2. No. KA5632 as manufactured by HE 100# ball bearing full extension.
3. No. 422.93 as manufactured by HF.
4. No. 7434 Ball Bearing manufactured by Accuride 100#/L HD full extension 1 inch over travel.

G. Drawer Slides (Heavy Duty Drawers - 42 inches wide or less):

1. No. 8525 as manufactured by KV 175# full extension 1-1/2 inch over travel.
2. No. 422.05 as manufactured by HF.
3. No. 3640 Ball Bearing manufactured by Accuride 100# 1 inch over travel.

H. Drawer Locks: No. 987 as manufactured by KV or equal provided by NCL.

I. Adjustable Shelf Standards and Supports: BHMA A156.9, B04071; with shelf rests, B04081.

J. Adjustable Shelf Supports: Standard side-mounted system using multiple holes for pin supports and coordinated self rests, satin chrome finish, for nominal 1 inch spacing adjustments.

2.7 FABRICATION

- A. Assembly: Shop assemble cabinets for delivery to site in units easily handled and to permit passage through building openings.
 1. Drawer Construction: At all casework, provide single species solid lumber drawer boxes dovetailed all 4 sides.
 - a. Drawer Bottoms: Veneer core, "B" face veneer; fully captured all 4 sides.
- B. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.
- C. Fitting: When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide matching trim for scribing and site cutting.
- D. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arises.
 1. Apply laminate backing sheet to reverse side of plastic laminate finished surfaces.

- E. Provide cutouts for plumbing fixtures. Verify locations of cutouts from on-site dimensions. Seal cut edges.
- F. Plastic Laminate:
 - 1. Install plastic laminate in accordance with printed instructions of manufacturer of plastic laminate. Install plastic balancing sheet on concealed face to prevent warping.
 - 2. Install plastic laminate on cabinet surfaces as follows:
 - a. All exposed and semi-exposed surfaces shall have laminate of same finish and pattern including cabinet interiors.
 - b. Cabinet Shelves: Melamine finish on all horizontal surfaces.
 - c. Exposed Adjustable Shelves: 3/4 inch thick panel product core with NEMA 0.028 inch thick plastic laminate as indicated and detailed.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify adequacy of backing and support framing.
- B. Verify location and sizes of utility rough-in associated with work of this section are in place and ready to receive this work.

3.2 INSTALLATION

- A. Set and secure custom built cabinets in place, assuring that they are rigid, plumb, and level.
- B. Use fixture attachments in concealed locations for wall mounted components.
- C. Use concealed joint fasteners to align and secure adjoining cabinet units.
- D. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim for this purpose.
- E. Secure cabinets to floor using appropriate angles and anchorages.
- F. Countersink anchorage devices at exposed locations. Conceal with solid wood plugs of species to match surrounding wood; finish flush with surrounding surfaces.

3.3 ADJUSTING

- A. Adjust installed work.
- B. Adjust moving or operating parts to function smoothly and correctly.

3.4 CLEANING

- A. Clean casework, counters, shelves, hardware, fittings, and fixtures.

END OF SECTION

SECTION 07 01 50 - MEMBRANE REROOFING PREPARATION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Removal of existing roofing membrane and base flashings as required for new penetrations and mechanical equipment.
 - 2. Protection of existing roofing system that is not reroofed.
- B. Related Sections include the following:
 - 1. Section 07 62 00 - Sheet Metal and Flashing: Metal roof penetrations.
 - 2. Division 23 - HVAC Equipment removal and replacement.

1.2 MATERIALS OWNERSHIP

- A. Except for items or materials indicated to be reused, reinstalled, or otherwise indicated to remain Owner's property, demolished materials shall become Contractor's property and shall be removed from Project site.

1.3 DEFINITIONS

- A. Roofing Terminology: Refer to ASTM D 1079 and glossary in NRCA's "The NRCA Roofing and Waterproofing Manual" for definition of terms related to roofing work in this Section.
- B. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and reinstalled.
- C. Existing to Remain: Existing items of construction that are not indicated to be removed.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Temporary Roofing: Include Product Data and description of temporary roofing system. If temporary roof will remain in place, submit surface preparation requirements needed to receive permanent roof, and submit a letter from roofing membrane manufacturer stating acceptance of the temporary membrane, and that its inclusion will not adversely affect the roofing system's warranty, resistance to fire and wind or its FMG rating.

1.5 QUALITY ASSURANCE

- A. Preliminary Reroofing Conference: Conduct conference at Project site. Review methods and procedures related to roofing system including, but not limited to, the following:
 - 1. Meet with Owner; Architect; Owner's insurer if applicable; testing and inspecting agency representative; roofing system manufacturer's representative; deck Installer; roofing Installer including project manager, superintendent, and foreman; and installers whose work interfaces with or affects reroofing including installers of roof accessories and roof-mounted equipment.
 - 2. Review methods and procedures related to reroofing preparation, including membrane roofing system manufacturer's written instructions.

3. Review temporary protection requirements for existing roofing system that is to remain, during and after installation.
4. Review roof drainage during each stage of reroofing and review roof drain plugging and plug removal procedures.
5. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
6. Review procedures to determine condition and acceptance of existing deck and base flashing substrate for reuse.
7. Review base flashings, special roofing details, drainage, penetrations, equipment curbs, and condition of other construction that will affect reroofing.
8. Review governing regulations and requirements for insurance and certificates if applicable.
9. Review existing conditions that may require notification of Architect before proceeding.

1.6 PROTECTION OF WORK, PROPERTY AND THE PUBLIC

- A. Contractor will prevent any work which could reasonably be deemed to be hazardous from taking place over or adjacent to occupied areas.
- B. At conclusion of each day's work, Contractor shall carefully inspect work including temporary daily tie-offs to ensure system is completely water tight; all stored materials are suitably protected from the weather and all equipment is stored in such a manner as not to interfere with facility operations. Materials stored on the roof must be properly secured to prevent blow off.
- C. Contractor will note that building will remain occupied during work. He is responsible for taking all precautions necessary to protect building, contents, and personnel from damage or injury from his operations, and from water entry into the building during construction. Dirt and dust must be kept to a minimum.
- D. Prior to starting work Contractor shall obtain approval of the Owner for locations of work operations at ground level, such as material storage, hoisting, dumping, etc. Work will be restricted to approved locations.
- E. Submit schedule for removal and reroofing to Owner for his approval prior to starting work so that, if necessary, inside operations can be coordinated with the roofing work.
- F. All debris and removed material shall be removed from the site in a timely manner to minimize accumulation. Contractor is required to contain all trash and debris and prevent trash and debris from being blown around campus. Contractor is to police trash and debris on a daily basis and place all trash and debris in proper containment. Owner reserves the right to judge whether or not debris is being removed in a timely manner.
- G. Contractor will be responsible for any damage to grounds and landscaping. In the event of damage he shall restore damaged property to a condition equivalent to that at time of start of operations.
- H. Contractor shall conduct work in a manner that will ensure the least possible obstruction to traffic and inconvenience to the general public, students and school personnel. The Contractor shall take all precautions to ensure the protection of persons and property.
- I. No roads, streets or sidewalks shall be closed to the public except with permission from the Owner. Requests for permission to obstruct roads must be delivered to the Owner 48 hours prior

to the time obstruction is required. Fire hydrants on or adjacent to the work shall be kept in operation. Provisions shall be made by the Contractor to ensure the safe use of sidewalks and proper functioning of all gutters, sewer inlets, temporary drainage ditches, etc. which shall not be obstructed except as approved by the Owner and the Engineer.

- J. On normal workdays when contractor does not work due to inclement weather or other reasons, Contractor's superintendent shall visit the site no later than his normal start time and verify that the system is completely water tight; all stored materials are suitably protected from the weather and all equipment is stored in such a manner as not to interfere with facility operations. Contractor shall be prepared to implement emergency repairs as necessary to prevent leakage into the facility.
- K. The Contractor will be responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the work. He will take all necessary precautions for the safety of, and will provide the necessary precaution to prevent damage, injury or loss to:
 - 1. All employees on the work and other persons who may be affected thereby.
 - 2. All the work and all materials or equipment to be incorporated therein, whether in storage on or off the site, and,
 - 3. Other property at the site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures and utilities not designated for removal, relocation or replacement in the course of construction.
- L. The Contractor will comply with all applicable laws, ordinances, rules, regulations and orders of any public body having jurisdiction for the safety of persons or property or to protect them from damage, injury or loss. He will erect and maintain, as required by the conditions and progress of the work, all necessary safeguards for safety and protection. All damage, injury or loss to any property caused, directly or indirectly in whole or in part, by the Contractor, and Subcontractor or anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable, will be remedied by the Contractor.
- M. The Contractor shall be responsible for all water damage to the building, including furnishings, occurring during the construction phase of the project. The Contractor shall survey, in the presence of the Owner, existing water damage prior to construction and prepare a written and photographic record of this survey with copies distributed to both the Owner and Engineer. The Contractor shall be responsible for all damage not so documented.
- N. Access to roof shall be from exterior. Interior access shall be limited to certain Contractor personnel with Owner approval.
- O. Contractor shall provide and maintain pedestrian and vehicular barricades as necessary for the situation. Pedestrian barricades shall be constructed of continuous temporary fencing completely containing the work area. Fencing shall be erected with sturdy bracing and shall extend from the ground to a minimum of 48 inches high and shall meet all ADA requirements for barricading for the visually impaired. Continuous, plastic mesh, orange safety fencing is acceptable. If the barricade blocks an existing pedestrian sidewalk, the Contractor shall properly mark an alternate route by installing and maintaining neat, legible signs. "Alternate Route" signs may be required at locations outside the Construction Limits.

1.7 COORDINATION

- A. Demolition in the roof slab shall be coordinated with the Architect prior to creating any roof penetrations for mechanical equipment.

1.8 INSPECTION OF WORK

- A. Work found to be in violation of specifications or not in accordance with established workmanship practices and standards will be subject to complete removal and proper replacement with new materials at Contractor's expense.
- B. Failure of Owner or Architect to discover or reject defective work, or work not in accordance with the Contract, shall not be deemed an acceptance thereof, nor a waiver of Owner's rights to Contractor's compliance with the Contract or performance of the work, or any part thereof. No partial or final payment, or partial or entire occupancy, by Owner shall be deemed to be an acceptance of work or of material which is not strictly in accordance with the Contract, nor shall it be deemed to be a waiver by Owner of any of Owner's rights pursuant to this Contract or otherwise.

1.9 GUARANTEES AND WARRANTY

- A. The Contractor shall guarantee the materials and workmanship associated with the roofing, flashing, modifications and sheet metal work incidental to the roofing, against defects due to faulty materials, workmanship and/or negligence by the Contractor(s) for a period of twenty-four (24) months following final acceptance of the work. The substitution of an equal or longer term manufacturer's warranty in lieu of this requirement will not be acceptable. Prior to commencement of any work on the existing roof, Contractor shall consult with the manufacturer's warranty department for all required procedures, materials, means and methods by which the Contractor must provide required modifications to the existing system to maintain without interruption of the warranty that is in force.
- B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during reroofing, by methods and with materials so as not to void existing roofing system warranty.
 - 1. Existing Roofing Membrane: The existing roofing membrane is Ultraply TPO manufactured by Firestone, 60 mils thick.
 - 2. Original Roofing Contractor: Commercial Roofing Associates, Keith Gilstrap, 704-334-1150.
 - 3. Notify warrantor of existing roofing system on completion of reroofing, and obtain documentation verifying that existing roofing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

PART 2 - PRODUCTS

2.1 INFILL MATERIALS

- A. Use infill materials matching existing membrane roofing system materials, unless otherwise indicated.

2.2 AUXILIARY REROOFING MATERIALS

- A. General: Auxiliary reroofing preparation materials recommended by roofing system manufacturer for intended use and compatible with components of existing roofing system.
- B. Metal Flashing Sheet: Metal flashing sheet is specified in Division 07 Section "Sheet Metal Flashing and Trim."

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect existing membrane roofing system that is indicated not to be reroofed. See Paragraph 1.9 for information on existing warranties.
 - 1. Loosely lay 1 inch minimum thick, molded expanded polystyrene (MEPS) insulation over the roofing membrane in areas indicated. Loosely lay 15/32 inch plywood or OSB panels over MEPS. Extend MEPS past edges of plywood or OSB panels a minimum of 1 inch.
 - 2. Limit traffic and material storage to areas of existing roofing membrane that have been protected.
 - 3. Maintain temporary protection and leave in place until replacement roofing has been completed.
- B. During removal operations, have sufficient and suitable materials on-site to facilitate rapid installation of temporary protection in the event of unexpected rain.
- C. Maintain roof drains in functioning condition to ensure roof drainage at end of each workday. Prevent debris from entering or blocking roof drains and conductors. Use roof-drain plugs specifically designed for this purpose. Remove roof-drain plugs at end of each workday, when no work is taking place, or when rain is forecast.
- D. Verify that rooftop utilities and service piping have been shut off before commencing Work.

3.2 INFILL MATERIALS INSTALLATION

- A. Immediately after removal of selected portions of existing membrane roofing system, and inspection and repair, if needed, of deck, fill in the required areas to match existing membrane roofing system construction.

3.3 EXISTING BASE FLASHINGS

- A. Remove existing base flashings around curbs and penetrations as required.
 - 1. Clean substrates of contaminants such as asphalt, sheet materials, dirt, and debris.
- B. Do not damage metal counterflashings that are to remain. Replace metal counterflashings damaged during removal with counterflashings of same metal, weight or thickness, and finish.

3.4 FIELD QUALITY CONTROL

- A. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion and submit report to Architect.
 - 1. Notify Architect or Owner 48 hours in advance of date and time of inspection.
- B. Repair or remove and replace components of roofing system where test results or inspections indicate that they do not comply with specified requirements.

- C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.5 DISPOSAL

- A. Collect and place demolished materials in containers. Promptly dispose of demolished materials. Do not allow demolished materials to accumulate on-site.
 - 1. Storage or sale of demolished items or materials on-site will not be permitted.
- B. Transport demolished materials off Owner's property and legally dispose of them.

END OF SECTION

SECTION 07 21 00 - THERMAL INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Batt insulation at for sound attenuation.

1.2 RELATED REQUIREMENTS

- A. Section 09 21 16 - Gypsum Board Assemblies: Framing for sound attenuation.

1.3 REFERENCE STANDARDS

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on product characteristics, performance criteria, and product limitations if required.
- C. Manufacturer's Installation Instructions: Include information on special environmental conditions required for installation and installation techniques.

1.5 PRODUCT HANDLING

- A. Storage Area: Provide suitable storage area for storage of materials and equipment.
- B. Delivery: Deliver manufactured items to site in original sealed containers or packages bearing manufacturer's name and brand designation. Where specified, materials shall have UL labels or manufacturer's certification.

1.6 FIELD CONDITIONS

- A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Insulation materials are as listed.
- B. Substitutions: See Section 01 60 00 - Product Requirements.

2.2 BATT INSULATION MATERIALS

- A. Sound Attenuation: ASTM C 665; preformed mineral fiber batt conforming to ASTM 423 for coefficient at frequencies; friction fit, conforming to the following:
 1. Surface Burning Characteristics: Flame spread index of 0; smoke developed index of 0, when tested in accordance with ASTM E 84.
 2. Combustibility: Non-combustible, when tested in accordance with ASTM E 136.
 3. Formaldehyde Content: Zero.
 4. Thermal Resistance: R of 11.
 5. Density: 2.5 pcf, minimum.
 6. Coefficient at Frequencies: NRC of 1.10, minimum.
 7. Thickness: 3-1/2 inches.

8. Facing: Unfaced.
9. Manufacturers:
 - a. CertainTeed Corporation: www.certainteed.com.
 - b. Johns Manville Corporation: www.jm.com.
 - c. Owens Corning Corp: www.owenscorning.com.
 - d. Thermafiber; Product SAFB: www.thermafiber.com. (Basis of Design)
10. Substitutions: See Section 01 60 00 - Product Requirements.

2.3 ACCESSORIES

- A. Tape: Polyethylene self-adhering type, mesh reinforced, 2 inch wide.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.
- B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

3.2 INSTALLATION OF SOUND ATTENUATION INSULATION

- A. Apply insulation units to substrates 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. Install mineral-fiber insulation in cavities formed by framing members according to the following requirements:
 1. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
 2. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.
- C. Installation of insulation at ceilings:
 1. Install unfaced glass-fiber blanket insulation over suspended ceilings at partitions in a width that extends insulation 48 inches on either side of partition.

3.3 PROTECTION

- A. Do not permit installed insulation to be damaged prior to its concealment.

END OF SECTION

SECTION 07 62 00 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Fabricated sheet metal items, including flashings and counterflashings in conjunction with re-roofing membrane system.

1.2 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Wood nailers.
- B. Section 07 01 50 - Membrane Reroofing Preparation: Repair/Replacement of existing roofing system.
- C. Section 07 90 05 - Joint Sealers.

1.3 REFERENCE STANDARDS

- A. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
- B. ASTM D4586 - Standard Specification for Asphalt Roof Cement, Asbestos-Free.
- C. SMACNA (ASMM) - Architectural Sheet Metal Manual; Sheet Metal and Air Conditioning Contractors' National Association.

1.4 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.
- C. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details. Show joints and terminations in isometric detail.
- D. Samples: Submit two samples, 6 x 12 inches in size illustrating material of typical flashing/counterflashing including finish.

1.5 QUALITY ASSURANCE

- A. Perform work in accordance with SMACNA Architectural Sheet Metal Manual requirements and standard details or NRCA Manual, except as otherwise indicated.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.
- B. Prevent contact with materials that could cause discoloration or staining.

PART 2 - PRODUCTS

2.1 SHEET MATERIALS

- A. Stainless Steel: ASTM A666 Type 304, soft temper, 0.015 inch thick; smooth No. 4 finish.

2.2 ACCESSORIES

- A. Fasteners: Same material and finish as flashing metal, with soft neoprene washers.
- B. Sealant: As specified in Section 07 90 05.
- C. Plastic Cement: ASTM D4586, Type I.

2.3 FABRICATION

- A. Form sections true to shape, accurate in size, square, and free from distortion or defects.
- B. Form pieces in longest possible lengths.
- C. Hem exposed edges on underside 1/2 inch; miter and seam corners.
- D. Form material with flat lock seams, except where otherwise indicated. At moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.
- E. Fabricate corners from one piece with minimum 18 inch long legs; seam for rigidity, seal with sealant.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.
- B. Verify roofing termination and base flashings are in place, sealed, and secure.

3.2 PREPARATION

- A. Install starter and edge strips, and cleats before starting installation.

3.3 INSTALLATION

- A. Insert flashings into reglets to form tight fit. Secure in place with lead wedges. Seal flashings into reglets with sealant.
- B. Secure flashings in place using concealed fasteners.
- C. Apply plastic cement compound between metal flashings and felt flashings.
- D. Fit flashings tight in place. Make corners square, surfaces true and straight in planes, and lines accurate to profiles.
- E. Seal metal joints watertight.

END OF SECTION

SECTION 07 81 00 - APPLIED FIREPROOFING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Fireproofing of interior structural steel and decking.
- B. Patching of existing fireproofing.

1.2 RELATED REQUIREMENTS

- A. Section 07 84 00 - Firestopping.
- B. Section 09 21 16 - Gypsum Board Assemblies: Gypsum board fireproofing.

1.3 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- B. ASTM E605 - Standard Test Methods for Thickness and Density of Sprayed Fire-Resistive Material (SFRM) Applied to Structural Members.
- C. ASTM E736 - Standard Test Method For Cohesion/Adhesion of Sprayed Fire-Resistive Materials Applied to Structural Members.
- D. ASTM E760 - Standard Test Method for Effect of Impact on Bonding of Sprayed Fire-Resistive Material Applied to Structural Members.
- E. ASTM E937 - Standard Test Method for Corrosion of Steel by Sprayed Fire-Resistive Material (SFRM) Applied to Structural Members.

1.4 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, for submittals procedures.
- B. Product Data: Provide data indicating product characteristics.
- C. Test Reports: Reports from reputable independent testing agencies for proposed products, indicating compliance with specified criteria, conducted under conditions similar to those on project, for:
 - 1. Bond Strength.
 - 2. Bond Impact.
 - 3. Density.
 - 4. Fire tests using substrate materials similar those on project.
- D. Manufacturer's Field Reports: Indicate environmental conditions under which fireproofing materials were installed.

1.5 FIELD CONDITIONS

- A. Do not apply spray fireproofing when temperature of substrate material and surrounding air is below 40 degrees F.
- B. Provide ventilation in areas to receive fireproofing during application and 24 hours afterward, to dry applied material.
- C. Provide temporary enclosure to prevent spray from contaminating air.

1.6 WARRANTY

- A. See Section 01 77 00 - Closeout Procedures, for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion.
 - 1. Include coverage for fireproofing to remain free from cracking, checking, dusting, flaking, spalling, separation, and blistering.
 - 2. Reinstall or repair failures that occur within warranty period.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Sprayed-On Cementitious Fireproofing:
 - 1. Grace Construction Products; Product Monokote MK-6: www.na.graceconstruction.com.
 - 2. Southwest Fireproofing Products Company.; Product 5GP: www.sfrm.com.
- B. Substitutions: See Section 01 60 00 - Product Requirements.

2.2 FIREPROOFING ASSEMBLIES

- A. Provide assemblies as indicated on the drawings.

2.3 MATERIALS

- A. Sprayed Fire-Resistive Material for Interior Applications: Manufacturer's standard factory mixed material, which when combined with water is capable of providing the indicated fire resistance, and conforming to the following requirements:
 - 1. Composition: Portland-cement-based, not mineral fiber-based.
 - 2. Bond Strength: 150 psf, minimum, when tested in accordance with ASTM E736 when set and dry.
 - 3. Dry Density: Minimum average density of 15 lb/cu ft, with minimum individual density of any test sample of 14 lb/cu ft, when tested in accordance with ASTM E605.
 - 4. Effect of Impact on Bonding: No cracking, spalling or delamination, when tested in accordance with ASTM E760.
 - 5. Corrosivity: No evidence of corrosion, when tested in accordance with ASTM E937.
 - 6. Surface Burning Characteristics: Maximum flame spread of 0 and maximum smoke developed of 0, when tested in accordance with ASTM E84.
- B. Existing Sprayed Fire Resistive Material: Provide patching of existing fireproofing compatible with existing system as determined by the fireproofing installer.

2.4 ACCESSORIES

- A. Primer Adhesive: Of type recommended by fireproofing manufacturer.
- B. Water: Clean, potable.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces are ready to receive fireproofing.
- B. Verify that clips, hangers, supports, sleeves, and other items required to penetrate fireproofing are in place.

- C. Verify that ducts, piping, equipment, or other items that would interfere with application of fireproofing have not been installed.
- D. Verify that voids and cracks in substrate have been filled. Verify that projections have been removed where fireproofing will be exposed to view as a finish material.

3.2 PREPARATION

- A. Perform tests as recommended by fireproofing manufacturer in situations where adhesion of fireproofing to substrate is in question.
- B. Remove incompatible materials that could affect bond by scraping, brushing, scrubbing, or sandblasting.
- C. Prepare substrates to receive fireproofing in strict accordance with instructions of fireproofing manufacturer.
- D. Apply fireproofing manufacturer's recommended bonding agent on primed steel.
- E. Protect surfaces not scheduled for fireproofing and equipment from damage by overspray, fall-out, and dusting.
- F. Close off and seal duct work in areas where fireproofing is being applied.

3.3 APPLICATION

- A. Apply primer adhesive in accordance with manufacturer's instructions.
- B. Apply fireproofing in thickness and density necessary to achieve required ratings, with uniform density and texture.
- C. Apply fireproofing in sufficient thickness to achieve required ratings, with as many passes as necessary to cover with monolithic blanket of uniform density and texture.

3.4 FIELD QUALITY CONTROL

- A. Inspect the installed fireproofing after application and curing for integrity, prior to its concealment. Ensure that actual thicknesses, densities, and bond strengths meet requirements for specified ratings.
- B. Re-inspect the installed fireproofing for integrity of fire protection, after installation of subsequent Work.

3.5 CLEANING

- A. Remove excess material, overspray, droppings, and debris. All floors shall be left in scraped condition. Concrete floor slabs which are scheduled to remain exposed shall be cleaned of all fireproofing residue and cleaned to the satisfaction of the Architect.
- B. Remove fireproofing from materials and surfaces not required to be fireproofed.

END OF SECTION

SECTION 07 84 00 - FIRESTOPPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Firestopping systems.
- B. Firestopping of all joints and penetrations in fire-resistance rated and smoke-resistant assemblies, whether indicated on drawings or not, and other openings indicated.

1.2 RELATED REQUIREMENTS

- A. Section 01 73 00 - Cutting and Patching: Cutting and patching.
- B. Section 07 81 00 - Applied Fireproofing.
- C. Section 09 21 16 - Gypsum Board Assemblies: Gypsum wallboard fireproofing.

1.3 REFERENCE STANDARDS

- A. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
- B. ITS (DIR) - Directory of Listed Products; Intertek Testing Services NA, Inc..
- C. FM 4991 - Approval of Firestop Contractors; Factory Mutual Research Corporation.
- D. FM P7825 - Approval Guide; Factory Mutual Research Corporation.
- E. SCAQMD 1168 - South Coast Air Quality Management District Rule No.1168; www.aqmd.gov.
- F. UL (FRD) - Fire Resistance Directory; Underwriters Laboratories Inc..

1.4 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Schedule of Firestopping: List each type of penetration to be used, including manufacturer's data sheet indicating certifier/classifier assembly number and construction components.
- C. Product Data: Provide data on product characteristics.
- D. LEED Report: Submit VOC content documentation for all non-preformed materials.
- E. Certificate from authority having jurisdiction indicating approval of materials used.

1.5 QUALITY ASSURANCE

- A. Fire Testing: Provide firestopping assemblies of designs that provide the scheduled fire ratings when tested in accordance with methods indicated.
 - 1. Listing in the current-year classification or certification books of UL, FM, or ITS (Warnock Hersey) will be considered as constituting an acceptable test report.
 - 2. Valid evaluation report published by ICC Evaluation Service, Inc. (ICC-ES) at www.icc-es.org will be considered as constituting an acceptable test report.
 - 3. Submission of actual test reports is required for assemblies for which none of the above substantiation exists.

- B. Installer Qualifications: Company specializing in performing the work of this section and:
 - 1. Approved by Factory Mutual Research under FM Standard 4991, Approval of Firestop Contractors, or meeting any two of the following requirements:.
 - 2. With minimum 3 years documented experience installing work of this type.
 - 3. Able to show at least 5 satisfactorily completed projects of comparable size and type.
 - 4. Licensed by authority having jurisdiction.
 - 5. Approved and trained by firestopping manufacturers used on the Project.
- C. A copy of each Assembly Data sheet shall be kept in a 3-ring binder at the jobsite for reference by all parties.
- D. Installation of firestopping shall be performed by a single company responsible for all firestopping construction.

1.6 FIELD CONDITIONS

- A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation. Maintain minimum temperature before, during, and for 3 days after installation of materials.
- B. Provide ventilation in areas where solvent-cured materials are being installed.

1.7 PRECONSTRUCTION CONFERENCE

- A. A preconstruction conference shall be held prior to the installation of elements affected by the installation of fire stopping materials.
- B. Attendees shall include, but not be limited to:
 - 1. General Contractor.
 - 2. Architect/Engineer.
 - 3. Masonry subcontractor.
 - 4. Drywall subcontractor.
 - 5. Fire Stopping installer.
 - 6. Mechanical contractor.
 - 7. Plumbing contractor.
 - 8. Electrical contractor

PART 2 - PRODUCTS

2.1 FIRESTOPPING - GENERAL REQUIREMENTS

- A. Firestopping Materials with Volatile Content: Provide only products having lower volatile organic compound (VOC) content than required by South Coast Air Quality Management District Rule No.1168.
- B. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Type required for tested assembly design.

2.2 FIRESTOPPING SYSTEMS

- A. Firestopping: Any material meeting requirements.
1. Fire Ratings: Use any system listed by UL or tested in accordance with ASTM E814 that has F Rating equal to fire rating of penetrated assembly and minimum T Rating Equal to F Rating or indicated on the Drawings and that meets all other specified requirements.

2.3 MATERIALS

- A. Elastomeric Silicone Firestopping: Single component silicone elastomeric compound and compatible silicone sealant; conforming to the following:
1. Elongation: 600 percent.
 2. Adhesion and Bond To Substrate: 25 psi.
 3. Density: 1.37 grams/ml.
 4. Durability and Longevity: Permanent.
 5. Color: Black, dark gray, or red.
 6. Manufacturers:
 - a. 3M Fire Protection Products; Product Fire Barrier 2000: www.3m.com/firestop.
 - b. Hilti, Inc; Product CP 601/CP 606: www.us.hilti.com.
 - c. International Protective Coatings Corp.; Product FS 1900: www.international-pc.com.
 - d. Tremco; Product Fyre-Sil/Fyre-Sil SL: www.tremcosealants.com
 - e. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Foam Firestopping: Multiple component silicone foam compound; conforming to the following:
1. Density: 18 to 25 lb/cu ft.
 2. Durability and Longevity: Permanent.
 3. Manufacturers:
 - a. 3M Fire Protection Products; Product Fire Stop Foam 2001: www.3m.com/firestop.
 - b. Hilti, Inc; Product CP 620 Fire Foam: www.us.hilti.com.
 - c. Specified Technologies, Inc.; Product Pensil 200 Foam.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Fibered Compound Firestopping: Formulated compound mixed with incombustible non-asbestos fibers; conforming to the following:
1. Density: 6-8 lb/cu ft.
 2. Durability and Longevity: Permanent.
 3. Color: Black.
 4. Manufacturers:
 - a. A/D Fire Protection Systems Inc.
 - b. Hilti, Inc.; Product CP 637 Firestop Compound www.us.hilti.com.
 - c. USG Corporation.; Product Thermafiber "Firespan", "FSP" or "Dark Firespan" with required fire rating.
 - d. Tremco; Product Cerablanket F.S.: www.tremcosealants.com.
 - e. Substitutions: See Section 01 60 00 - Product Requirements.
- D. Fiber Firestopping: Mineral fiber insulation used in conjunction with elastomeric surface sealer forming airtight bond to opening; conforming to the following:
1. Durability and Longevity: Permanent.

2. Manufacturers:
 - a. A/D Fire Protection Systems Inc.
 - b. Hilti, Inc.; Product CP 677 Speed Plugs: www.us.hilti.com
 - c. Pecora Corp.
 - d. USG Corporation.
 - e. Substitutions: See Section 01 60 00 - Product Requirements.
- E. Firestop Devices: Mechanical device with incombustible filler and collar.
 1. Durability and Longevity: Permanent; suitable for pedestrian traffic.
 2. Manufacturers:
 - a. Hilti, Inc.; Product CP642/CP643 Firestop Collar: www.us.hilti.com.
 - b. International Protective Coatings Corp www.international-pc.com.
 - c. 3M Fire Protection Products: www.3m.com/firestop.
 - d. Specified Technologies, Inc.
 - e. Tremco; Product Tremstop WS, MCR (Master Collar Roll), Tremstop D, Tremstop Fyre-Can, Tremstop Fyre Can Sleeve: www.tremcosealants.com.
 - f. Substitutions: See Section 01 60 00 - Product Requirements.
- F. Intumescent Putty: Compound that expands on exposure to surface heat gain; conforming to the following:
 1. Potential Expansion: Minimum 1000 percent.
 2. Durability and Longevity: Permanent.
 3. Color: Black, dark gray, or red.
 4. Manufacturers:
 - a. 3M Fire Protection Products; Product Fire Barrier Moldable Putty: www.3m.com/firestop.
 - b. Hilti, Inc; Product CP618 Putty Stick/CP617 Putty Pad: www.us.hilti.com.
 - c. International Protective Coatings Corp. Product Flame-Safe FSP1000 Putty: www.international-pc.com.
 - d. Tremco; Product Tremstop MP: www.tremcosealants.com.
 - e. Substitutions: See Section 01 60 00 - Product Requirements.
- G. Firestop Pillows or Blocks: Removable and reusable intumescent pillows or blocks. Pillows shall consist of a glass-fiber cloth case filled with mineral fibers. Blocks shall be made of sponge-like polyurethane material.
 1. Density: 24.9 lb/cu ft plus/minus 6.33 pounds.
 2. Durability and Longevity: Permanent.
 3. Manufacturers:
 - a. Hilti, Inc; Product FS 657/CP 658 Fire Block/Plug: www.us.hilti.com.
 - b. Nelson Firestop Products.
 - c. Specified Technologies, Inc.
 - d. Tremco; Product Tremstop P.S. (Pillow System): www.tremcosealants.com.
 - e. Substitutions: See Section 01 60 00 - Product Requirements.
- H. Intumescent Firestop Sealant: Single component acrylic sealant conforming to the following:
 1. Density: 1.5 grams/ml.
 2. Durability & Longevity: Permanent.
 3. Color: Red.

4. Manufacturers:
 - a. Hilti, Inc.; Product CP 604 Self-Leveling Intumescent Firestop Sealant or FS-ONE intumescent firestop acrylic sealant: www.us.hilti.com.
 - b. 3M Fire Protection Products; Product Fire Barrier CP25 WB: www.3m.com.
 - c. Tremco; Product Tremstop WBM Intumescent Firestop Sealant www.tremcosealants.com.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
- I. Firestop Joint Spray: Single component elastomeric spray-on firestop sealant conforming to the following:
 1. Density: 9lb/gal.
 2. Durability and Longevity: Permanent.
 3. Color: Red.
 4. Manufacturers:
 - a. Hilti, Inc.; Product CP 672 Speed Spray; www.us.hilti.com.
 - b. 3M Fire Protection Products; Product Fire Dam Spray: www.3m.com.
 - c. Nelson FireStop Products; Product FSC Coating: www.nelsonfirestop.com.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
- J. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Type required for tested assembly design.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify openings are ready to receive the work of this section.

3.2 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter that could adversely affect bond of firestopping material.
- B. Remove incompatible materials that could adversely affect bond.
- C. Install backing materials to arrest liquid material leakage.

3.3 INSTALLATION

- A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.
- B. Do not cover installed firestopping until inspected by authority having jurisdiction.
- C. Install labeling at each penetration indicating certifier/classifier assembly number.

3.4 PROTECTION

- A. Protect adjacent surfaces from damage by material installation.

END OF SECTION

SECTION 07 90 05 - JOINT SEALERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Sealants and joint backing.

1.2 RELATED REQUIREMENTS

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 07 01 50 - Membrane Reroofing Preparation: Sealants required in conjunction with roofing.
- C. Section 07 62 00 - Sheet Metal Flashing and Trim.

1.3 REFERENCE STANDARDS

- A. ASTM C834 - Standard Specification for Latex Sealants.
- B. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications.
- C. ASTM C920 - Standard Specification for Elastomeric Joint Sealants.
- D. ASTM C1193 - Standard Guide for Use of Joint Sealants.
- E. ASTM D1667 - Standard Specification for Flexible Cellular Materials--Poly(Vinyl Chloride) Foam (Closed-Cell).
- F. SCAQMD 1168 - South Coast Air Quality Management District Rule No.1168; www.aqmd.gov.

1.4 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Provide data indicating sealant chemical characteristics.
- C. LEED Report: Submit VOC content documentation for all non-preformed sealants and primers.
- D. Caulking Schedule: The Contractor, together with the manufacturer's selected from those specified, shall prepare a detailed schedule of caulking and sealing work. For all conditions, the schedule shall indicated joint function; materials forming the joint together with cleaning, preparation, and backing requirements; priming requirements; sequence and timing of caulking and sealing operations showing maximum allowable time joints may be exposed before sealing, minimum and maximum allowable time intervals between successive steps in sealing operations, and governing weather conditions including temperature, humidity, wind, etc., and requirements for storage and preconditioning of materials.

1.5 QUALITY ASSURANCE

- A. Maintain one copy of each referenced document covering installation requirements on site.
- B. Applicator Qualifications: Company specializing in performing the work of this section with minimum three years experience.

1.6 FIELD CONDITIONS

- A. Maintain temperature and humidity recommended by the sealant manufacturer during and after installation. Install in dry weather or conditions favorable for curing.

1.7 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective work within a five year period after Date of Substantial Completion.
- C. Warranty: Include coverage for installed sealants and accessories which fail to achieve airtight seal, exhibit loss of adhesion or cohesion, or do not cure.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Silicone Sealants:
 - 1. Momentive Performance Materials, Inc (formerly GE Silicones); Product Silpruf: www.momentive.com.
 - 2. Pecora Corporation; 864NST Low Modulus Architectural Silicone Sealant - Class 50: www.pecora.com.
 - 3. BASF Construction Chemicals-Building Systems; Product Omni Seal: www.buildingsystems.basf.com.
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Acrylic Emulsion Latex Sealants:
 - 1. Pecora Corporation; AC-20 + Silicone Acrylic Latex Caulking Compound: www.pecora.com.
 - 2. BASF Construction Chemicals-Building Systems; Product Sonolac: www.buildingsystems.basf.com.
 - 3. Sherwin-Williams Company; 850A Acrylic Latex Caulk: www.sherwin-williams.com.

2.2 SEALANTS

- A. Sealants and Primers - General: Provide only products having lower volatile organic compound (VOC) content than required by South Coast Air Quality Management District Rule No.1168.
- B. Low Modulus Silicone Sealant: Neutral curing; ASTM C 920, Grade NS, Class 25, Uses N, T, G A, M and O; single component.
 - 1. Color: Match adjacent finished surfaces.
 - 2. Product: 864/890 manufactured by Pecora or approved equal.
- C. General Purpose Interior Sealant: Acrylic emulsion latex; ASTM C834, Type OP, Grade NF single component, paintable.
 - 1. Color: To be selected by Architect from manufacturer's full range.
 - 2. Applications: Use for:
 - a. Interior wall and ceiling control joints.
 - b. Joints between door and window frames and wall surfaces.
 - c. Other interior joints for which no other type of sealant is indicated.

- D. Acoustical Sealant for Concealed Locations: Permanently tacky non-hardening butyl sealant.
 - 1. Product: AC-20 FTR Acoustical and Insulation Sealant manufactured by Pecora Corp. or approved equal.
 - 2. Applications: Use for concealed locations only:
 - a. Sealant bead between top stud runner and structure and between bottom stud track and floor.

2.3 ACCESSORIES

- A. Primer: Non-staining type, recommended by sealant manufacturer to suit application.
- B. Joint Backing: Round foam rod compatible with sealant; ASTM D 1667, closed cell PVC; oversized 30 to 50 percent larger than joint width.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work.
- B. Verify that joint backing and release tapes are compatible with sealant.

3.2 PREPARATION

- A. Remove loose materials and foreign matter that could impair adhesion of sealant.
- B. Clean and prime joints in accordance with manufacturer's instructions.
- C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.
- D. Protect elements surrounding the work of this section from damage or disfigurement.

3.3 INSTALLATION

- A. Clean nonporous 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:
 - 1. Metal.
 - 2. Glass.
- B. Perform installation in accordance with ASTM C1193.
- C. Perform acoustical sealant application work in accordance with ASTM C919.
- D. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
- E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified 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 configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.
4. Provide flush joint configuration where indicated per Figure 5B in ASTM C 1193.
5. Provide recessed joint configuration of recess depth and at locations indicated per Figure 5C in ASTM C 1193.
 - a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

3.4 CLEANING

- A. Clean adjacent soiled surfaces.

3.5 PROTECTION

- A. Protect sealants until cured.

END OF SECTION

SECTION 08 11 13 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Non-fire-rated steel doors and frames.
- B. Steel frames for wood doors.
- C. Fire-rated steel doors and frames.
- D. Sound-rated steel doors and frames.
- E. Steel glazing frames.
- F. Accessories, including glazing.

1.2 RELATED REQUIREMENTS

- A. Section 08 14 16 - Flush Wood Doors.
- B. Section 08 71 00 - Door Hardware.
- C. Section 08 80 00 - Glazing: Glass for doors and frames.
- D. Section 09 90 00 - Painting and Coating: Field painting.

1.3 REFERENCE STANDARDS

- A. ANSI A250.8 - SDI-100 Recommended Specifications for Standard Steel Doors and Frames.
- B. ANSI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.
- C. BHMA A156.115 - Hardware Preparation in Steel Doors and Steel Frames.
- D. NAAMM HMMA 840 - Guide Specifications for Installation and Storage of Hollow Metal Doors and Frames; The National Association of Architectural Metal Manufacturers.
- E. NFPA 80 - Standard for Fire Doors and Other Opening Protectives.
- F. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; National Fire Protection Association.
- G. UL 10B - Standard for Fire Tests of Door Assemblies.

1.4 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced grade standard.
- C. Shop Drawings: Submit shop drawings of all items specified herein. Obtain approval of Drawings prior to proceeding with manufacturing. Shop drawings shall indicate following: elevations of each door type; details of each frame type, location in building for each item; conditions at openings with various wall thicknesses and materials; typical and special details of

construction; methods of assembling sections; location and installation requirements for hardware; size, shape and thickness of materials; anchorage; joints and connections; and any additional pertinent information.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store in accordance with NAAMM HMMA 840.
- B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Steel Doors and Frames:
 - 1. Ceco: www.assaabloydss.com.
 - 2. Curries: www.assaabloydss.com.
 - 3. Fleming: www.assaabloydss.com.
 - 4. Steelcraft: www.steelcraft.com.
 - 5. Substitutions: See Section 01 60 00 - Product Requirements.

2.2 DOORS AND FRAMES

- A. Requirements for All Doors and Frames:
 - 1. Interior doors and frames shall be constructed of commercial quality cold-rolled steel conforming to ASTM A 366 or commercial quality cold rolled steel conforming to ASTM A 924, hot dip galvanized to ASTM A 653, Commercial Steel (CS), coating designation A25, commercially known as Paintable Galvanneal.
 - 2. Finish: After appropriate metal preparation, all exposed surfaces of cold-rolled and galvanized steel doors and frames to receive a factory applied coat of primer. Galvanneal steel doors and frames shall receive zinc-rich primer touch-up only, at areas where galvanizing has been removed during fabrication.
 - 3. Hardware Preparation: In accordance with BHMA A156.115, with reinforcement welded in place, in addition to other requirements specified in door grade standard.
- B. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with all the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

2.3 STEEL DOORS

- A. Types and Gauges of Metal: Metal for doors shall be commercial quality, leveled, cold-rolled, steel sheets with clean, smooth surfaces. Metal shall be phosphate treated prior to painting. Gauges of face sheets shall be as specified for door types.
- B. Hardware Reinforcements: Doors shall be mortised, reinforced, drilled and tapped at factory for fully template hardware only, in accordance with approved HARDWARE SCHEDULE and templates provided by Hardware Contractor. Where surface mounted hardware is to be applied, doors shall have reinforcing plates only; all drilling and tapping shall be done by others.

- C. Edge Profiles:
1. Bevels shall be provided on lock stiles of doors as follows:
 2. Single acting swing doors - beveled 1/8 inch in 2 inches.
 3. Opposite swing double doors - beveled 1/8 inch in 2 inches.
- D. Clearances:
1. Between doors and frames; at head and jambs - 1/8 inch.
 2. At door sills, where no threshold is scheduled - 3/8 inch maximum.
 3. Between meeting stiles or pair of doors - 1/8 inch.
- E. Workmanship: Finish work shall be rigid, neat in appearance, and free from defects. Form moulded members straight and true, with joints coped or mitered, well formed, and in true alignment. All welded joints on exposed surfaces shall be dressed smooth so that they are invisible after finishing.
- F. Construction: In accordance with ANIS Standard specified herein and the following: Construct doors of two outer steel sheets not lighter than 18 gauge, with edges welded and finished flush. Seams or joints will not be permitted on door faces or edges. Reinforce the outer face sheets with 20 gauge interlocking vertical channels of Z-shaped members spaced not over 6 inches apart and spot welded to outer face sheets. Cap tops of exterior doors to prevent the accumulation of water.
- G. Reinforcement: Provide continuous reinforcing channels welded to face sheets at top and bottom of door. Place cork, fiberboard or mineral wool board in spaces between reinforcing channels.
- H. Mouldings: Mouldings shall be not lighter than 18 gauge steel. Doors shall be prepared to receive hardware specified under Hardware Section.
- I. Interior Doors, Non-Fire-Rated:
1. Grade: ANSI A250.8 Level 2, physical performance Level B, Model 2, seamless.
 2. Core: Cardboard honeycomb.
 3. Thickness: 1-3/4 inches.
 4. Texture: Smooth faces.
 5. Finish: Factory primed, for field finishing.
- J. Interior Doors, Fire-Rated:
1. Grade: ANSI A250.8 Level 1, physical performance Level C, Model 2, seamless.
 2. Fire Rating: As indicated on Door and Frame Schedule, tested in accordance with UL 10B or NFPA 252 ("neutral pressure").
 3. Core: Mineral fiberboard.
 4. Texture: Smooth faces.
 5. Finish: Factory primed, for field finishing.
- K. Interior Doors and Door Frames, Sound-Rated:
1. STC Rating of Assembled Door, Frame, and Seals: 55, calculated in accordance with ASTM E 413, tested in accordance with ASTM E 90 or ASTM E 1408.
 2. Texture: Smooth faces.
 3. Finish: Factory primed, for field finishing.
 4. Sound Seals: Integral, concealed in door or frame.
 5. Door Bottom: Manufacturer's standard for door rating specified.

6. Acoustic Door Frame: Manufacturer's standard, fully welded.
7. Provide Model No. 5592175 manufactured by Overly Door Company or approved equal.

2.4 STEEL FRAMES

A. General:

1. Frames, including window frames and glazing in door, shall be combination type with integral trim and fabricated with mitered and full-profile type construction.
2. Type and Gauges of Metal: Metal for interior frames shall be phosphate-treated prior to painting. Frames shall be fabricated from steel not lighter than the following gauges:
 - a. Interior frames: 16 gauge.
 - b. Interior frames over 4 feet: 14 gauge.
3. Metal Reinforcement: Provide concealed metal reinforcements for hardware as required. Gauge of metal for reinforcement shall be in accordance with manufacturer's recommendations for type of hardware and the thickness and width of doors to be hung in frame, provided gauges used are not lighter than following:
 - a. Hinge and pivot reinforcements (1-1/4 inch x 10 inch minimum size): 7 gauge
 - b. Strike reinforcements: 12 gauge
 - c. Flush bolt reinforcements: 12 gauge
 - d. Closer reinforcements: 12 gauge
 - e. Surface mounted hardware reinforcement: 12 gauge
4. Workmanship and Design: The finished work shall be strong and rigid, neat in appearance, and free from defects. Fabricate moulded members straight and true, with corner joints well formed and in true alignment, and with fastenings concealed where practicable.
5. Forming Corner Joints:
 - a. Corner joints shall have all contact joints tight with trim face mitered and full-profile welded and stops butted and welded on back.
6. Provisions for Hardware: Frames shall be prepared at the factory for the installation of hardware. Frames shall be mortised, reinforced, drilled and tapped to templates to receive all mortised hardware; frames to receive surface-applied hardware shall be provided with reinforcing plates only. Provide cover boxes in back of all hardware cutouts. Door frames shall be punched to receive rubber door silencers; provide three silencers on lock side of single doors and one silencer for each leaf in heads of double door frames.
7. Mullions and Transom Bars: Mullions and transom bars shall be closed, of tubular construction, and shall member with heads and jambs and be secured thereto. Use butt-welded joints. Reinforce the joints between members with concealed slip angles of the same thickness as frame. Provide adjustable floor anchors and spreader connections at bottom of mullions.
8. Wall Anchors:
 - a. Provide metal anchors of shapes and sizes required for the adjoining type of wall construction. Fabricate jamb anchors of steel, not lighter than the gauge used for frame. Locate anchors on jambs near the top and bottom of each frame and at intermediate points not over 24 inches apart.
 - b. For frames set in masonry: Provide 10 inches long, corrugated or other deformed type adjustable anchors at jambs.

- c. For frames set in metal stud partitions: Weld jamb anchor clips to back of frames at jambs. Make provisions for securing anchors to steel studs with 1/4 round-head self-tapping screws, or by welding.
 9. Floor Anchors: Provide floor clips of not less than 16-gauge steel and fasten to bottom of each jamb member for anchoring frame to floor construction. Clips shall be fixed and drilled for 3/8 inch diameter anchor bolts.
 10. Stops and Beads: Furnish 20-gauge metal glazing beads with the hollow metal frames. Beads shall be minimum 5/8 inch high. Drill and tap frames to receive the type of glazing beads, stops and gaskets required. Secure beads to frames with countersunk self-taping screws, spaced approximately 16 inches o.c. Beads having a moulded shape shall be mitered at corners; square or rectangular beads may be either mitered or butted at corners.
 11. Finish: Same as for door.
 12. Provide mortar guard boxes for hardware cut-outs in frames to be installed in masonry or to be grouted.
 13. Frames in Masonry Walls: Size to suit masonry coursing with head member 4 inches high to fill opening without cutting masonry units.
- B. Interior Door Frames, Non-Fire-Rated: Fully welded type.
- C. Interior Door Frames, Fire-Rated: Fully welded type.
1. Fire Rating: Same as door, labeled.
- D. Frames for Interior Glazing or Borrowed Lights: Construction and face dimensions to match door frames, and as indicated on drawings.

2.5 ACCESSORY MATERIALS

- A. Glazing: As specified in Section 08 80 00, factory installed.
- B. Grout for Frames: Portland cement grout of maximum 4-inch slump for hand troweling.
- C. Silencers: Resilient rubber, fitted into drilled hole; 3 on strike side of single door, 3 on center mullion of pairs, and 2 on head of pairs without center mullions.
- D. Temporary Frame Spreaders: Provide for all factory- or shop-assembled frames.

2.6 FINISH MATERIALS

- A. Primer: Rust-inhibiting, complying with ANSI A250.10, door manufacturer's standard.
- B. Bituminous Coating: Asphalt emulsion or other high-build, water-resistant, resilient coating.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.

3.2 PREPARATION

- A. Coat inside of frames to be installed in masonry or to be grouted, with bituminous coating, prior to installation.

3.3 INSTALLATION

- A. Install in accordance with the requirements of the specified door grade standard and NAAMM HMMA 840.
- B. In addition, install fire rated units in accordance with NFPA 80.
- C. Coordinate frame anchor placement with wall construction.
- D. Grout frames in masonry construction, using hand trowel methods; brace frames so that pressure of grout before setting will not deform frames.
- E. Coordinate installation of hardware.
- F. Coordinate installation of glazing.
- G. Coordinate installation of electrical connections to electrical hardware items.

3.4 TOLERANCES

- A. Clearances Between Door and Frame: As specified in ANSI A250.8.
- B. Squareness: +/- 1/16 inch measured at rabbet on a line 90 degrees from jamb perpendicular to frame head.
- C. Alignment: +/- 1/16 inch measured at jambs on a horizontal line parallel to the plane of the face.
- D. Twist: +/- 1/16 inch measured at opposite face corners of jambs on parallel lines, perpendicular to the plane of the door rabbet.

3.5 ADJUSTING

- A. Adjust for smooth and balanced door movement.

3.6 SCHEDULE - See Drawings

END OF SECTION

SECTION 08 14 16 - WOOD DOORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Wood doors; flush type, fire rated and non-rated.

1.2 RELATED REQUIREMENTS

- A. Section 08 11 13 - Hollow Metal Doors and Frames.
- B. Section 08 71 00 - Door Hardware.
- C. Section 08 80 00 - Glazing.

1.3 REFERENCE STANDARDS

- A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards.
- B. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; National Fire Protection Association.
- C. UL (BMD) - Building Materials Directory; Underwriters Laboratories Inc..
- D. UL 10B - Standard for Fire Tests of Door Assemblies.

1.4 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Indicate door core materials and construction; veneer species, type and characteristics.
- C. Shop Drawings: Show doors and frames, elevations, sizes, types, swings, undercuts, beveling, blocking for hardware, factory machining, factory finishing, cutouts for glazing and other details.
- D. Samples for Initial Selection: Color charts consisting of actual materials in small sections for the following:
 - 1. Faces of Factory-Finished Doors: Show the full range of colors available for stained finishes.
- E. Samples for Verification:
 - 1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches, 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 the finished work.
 - 2. Corner sections of doors, approximately 8 by 10 inches, with door faces and edgings representing typical range of color and grain for each species of veneer and solid lumber required. Finish sample with same materials proposed for factory-finished doors.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Package, deliver and store doors in accordance with specified quality standard.
- B. Accept doors on site in manufacturer's packaging. Inspect for damage.

- C. Protect doors with resilient packaging sealed with heat shrunk plastic. Do not store in damp or wet areas; or in areas where sunlight might bleach veneer. Seal top and bottom edges with tinted sealer if stored more than one week. Break seal on site to permit ventilation.

1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form, signed by manufacturer, Installer, and Contractor, in which manufacturer agrees to repair or replace doors that are defective in materials or workmanship, have warped (bow, cup, or twist) more than 1/4 inch in a 42 by 84 inch section, or show telegraphing of core construction in face veneers exceeding 0.01 inch in a 3 inch span.
 - 1. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
 - 2. Warranty shall be in effect during the following period of time from date of Project Acceptance:
 - a. Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Wood Veneer Faced Doors:
 - 1. Algoma: www.algomahardwoods.com.
 - 2. Eggers Industries: www.eggersindustries.com.
 - 3. Lambton Doors: www.lambtondoors.com.
 - 4. Marshfield DoorSystems, Inc: www.marshfielddoors.com. (Basis of Design)
 - 5. Oshkosh Door Company: www.oshkoshdoor.com
 - 6. VT Industries, Inc: www.vtindustries.com.
 - 7. Substitutions: See Section 01 60 00 - Product Requirements.

2.2 DOORS

- A. All Doors: See drawings for locations and additional requirements.
 - 1. Quality Level: Premium Grade with A grade veneer, in accordance with AWI/AWMAC/WI Architectural Woodwork Standards.
 - 2. Wood Veneer Faced Doors: 5-ply.
- B. Interior Doors: 1-3/4 inches thick unless otherwise indicated; flush construction.
 - 1. Provide solid core doors at all locations.
 - 2. Fire Rated Doors: Tested to ratings indicated on drawings in accordance with NFPA 252, UL 10B, or UBC Standard 7-2-94 ("neutral pressure"); UL labeled without any visible seals when door is open.

2.3 DOOR AND PANEL CORES

- A. Non-Rated Solid Core and 20 Minute Rated Doors: Type particleboard core (PC), plies and faces as indicated above. Binder shall contain no urea-formaldehyde resin.
- B. Fire Rated Doors: Mineral core, Type FD, plies and faces as indicated above; with core blocking as required to provide adequate anchorage of hardware without through-bolting.

2.4 DOOR FACINGS

- A. Wood Veneer Facing for Transparent Finish: Red oak, veneer grade as specified by quality standard, plain sliced, book veneer match, center balance assembly match; unless otherwise indicated.
 - 1. Vertical Edges: Same species as face veneer. Provide concealed intumescent edge seals at all fire-rated doors.
 - 2. Face veneer and crossband shall be pressed to the core in a hot-press with Type I waterproof glue.
 - 3. Pairs: Pair match each pair; set match pairs within 10 feet of each other when doors are closed.
 - 4. Room Match: Provide door faces of compatible color and grain within each separate room or area of building.

2.5 ACCESSORIES

- A. Wood Beads for Light Openings in Wood Doors: Provide manufacturer's standard wood beads as follows unless otherwise indicated.
 - 1. Wood Species: Same species as door faces.
 - 2. Profile: "VT" wood bead detail

2.6 DOOR CONSTRUCTION

- A. Fabricate doors in accordance with AWI Quality Standards, Section 1300 requirements.
- B. Cores Constructed with Stiles and Rails.
- C. Blocking: Provide wood blocking in particleboard-core doors as needed to eliminate through-bolting hardware.
 - 1. 5 inch top-rail blocking, in doors indicated to have closers.
 - 2. 5 inch bottom-rail blocking, in exterior doors and doors indicated to have kick, mop, or armor plates.
 - 3. 5 inch midrail blocking, in doors indicated to have exit devices.
- D. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.
- E. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.
- F. Provide edge clearances in accordance with the quality standard specified.

2.7 FACTORY FINISHING - WOOD VENEER DOORS

- A. Finish work in accordance with AWI/AWMAC/WI Architectural Woodwork Standards, Section 5 - Finishing for Grade specified and as follows:
 - 1. Transparent:
 - a. System - 11, Polyurethane, Catalyzed.
 - b. Stain: As selected by Architect to match existing door finish.
 - c. Sheen: Satin.
- B. Seal door top edge with color sealer to match door facing.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.
- C. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

3.2 INSTALLATION

- A. Install doors in accordance with manufacturer's instructions and specified quality standard.
 - 1. Install fire-rated doors in accordance with NFPA 80 requirements.
- B. Factory-Finished Doors: Do not field cut or trim; if fit or clearance is not correct, replace door.
- C. Clearances:
 - 1. Provide clearances of 1/8 inch at sides and top; lock edge shall have required bevel to clear frame. Provide at the bottom, for specific locations, the minimum adequate clearance of the finish floor coverings and/or thresholds, not to exceed 3/4 inch.
 - 2. Trim equal amounts of wood from each stile and rail when fitting doors.
- D. Use machine tools to cut or drill for hardware.
- E. Coordinate installation of doors with installation of frames and hardware.
- F. Coordinate installation of glazing.

3.3 TOLERANCES

- A. Conform to specified quality standard for fit and clearance tolerances.
- B. Conform to specified quality standard for telegraphing, warp, and squareness.

3.4 ADJUSTING

- A. Adjust doors for smooth and balanced door movement.
- B. Adjust closers for full closure.

3.5 SCHEDULE - See Drawings

END OF SECTION

SECTION 08 31 00 - ACCESS DOORS AND PANELS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Wall access door and frame units.
- B. Ceiling access door and frame units.

1.2 RELATED REQUIREMENTS

- A. Section 09 21 16 - Gypsum Board Assemblies: Openings in partitions.
- B. Section 09 21 16 - Gypsum Board Assemblies: Openings in ceilings.
- C. Section 09 90 00 - Painting and Coating: Field paint finish.

1.3 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Provide sizes, types, finishes, hardware, scheduled locations, and details of adjoining work.
- C. Shop Drawings: Indicate exact size and location of all access door units.
- D. Project Record Documents: Record actual locations of all access units.

PART 2 - PRODUCTS

2.1 ACCESS DOOR AND PANEL APPLICATIONS

- A. Walls, Unless Otherwise Indicated:
 - 1. Material: Stainless steel, Type 304.
 - 2. Size: 24 x 24 inches, minimum or as required to provide access to installation being accessed.
- B. Fire Rated Walls: See drawings for wall fire ratings.
 - 1. Material: Stainless steel, Type 304.
 - 2. Size: 24 x 24 inches, minimum or as required to provide access to installation being accessed.
- C. Ceilings, Unless Otherwise Indicated: Same type as for walls.
 - 1. Material: Steel or stainless steel Type 304 where indicated..
 - 2. Size: 24 x 24 inches, unless otherwise indicated.
 - 3. Standard duty, hinged door.
 - 4. Tool-operated cam lock.

2.2 CEILING UNITS

- A. Manufacturers:
 - 1. Acudor Products Inc: www.acudor.com.
 - 2. Karp Associates, Inc: www.karpinc.com.
 - 3. Milcor by Commercial Products Group of Hart & Cooley, Inc: www.milcorinc.com.
(Basis of Design)
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.

- B. Access Doors: Factory fabricated door and frame units, fully assembled units with corner joints welded, filled, and ground flush; square and without rack or warp; coordinate requirements with assemblies units are to be installed in.
 - 1. Style: Frame concealed by door panel.
 - a. In Gypsum Board: Use drywall bead type frame.
 - 2. Door Style: Single thickness with rolled or turned in edges.
 - 3. Frames: 16 gage, 0.0598 inch, minimum.
 - 4. Single Thickness Steel Door Panels: 0.070 inch, minimum.
 - 5. Gaskets: Provide all access doors with gaskets.
- C. Door and Frame Units: Formed steel or stainless steel as indicated.
 - 1. Units in Fire Rated Assemblies: Fire rating as required by applicable code for the fire rated assembly in which they are to be installed.
 - a. Provide products listed and labeled by UL or ITS (Warnock Hersey) as suitable for the purpose specified and indicated.
 - 2. Steel Finish: Primed.
 - 3. Stainless Steel Finish: No. 4 brushed finish.
 - 4. Hardware:
 - a. Hardware for Fire Rated Units: As required for listing.
 - b. Hinges for Non-Fire-Rated Units: Continuous piano hinge.
 - c. Latch/Lock: Screw driver slot for quarter turn cam latch. Locks and latches that can be opened without the use of a tool are not acceptable.
 - d. Gasketing: Extruded neoprene, around the perimeter of the door panel.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that rough openings are correctly sized and located.

3.2 INSTALLATION

- A. Install units in accordance with manufacturer's instructions.
- B. Install frames plumb and level in openings. Secure rigidly in place.
- C. Position units to provide convenient access to the concealed work requiring access.
- D. Orient access door(s) so that access door swing does not intersect with the swing of the room door. Coordinate access door location with all other doors.

3.3 ADJUSTING AND CLEANING

- 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

SECTION 08 7100

DOOR HARDWARE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.02 DESCRIPTION OF WORK

- A. Definition: "Finish Hardware" includes items known commercially as finish / security hardware and systems which are required for swing, sliding and folding doors, except special types of unique and non-matching hardware specified in the same section as the door and door frame.
- B. Extent of finish / security hardware required is indicated on drawings and in schedules.
- C. Types of finish hardware required include, but are not limited to, the following:
 - 1. Butt Hinges
 - 2. Continuous Hinges
 - 3. Lock cylinders and keys
 - 4. Lock and latch sets
 - 5. Exit devices
 - 6. Pull units/Custom Pulls
 - 7. Closers
 - 8. ADA Operators and actuators
 - 9. Door trim units
 - 10. Weatherstripping for exterior doors
 - 11. Protection plates
 - 12. Thresholds, Gaskets, and Door Bottoms
 - 13. Key Cabinet
 - 14. Electrified Hardware
 - 15. Coat Hooks at office doors
- D. References
 - 1. NFPA-80-2007 - Standard for Fire Doors and Windows
 - 2. NFPA-101-2003 - Life Safety Code
 - 3. NFPA - 70 - National Electric Code
 - 4. ADA - The Americans with Disabilities Act - Title III - Public Accommodations
 - 5. ANSI-A 117.1-American National Standards Institute - Accessible and Usable Buildings and Facilities
 - 6. ANSI-A156.5-American National Standards Institute - Auxiliary Locks and Associated Products
 - 7. International Building Code as Adopted
 - 8. Positive Pressure Testing UL10C & UBC7.2
 - 9. UL - Underwriters Laboratories
 - 10. WHI - Warnock Hersey International, Division of Inchscape Testing Services
 - 11. State, Local and Federal Codes, National Electrical Building Codes, including the Authority Having Jurisdiction

1.04 QUALITY ASSURANCE

- A. Manufacturer: Obtain each type of hardware (ie., lock sets / security equipment) from a single manufacturer, although several may be indicated as offering products complying with requirements.
- B. Supplier: A recognized architectural finish hardware supplier, with warehousing facilities, who has been furnishing hardware and installation in the project's vicinity for a period of not less than 4 years. The supplier shall be, or shall employ, a certified Architectural Hardware Consultant (AHC) who is available, at reasonable times during the course of the work, for consultation about project's hardware requirements, to the Owner, Architect and the Contractor. The certified architectural hardware consultant (AHC) shall prepare all hardware and wiring diagrams. This Supplier is responsible for proper coordination of all finished hardware with related sections to insure compatibility of products.
- C. Fire-Rated Openings: Provide hardware for fire-rated openings in compliance with NFPA Standard No. 80 and local building code requirements. Provide only hardware, which has been tested and listed by UL / WHI or FM for types and sizes of doors required and complies with requirements of door and door frame labels. Provide door seals to meet Positive Pressure Testing UL10C and UBC7 - 2 as required.
- D. Where emergency exit devices are required on fire-rated doors (with supplementary marking on doors' UL or FM labels indicating "Fire Door to be Equipped with Fire Exit Hardware") provide UL / WHI or FM label on exit devices indicating "Fire Exit Hardware".
- E. Thru bolt door closers and exit devices. Verify and coordinate proper blocking if provided from the door manufacturer for hardware attachment on doors.
- F. Unless otherwise specified, provide lever handle locksets ADA compliant.
- G. Pre-Installation Meeting: The Contractor shall initiate and conduct a jobsite meeting with the hardware supplier and the Installer, and all related trades for mechanical and electrical hardware. This meeting shall convene at least one month prior to commencement of the related work, specifically, the electrical rough-in for coordination of electrified hardware applications. All approved shop drawings, wiring diagrams, and schedules shall be made available to all related trades as required for work to be performed. The Owner's representative shall attend all pre-install meetings. In addition to reviewing and coordination, the hardware supplier shall, with the assistance of the manufacturer's representative, provide review/training to the Installers of the following products prior to installation of these products: closers, exit devices, locks, and electrified hardware.

1.05 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data for each item of hardware in accordance with Division-1 section "Submittals". Include whatever information may be necessary to show compliance with requirements, and include instructions for installation and for maintenance of operating parts and finish.

- B. Hardware Schedule: Submit copies of the schedule in accordance with Division 1 - "Submittals", General Requirements. Schedule shall be in vertical format, listing each door opening, including: handing, all hardware scheduled for the opening or otherwise required to allow for proper function of door openings as intended, and the finish of the hardware. At doors with door closers or door controls, include degree of door opening. If requested, all submittals (schedules, cut sheets, diagrams) shall be reviewed by the Owner's representative prior to ordering the material. Submit the schedules and all templates within two (2) weeks from date purchase order is received by the door openings supplier. Furnish wiring diagrams (elevation, riser, and point-to-point) for all electrified hardware.
1. Final Hardware Schedule Content: Based on finish hardware indicated, organize hardware schedule into a vertical format with "hardware sets" indicating complete designations of every item required for each door or opening. Include the following information:
 - a. Type, style, function, size and finish of each hardware item.
 - b. Name and manufacturer of each item.
 - c. Fastenings and other pertinent information.
 - d. Maintain the same Set/Heading numbering from Part 3 of this section, or reference to the Spec Set number in the Heading.
 - e. Reference door numbers from the door/frame schedule in the plan set.
 - f. Explanation of all abbreviations, symbols, codes, etc., contained in schedule.
 - g. Mounting locations for hardware.
 - h. Door and frame sizes and materials.
 - i. Keying information as available.
- C. Submittal Sequence: Submit hardware schedule and wiring diagrams according to the GC's established project schedule, particularly where acceptance of hardware schedule must precede fabrication of other work (e.g., hollow metal frames), and electrical rough-in, which is critical in the project construction schedule. Include with schedule the product data, catalog cuts, samples, templates, shop drawings of other work affected by finish hardware, and other information essential to the coordinated review of hardware schedule.
- D. Keying Schedule: Submit separate detailed schedule after meeting with the Owner to determine the Owner's instructions for keying.
- E. Samples if Requested: Prior to submittal of the final hardware schedule and prior to final ordering of finish hardware, submit any requested samples of type of exposed hardware unit, finished as required, and tagged with full description for coordination with schedule.
- F. Templates: Furnish hardware templates to each fabricator of doors, frames and other work to be factory-prepared for the installation of hardware. Upon request, check shop drawings of such other work, to confirm that adequate provisions are made for proper location, coordination and installation of hardware.
- G. Manufacturer's Catalog Cuts: Submit manufacturer's cut/catalog sheets on all hardware items and any required special mounting instructions with the hardware schedule.
- H. Wiring Diagrams: Provide complete wiring diagrams for each opening requiring electrified hardware. Provide a copy with each hardware schedule submitted after approval. Supply a copy with delivery of hardware to job site and another copy to the Owner at time of job completion. All electrical components shall be listed by opening in the hardware submittals. Include an operational description with each diagram.
- I. Operational Descriptions: Provide a complete operational description of the specified electrified hardware components for each opening, and include the description under the hardware set/heading in the hardware submittal. Operational descriptions shall detail how each electrified component functions within the opening, incorporating all conditions of ingress and egress. Review these descriptions with all related trades at the Pre-Install meetings.

- J. Elevation Drawings: Provide elevation drawings of electronic hardware and systems identifying locations of the system components with respect to their placement in the door opening. Provide a copy with each hardware schedule submitted for approval. Supply another copy to the Owner upon project completion. Include an operational description with each drawing.

1.06 PRODUCT HANDLING

- A. Tag each item or package separately, with identification related to final hardware schedule, and include basic installation instructions with each item or package.
- B. Inventory hardware jointly with the General Contractor, representatives of hardware supplier / hardware installer until each is satisfied that count is correct.
- C. Deliver individually packaged hardware items at the proper times to the proper locations (shop or project site) for installation.
- D. The General Contractor shall provide secure lock-up for hardware and security equipment delivered to the project, but not yet installed. Control handling and installation of hardware items, which are not immediately replaceable, so that completion of the work will not be delayed by hardware losses, both before and after installation.

1.07 SEQUENCING AND SCHEDULING

- A. Deliver all finish hardware to the job site in a timely manner so not to delay progress of other trades.

1.08 WARRANTY

- A. All Door closer shall include a ten (10) year manufacturers' warranty against defects in materials and workmanship.
- B. Exit Devices shall include a three (3) year warranty. ADA operators shall include a two (2) year warranty.
- C. Hinges:
 - 1. Life of Building.
 - 2. Electrified Hardware: one (1) year
 - 3. Other Hardware: two (2) years.

PART 2 - PRODUCTS

2.01 SCHEDULED HARDWARE

- A. Requirements for design, grade, function, finish, size and other distinctive qualities of each type of finish hardware is indicated in the Finish Hardware Data Sheet and Hardware Schedule at the end of this section. Products are identified by using hardware designation numbers of the following:

- B. Manufacturers:

Hardware Item:	Specified Manufacturer	Designation
1. Butts:	Ives	IVE
2. Continuous Hinges	Ives	IVE
3. Locksets:	Schlage	SCH
4. Cylinders/Cores	Best	BES
5. Silencers:	Ives	IVE
6. Stops:	Ives	IVE
7. Overhead Stops	Glynn-Johnson	GLY
8. Closers:	Norton	NOR
9. Thresholds:	Zero	ZER
10. Gasket/Door Bottoms:	Zero	ZER
11. Kickplates:	Ives	IVE

12. Pull/Push Plates:	Ives	IVE
13. -----		
14. Exit Devices:	Von Duprin	VON
15. Flush Bolts:	Ives	IVE
16. Automatic Flush Bolts:	Ives	IVE
17. Magnetic Holders:	LCN	LCN
18. Miscellaneous Hardware:	Ives, Glynn-Johnson	IVE/GLY
19. Key Control:	Not Required	
20. Monitor Strikes; Electric Strikes	Von Duprin	VON
21. Power Supplies Power Transfers	Von Duprin	VON
22. Door Position Switch; Request To Exit Switch	Schlage Electronics	SCE
23. Magnetic Lock	SCE	SCE

- C. Provide products as hereafter specified. Substitutions other than those manufacturers listed , must be approved, in writing, via addenda, prior to bid. Procedure for substitutions shall be as outlined in Division 1. No substitutions will considered after award of contract.

2.02 MATERIALS AND FABRICATION

A. General:

1. Hand of door: Drawings show direction of slide, swing or hand of each door leaf. Furnish each item of hardware for proper installation and operation of door movement as shown.
2. Manufacturer's Name Plate: Do not use manufacturer's products which have manufacturer's name or trade name displayed in a visible location (omit removable nameplates), except in conjunction with required UL labels and as otherwise acceptable to Architect.
3. Manufacturer's identification will be permitted on rim of lock cylinders only.
4. Finishes:
 - a. 626/652 for all finished metal hardware items except as 630 is otherwise indicated. Door closers to be powder coated to match 652/626. Exit devices shall be US26D with stainless steel touchbars.
5. Fasteners: Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation. Do not provide hardware, which has been prepared for self-tapping sheet metal screws, except, as specifically indicated.
6. Furnish screws for installation, with each hardware item. Provide Phillips flat-head screws except as otherwise indicated. Finish exposed (exposed under any condition) screws to match hardware finish or, if exposed in surfaces of other work, to match finish of such other work as closely as possible, including "prepared for paint" in surfaces to receive painted finish.
7. Provide concealed fasteners for hardware units which are exposed when door is closed, except to extent no standard units of type specified are available with concealed fasteners. Use thru-bolts for closer and exit devices. Coordinate wood door blocking at all wood doors and all fire-rated wood doors. Provide sleeves for each thru-bolt or use sex screw fasteners.
8. Tools and Maintenance Instructions for Maintenance: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of finish hardware.

2.03 HINGES AND BUTTS

- A. Templates: Except for hinges and pivots to be installed entirely (both leaves) into wood doors and frames, provide only template-produced units.

- B. Screws: Furnish Phillips flat-head or machine screws for installation of units, except furnish Phillips flat-head or wood screws for installation of units into wood. Finish screw heads to match surface of hinges or pivots.
- C. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:
 - 1. Steel Hinges: Steel pins.
 - 2. Non-ferrous Hinges: Stainless steel pins.
 - 3. Exterior Doors: Non-removable pins.
 - 4. Out-swing Corridor Doors: Non-removable pins.
 - 5. Interior Doors: Non-rising pins.
 - 6. Tips: Flat button and matching plug, finished to match leaves.
 - 7. Number of hinges: Provide number of hinges indicated but not less than 3 hinges for door leaf for doors 90" or less in height and one additional hinge for each 30" of additional height.
 - 8. Acceptable Manufacturers:
 - a. Ives 5BB1/5BB1HW.
 - b. Hager: BB1279/BB1191/BB1168/BB1199.
 - c. Bommer: BB5000/BB5002/BB5004/BB5006.
- D. Continuous Hinges: Provide concealed, non-handed, full height hinges with interlocking cover and symmetrically template hole pattern made from extruded aluminum. Finish shall be BHMA 628. minutes). Field modifications for cutting shall be permitted up to 6" from the bottom.
 - 1. Acceptable Manufacturers:
 - a. Ives: 700.
 - b. Select: SL300.
 - c. Markar: FM300.

2.04 LOCK CYLINDERS AND KEYING

- A. General: Supplier will meet with Owner to finalize keying requirements and obtain final instructions in writing. Allow for a minimum size system as a Grand Master Key System.
- B. Review the keying system with the Owner and provide the type required (master, grandmaster or great-grandmaster).
- C. Equip locks and cylinders as 7-pin with construction cores as specified. All cylinders shall accept Best keyed permanent cores. The Owner shall furnish the keyed Best cores and keys. The Owner shall install all permanent keyed cores.
- D. The Hardware Supplier shall furnish temporary construction keyed cores for the construction period of the project. Construction cores shall not be furnished as part of the Owner's existing key system, and shall remain the property of Hardware Supplier. All construction cores and keys shall be returned to the Hardware Supplier at the project completion. Furnish five(5) Construction Keys and one (1) control key for the General Contractor's use during project construction.
- E. Equip locks with cylinders that comply with performance requirements for Grade 1 cylinders as listed in ANSI A156, and are UL-listed.

2.05 LOCKS, LATCHES AND BOLTS

- A. Locksets shall be as specified: Mortise lockset shall be Series 1000 ,Grade 1 Operational and Security, UL Listed for 3-hour fire door. Strikes: Provide manufacturer's standard wrought box strike for each latch or lock bolt, with ANSI curved lip extended to protect frame, finished to match hardware set. Where specified, provide a replaceable breakaway spindle mechanism residing inside the lock chassis. The lock case shall be full wrapped heavy gauge steel with all metal zinc dichromate plated working parts. Lock case shall be universal function type and allow for field reversible handing without opening the lock case. Lever rotation shall be in both directions for ease of use, and allow for independent lever rotation.
 - 1. Acceptable Manufacturers:
 - a. Schlage L9000 series.
 - b. Best 45H series.
 - c. Corbin-Russwin ML series.
 - d. Yale 8800 series.
- B. Provide dust-proof strikes for foot bolts, except where special threshold construction provides non-recessed strike for bolt.
- C. Lock Throw: Provide solid stainless steel 1 ½" deadbolt with 1" minimum throw. Comply with UL requirements for throw of bolts and latch bolts on rated fire openings.
- D. Provide ¾" minimum throw on latch bolts.
- E. Flush Bolt Heads: Minimum of ½" diameter rods of brass, bronze or stainless steel, with minimum 12" long rod for doors up to 7'-0" in height. Provide longer rods as necessary for doors exceeding 7'-0" in height.
- F. Exit Device Dogging: Except on fire-rated doors, wherever closers are provided on doors equipped with exit devices, equip the units with keyed dogging device to hold the push bar down and the latch bolt in the open position.

2.06 PULLS/ PUSH PLATES

- A. Exposed Fasteners: Provide manufacturer's standard exposed fasteners for installation; through-bolted for matched pairs, but not for single units. Furnish type and size as specified in Hardware Sets.
- B. Acceptable Manufactures
 - 1. Rockwood
 - 2. Ives
 - 3. Trimco
 - 4. Forms & Surfaces

2.07 CLOSERS AND DOOR CONTROL DEVICES

- A. Size of Units: Except as otherwise specifically indicated, comply with the manufacturer's recommendations for size of door control unit, depending upon size of door, exposure to weather and anticipated frequency of use.

- B. Closers: All door closers shall be of one manufacturer to provide for proper installation and servicing after installation. All closers shall be inspected after installation by a factory representative to ensure proper adjustment and operation. A report shall be filed with the architect after said visit has been made. Closer shall carry a manufacturer's TEN YEAR WARRANTY for hydraulic units and 2-year warranty for electrical and/or handicap power assist door closers against manufacturing defects and workmanship. PRV [pressure relief valves] are not acceptable.
- C. Parallel Arm Closers: Shall incorporate one piece solid forged steel arms with bronze bushings. 1-9/16" x 1/2" steel stud shoulder bolts, shall be incorporated in regular arms, hold open arms, arms with stop built in, arms with hold open and stop built in. All other closers to have forged steel main arms for strength, and durability.
- D. Built-In Stops: Where closers with built-in positive stops are used, the stops shall be of one piece cast malleable iron material with built in springs. Where required, the hold-open assembly handle for these stops shall rotate on ball bearings.
- E. All door closers shall pass UL10C positive pressure fire test.
- F. Non-sized: All exterior closers shall be non-sized to provide a full range of Size 1 to 5 closing power, and shall be handed.
- G. Hydraulic Fluid: All closers, with the exception of interior electronic closers, shall utilize temperature stable fluid capable of withstanding temperature ranges of 120 degrees F. to -30F. without requiring seasonal adjustment of closer speed to properly close the door. Fluid shall be nonflammable.
- H. All closers shall have a powder coat finish on closer body, arm, cover and adapter plate. Furnish special rust inhibiting pretreat coating, as specified, for closer body, arm, cover and plates before the powder coat finish.
- I. Provide all drop plates, shoe supports, templates, etc. to properly mount closers according to manufacturers' recommendations.
- J. Acceptable Closer Manufacturers:
 - 1. Norton 7500 series.
 - 2. Corbin-Russwin DC6200/6210 series.
 - 3. LCN 4111/4011.

2.08 EXIT DEVICES

- A. General: All devices shall be of one manufacturer to provide for proper installation and servicing. Devices shall be furnished non-handed and capable of direct field conversion for all available trim functions. All devices shall carry a three year warranty against manufacturing defects and workmanship. All devices shall be push-through touch pad design as specified. No exposed touch bar fasteners, no exposed cavities when operated.
- B. Furnish all touch-pad type devices with stainless steel touch bars. Plastic parts are not acceptable. Dogging mechanism shall be mechanical hook type with no plastic dogging cams.
- C. Furnish all touch-pad type exit devices with deadlocking latch bolts. Latchbolts shall be moly-coated to reduce friction against the strike.
- D. Furnish all touch-pad exit devices with heavy duty metal alloy construction, with horizontal adjustment to provide flush alignment with the device cover plate. End caps shall be flush with device housing with no raised edges.
- E. Furnish roller strikes with all rim exit devices.

- F. Furnish stabilizers similar to Von Duprin 154 with all removable mullions.
- G. Outside Trim: Shall be heavy duty type and fastened by means of concealed welded lugs and thru-bolts from the inside. Trim shall be forged brass with a minimum average thickness on the escutcheon of .130. Plate with trim shall be brass with minimum average thickness of .090 and have forged pulls. Where Lever Handles are specified provide 996 type Break Away Trim. Where outside trim is specified, furnish trim that thru-bolts directly to the exit device center case.
- H. Furnish cylinders with all lockable exit devices.
- I. Furnish required filler plates and shim kits for flush mounting of exit devices on all doors requiring same.
- J. Springs: Compression type only. Torsion springs are not acceptable.
- K. Electrified Functions: Electric Latch Retraction shall be provided with a continuous duty solenoid, retracting the latch bolt for momentary latch retraction, or may be held retracted for extended periods of time. Electric operated trim device shall be furnished as Fail-Safe. When the power is off, the trim is unlocked for free entry. The trim may then be relocked electrically by applying power.
- L. All exit devices shall be Von Duprin 98 series as specified in the hardware sets.

2.09 DOOR TRIM UNITS

- A. Fasteners: Provide manufacturer's standard exposed fasteners for door trim units (kick plates, edge trim, viewers, knockers, mail drops and similar units); either machine screws or self-tapping screws.
- B. Fabricate edge trim of stainless steel, not more than 1/2" nor less than 1/16" smaller in length than door dimension.
- C. Fabricate protection plates (armor, kick or mop) not more than 2" less than door width on stop side and not more than 1" less than door width on pull side, x the height indicated.
- D. Metal Plates: Stainless steel, .050" (U.S. 18 ga.), bevel 3 edges: top and both sides.

2.10 GASKETS, DOOR BOTTOMS

- A. General: Except as otherwise indicated, provide continuous weatherstripping at each edge of every exterior door leaf, except where stated the door manufacturer will provide the weatherstripping. Provide type, sizes and profiles shown or scheduled. Provide non-corrosive fasteners as recommended by manufacturer for application indicated. All gaskets for fire label doors shall comply the door manufacturers label approvals. Fire-label wood doors shall be furnished as "Category A" type with the intumescent seal, integral to the door construction.

2.11 THRESHOLDS

- A. General: Except as otherwise indicated provide standard aluminum threshold unit of type, size and profile as shown or scheduled.
- B. Provide thresholds that are 1" wider than depth of frame.
- C. Provide thresholds with return closed ends where specified in Hardware Sets.

2.12 DOOR SILENCERS

- A. All hollow metal frames shall have gray resilient type silencers. Quantity (3) on single doors and quantity (2) on pair of doors.

2.13 ELECTRIFIED HARDWARE

- A. Where scheduled, supply electrified function as specified. Electric exit devices shall be

furnished with electric latch retraction feature or electrified locking for outside trim. All electric devices shall be free egress at all times. The Access Control System, furnished by the Owner's Security Integrator, shall allow for credentials, cardreaders, monitoring, alarms, and client software. All wiring, junction boxes, and final connections for electrified hardware shall be furnished and installed by the electrical contractor.

- B. Electrically operated locking devices shall be connected to the building fire and smoke/heat alarm systems as required for the specified function. Activation of alarm system shall disengage electric locking mechanism, allowing free, unrestricted egress through opening.
- C. Coordinate installation of electrically operated hardware to insure proper size wire is used to power load (s).
 - 1. Voltage drop shall not exceed 5% of load's stated voltage.
 - 2. Wire length shall equal distance to load and back to supply (lock @ 50ft from power supply; wire length = 100 ft.) Two loads powered by on pair of wires draw double current and have half (50%) of resistance.

Wire Size	Resistance Per 1,000 Feet
12 Gauge	1.6 OHM
14 Gauge	2.5 OHM
16 Gauge	4.1 OHM
18 Gauge	6.4 OHM
20 Gauge	10.1 OHM
22 Gauge	16.0 OHM

- D. Furnish electrically operated hardware with power supply units, junction boxes, and other accessories needed for a complete, efficient installation. Coordinate electrified hardware requirements with all related trades at the Pre-Installation meeting, prior to project electrical rough-in.
- E. Components Specified
 - 1. Power Transfers: Furnish type recessed into the door and frame to allow electrical power to pass from door to frame without the use of door cords or butt type transfer hinges for electric latch retraction function. Furnish manufacturer's back box of zinc dichromated treated steel , both power transfer and thru-wire butt hinge. Back boxes shall be provided to the hollow metal frame manufacture for installation on the frame prior to frame shipped to jobsite.
 - 2. Electric Butt Hinge:
Electric Butt hinges shall comply with requirements for size, quantity, type, tcs., as set forth for non-electric butt hinges. Provide the number of electrified hinges as required for the opening, as close to the load to receive power. Electric hinges shall have a motar box fastened to the frame prior to installing the frame in the wall. Electric hinge shall permit passage of a constant flow of current from the jamb to door, regardless of door position. Provide the number of wires needed by the electro-mechanicl hardware it supports, plus two additional wires for future consideration. Continuous circuit hinge to have wires concealed with 12" lead.
 - 3. Power Supply: Power Supply shall be tested and certified to meet UL294. Furnish type required for the specified electrical function. Power supply shall have a constant output rating at both 12v and 24v settings. Furnish as universal 120VAC to 240VAC input, and include polarized option board connectors. The fire alarm interface board shall allow outputs to be configured as switched (power cut) or unswitched (power continues) when a signal is provided.
 - 4. Door Position Switch: Furnish concealed type in frame and door.
 - 5. Electro-Magnetic Lock: ANSI/BHMA A156.23. Electro-magnetic locks shall conform to

highest classification and allow for both lateral and vertical field adjustment. Locks uses on labeled fire door assemblies shall be listed or labeled by a nationally recognized independent testing laboratory. Locks shall be dual voltage electro-magnets. Operation shall be fail safe, functioning with access control and fire alarm system. Locks shall be surface mounted. Locks shall be equipped with concealed sensors to monitor lock status and door status where needed to interface with the access control system. Provide all mounting accessories as required for the frame and door application, including filler plates, angle brackets as needed for proper installation with hollow metal, wood door and frame assemblies.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Mount hardware units at heights indicated in "Recommended Locations for Builders Hardware for Standard Steel Doors and Frames" by the Door and Hardware Institute, except as specifically indicated or required to comply with governing regulations, and except as may be otherwise directed by Architect.
- B. Install each hardware item in compliance with the manufacturer's instructions and recommendations. Wherever cutting and fitting is required to install hardware onto or into surfaces, which are later to be painted or finished in another way, coordinate removal, storage and reinstallation or application of surface protections with finishing work specified in the Division-9 sections. Do not install surface-mounted items until finishes have been completed on the substrate.
- C. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.
- D. Drill and countersink units, which are not factory-prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.
- E. Set thresholds for exterior doors in full bed of butyl-rubber or polyisobutylene mastic sealant.
- F. Adjust and reinforce attachment substrate for proper installation and operation:
 - 1. Gaskets: install jamb-applied gaskets before closers, overhead stops, rim strikes, etc.
- G. Locate floor stops not more than 4 inches from the wall.
- H. Verify actual locations of wiring connections before electrified door hardware is installed.
- I. Examine doors and frames with the hardware installer for compliance with requirements for installation tolerances, labeled fire door assembly, wall and floor construction, and other conditions affecting door performance.

3.02 ADJUST AND CLEAN

- A. Adjust and check each operating item of hardware and each door, to ensure proper operation or function of every unit. Replace units, which cannot be adjusted to operate freely and smoothly as intended for the application made.
- B. Clean adjacent surfaces soiled by hardware installation.
- C. Final Adjustment: Wherever hardware installation is made more than one month prior to acceptance or occupancy of a space or area, return to the work during the week prior to acceptance or occupancy, and make final check and adjustment of all hardware items in such space or area. Clean operating items as necessary to restore proper function and finish of hardware and doors. Adjust door control devices to compensate for final operation of heating and ventilating equipment.
- D. Instruct Owner's Personnel in proper adjustment and maintenance of hardware and hardware

finishes, during the final adjustment of hardware.

- E. Continued Maintenance Service: Approximately six months after the acceptance of hardware in each area, the Installer, accompanied by the representative[s] of the Finish Hardware manufacturer[s], shall return to the project and re-adjust every item of hardware to restore proper function of doors and hardware. Consult with and instruct Owner's personnel in recommended additions to the maintenance procedures. Replace hardware items, which have deteriorated or failed due to faulty design, materials or installation of hardware units. Prepare a written report of any current or predictable problems (of substantial nature) in the performance of the hardware and furnish copy to Owners Agent / Representative.

3.02 SCHEDULE

HARDWARE GROUP NO. 01

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	CLASSROOM LOCK	L9070BD 03A	626	SCH
1	EA	PERMANENT CORE	OWNER SUPPLIED	626	SCH
1	EA	CLOSER	7500 REG ARM X TB	689	NOR
1	EA	KICK PLATE	8400 8" X 2" LDW	630	IVE
1	EA	WALL STOP	WS406CCV	630	IVE
3	EA	SILENCER	SR64-1	GRY	IVE

HARDWARE GROUP NO. 02

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	L9080BD 03A	626	SCH
1	EA	PERMANENT CORE	OWNER SUPPLIED	626	SCH
1	EA	CLOSER	7500 REG ARM X TB	689	NOR
1	EA	KICK PLATE	8400 8" X 2" LDW	630	IVE
1	EA	FLOOR STOP	FS436	626	IVE

3	EA	SILENCER	SR64-1	GRY	IVE
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HARDWARE GROUP NO. 03

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	L9080BD 03A	626	SCH
1	EA	PERMANENT CORE	OWNER SUPPLIED	626	SCH
1	EA	CLOSER	7500 REG ARM X TB	689	NOR
1	EA	KICK PLATE	8400 8" X 2" LDW	630	IVE
1	SET	SEAL	188S	CL	ZER
3	EA	SILENCER	SR64-1	GRY	IVE

HARDWARE GROUP NO. 05

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	L9080BD 03A	626	SCH
1	EA	PERMANENT CORE	OWNER SUPPLIED	626	SCH
1	EA	CLOSER	7500 REG ARM X DEL ACTION X TB	689	NOR
1	EA	KICK PLATE	8400 8" X 2" LDW	630	IVE
1	EA	WALL STOP	WS406CCV	630	IVE
1	SET	SEAL	188S	CL	ZER
3	EA	SILENCER	SR64-1	GRY	IVE

HARDWARE GROUP NO. 06

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	CLASSROOM LOCK	L9070BD 03A	626	SCH
1	EA	PERMANENT CORE	OWNER SUPPLIED	626	SCH
1	EA	WALL STOP	WS406CCV	630	IVE
1	EA	COAT AND HAT HOOK	582	626	IVE
3	EA	SILENCER	SR64-1	GRY	IVE

COAT HOOK NOT REQUIRED AT CONFERENCE ROOM DOORS.

HARDWARE GROUP NO. 07

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

3	EA	HW HINGE	5BB1HW 5 X 4.5	652	IVE
1	EA	PASSAGE SET	L9010 03A	626	SCH
1	EA	WALL STOP	WS406CCV	630	IVE
1	SET	SEAL	188S	CL	ZER
1	EA	DOOR SWEEP	8191AA	CL	ZER
3	EA	SILENCER	SR64-1	GRY	IVE

HARDWARE GROUP NO. 08

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	CLASSROOM LOCK	L9070BD 03A	626	SCH
1	EA	PERMANENT CORE	OWNER SUPPLIED	626	SCH

1	EA	CLOSER	7500 REG/PA ARM X TB	689	NOR
1	EA	KICK PLATE	8400 8" X 2" LDW	630	IVE
3	EA	SILENCER	SR64-1	GRY	IVE

HARDWARE GROUP NO. 09

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	PUSH/PULL LATCH	HL6 E5 9070 2 3/4" A SFIC CYLINDER X CONSTR CORE. OWNER SUPPLIED PERMANENT CORE.	US32D- AM	GLY
1	EA	CLOSER	7500 PA DEL TB	689	NOR
1	EA	ARMOR PLATE	8400 34" X 2" LDW	630	IVE
3	EA	SILENCER	SR64-1	GRY	IVE

HARDWARE GROUP NO. 10

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

3	EA	HW HINGE	5BB1HW 5 X 4.5	652	IVE
1	EA	PUSH/PULL LATCH	HL6 E5 9070 2 3/4" A SFIC CYLINDER X CONSTR CORE. OWNER SUPPLIED PERMANENT CORE.	US32D- AM	GLY
1	EA	CLOSER	7500 PA DEL TB	689	NOR
1	EA	ARMOR PLATE	8400 34" X 2" LDW	630	IVE
1	EA	WALL STOP	WS406CCV	630	IVE
3	EA	SILENCER	SR64-1	GRY	IVE

DELETE WALL STOP @ DR# 325A.

HARDWARE GROUP NO. 11

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PUSH/PULL LATCH	HL6 E5 9070 2 3/4" A SFIC CYLINDER X CONSTR CORE. OWNER SUPPLIED PERMANENT CORE.	US32D- AM	GLY
1	EA	CLOSER	7500 CLP X DEL X TB	689	NOR
1	EA	ARMOR PLATE	8400 34" X 2" LDW	630	IVE
1	EA	MOP PLATE	8400 4" X 1" LDW	630	IVE
3	EA	SILENCER	SR64-1	GRY	IVE

HARDWARE GROUP NO. 12

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	CLASSROOM LOCK	L9070BD 03A	626	SCH
1	EA	PERMANENT CORE	OWNER SUPPLIED	626	SCH
1	EA	CLOSER	7500 REG ARM TB	689	NOR
1	EA	KICK PLATE	8400 8" X 2" LDW	630	IVE
1	EA	WALL STOP	WS406CCV	630	IVE
1	SET	SEAL	188S	CL	ZER
1	EA	DOOR SWEEP	8191AA	CL	ZER
3	EA	SILENCER	SR64-1	GRY	IVE

HARDWARE GROUP NO. 14

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

2	EA	HW HINGE	5BB1HW 5 X 4.5 NRP	652	IVE
1	EA	ELECTRIC HW HINGE	5BB1HW 5 X 4.5 TW8	652	IVE
1	EA	EU STOREROOM LOCK	LV9080BDCEU 03A	626	SCH
1	EA	PERMANENT CORE	OWNER SUPPLIED	626	SCH
1	EA	MAGNETIC LOCK	M450P	628	SCE
1	EA	CLOSER	7500 REG ARM TB	689	NOR
1	EA	ARMOR PLATE	8400 34" X 2" LDW	630	IVE
1	EA	WALL STOP	WS406CCV	630	IVE
3	EA	SILENCER	SR64-1	GRY	IVE
1	EA	DOOR CONTACT	7764	628	SCE
1	EA	POWER SUPPLY	PS904 900-4RLFA	LGR	SCE

OPERATIONAL DESCRIPTION

VANDLGARD LEVER. OUTSIDE KNOB/LEVER UNLOCKED BY 24V AC OR DC. LATCHBOLT RETRACTED BY KEY OUTSIDE OR KNOB/LEVER INSIDE. AUXILIARY LATCH DEADLOCKS LATCHBOLT WHEN DOOR IS LOCKED. INSIDE KNOB/LEVER ALWAYS FREE FOR IMMEDIATE EXIT. INSIDE LEVER IS ALWAYS FREE FOR IMMEDIATE EGRESS. ELECTRIC LOCK = CORR H306 FROM ANIMAL TEST

MAGNETIC LOCK SECURED WHEN POWERED (FAIL SAFE). DOOR STATUS MONITOR/MAGNETIC BOARD SENSOR MONITORS WHETHER THE DOOR IS OPEN OR CLOSED.MAGNETIC BOND SENSOR MONITORS DOOR IS SECURE AT OPTIMAL HOLDING FORCE. RELOCK TIME DELAY PROVIDES ADJUSTABLE RELOCK DELAY.

DOOR FUNCTION: THIS IS NOT A MEANS OF EGRESS. CARDREADERS BOTH SIDES OF DOOR. THE MAG LOCK SHALL BE WIRED TO THE FIRE-ALARM FOR IMMEDIATE RELEASE. ENTRY TO EITHER CORRIDOR SHALL BE CREDENTIAL TO WALL-MAOUNTED READER FOR RELEASE OF TRIM AND THE MAG LOCK OR JUST THE MAG LOCK. UPON SIGNAL FROM THE FIRE ALARM THE MAG LOCK SHALL RELEASE ALLOWING PASSAGE FROM 316 INTO H306. DOOR REMAINS SECURE ON H306 SIDE.

CARDREADER, CREDENTIALS, CLIENT SOFTWARE, WIRING, ELECTRICAL CONNECTIONS SHALL BE FURNISHED BY OTHERS.

HARDWARE GROUP NO. 15

DOOR HARDWARE

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

3	EA	HW HINGE	5BB1HW 5 X 4.5	652	IVE
1	EA	PASSAGE SET	L9010 03A	626	SCH
1	EA	OH STOP	410S	630	GLY
1	SET	SEAL	188S	CL	ZER
1	EA	DOOR SWEEP	8191AA	CL	ZER
3	EA	SILENCER	SR64-1	GRY	IVE

HARDWARE GROUP NO. 16

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

2	EA	HW HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
	EA	ELECTRIC HW HINGE	5BB1HW 4.5 X 4.5 TW8	652	IVE
1	EA	EU INSTITUTION LOCK	L9082BDCEU 03A	626	SCH
1	EA	PERMANENT CORE	OWNER SUPPLIED	626	SCH
1	EA	CLOSER	7500 CLP TB	689	NOR
1	EA	ARMOR PLATE	8400 34" X 2" LDW	630	IVE
1	EA	MOP PLATE	8400 4" X 1" LDW	630	IVE
3	EA	SILENCER	SR64-1	GRY	IVE
1	EA	DOOR CONTACT	7764	628	SCE
1	EA	POWER SUPPLY	PS902 900-4RL	LGR	SCE
1	EA	POWER SUPPLY	PS902	LGR	VON

OPERATIONAL DESCRIPTION

OUTSIDE AND INSIDE KNOB/LEVER UNLOCKED ELECTRICALLY. LATCHBOLT RETRACTED BY KEY EITHER SIDE. SWITCH OR POWER FAILURE KEEPS INSIDE AND OUTSIDE KNOB/LEVER LOCKED. AUXILIARY LATCH DEADLOCKS LATCHBOLT WHEN DOOR IS LOCKED. (PREVIOUSLY XL11452)

DOOR POSITION SWITCH MONITORS WHETHER THE DOOR IS OPEN OR CLOSED.

CARDREADER, CREDENTIALS, CLIENT SOFTWARE, WIRING, ELECTRICAL CONNECTIONS SHALL BE FURNISHED BY OTHERS.

HARDWARE GROUP NO. 17

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	CLASSROOM LOCK	L9070BD 03A	626	SCH
1	EA	PERMANENT CORE	OWNER SUPPLIED	626	SCH
1	EA	CLOSER	7500 PA ARM TB	689	NOR
1	EA	KICK PLATE	8400 8" X 2" LDW	630	IVE
1	SET	SEAL	188S	CL	ZER
1	EA	DOOR SWEEP	8191AA	CL	ZER
3	EA	SILENCER	SR64-1	GRY	IVE

HARDWARE GROUP NO. 18

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PUSH/PULL LATCH	HL6 E5 9070 2 3/4" A	US32D- AM	GLY
1	EA	CLOSER	7500 REG TB	689	NOR
1	EA	ARMOR PLATE	8400 34" X 2" LDW	630	IVE
1	EA	MOP PLATE	8400 4" X 1" LDW	630	IVE
1	EA	WALL STOP	WS406CCV	630	IVE
3	EA	SILENCER	SR64-1	GRY	IVE

HARDWARE GROUP NO. 19

DOOR HARDWARE

PROVIDE EACH PR DOOR(S) WITH THE FOLLOWING:

6	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
2	EA	MANUAL FLUSH BOLT	FB458	626	IVE
1	EA	DUST PROOF STRIKE	DP2	626	IVE
1	EA	STOREROOM LOCK	L9080BD 03A	626	SCH
1	EA	PERMANENT CORE	OWNER SUPPLIED	626	SCH
2	EA	WALL STOP	WS406CCV	630	IVE
2	EA	SILENCER	SR64-1	GRY	IVE

HARDWARE GROUP NO. 20 UNEQUAL PAIR

PROVIDE EACH PR DOOR(S) WITH THE FOLLOWING:

6	EA	HW HINGE	5BB1HW 5 X 4.5 NRP	652	IVE
1	SET	CONST LATCHING BOLT	FB52	630	IVE
1	EA	DUST PROOF STRIKE	DP2	626	IVE
1	EA	CLASSROOM LOCK	L9070BD 03A	626	SCH
1	EA	PERMANENT CORE	OWNER SUPPLIED	626	SCH
1	EA	COORDINATOR	COR X FL	628	IVE
2	EA	MOUNTING BRACKET	MB	689	IVE
2	EA	CLOSER	7500 ACTIVE LEAF SHALL BE HAVE DELAYED ACTION. PA X TB	689	NOR
2	EA	KICK PLATE	8400 8" X 2" LDW	630	IVE
2	EA	WALL STOP	WS406CCV	630	IVE
1	SET	SEAL	188S	CL	ZER

HARDWARE GROUP NO. 21

DOOR HARDWARE

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PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

3	EA	HW HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
1	EA	CLASSROOM LOCK	L9070BD 03A	626	SCH
1	EA	PERMANENT CORE	OWNER SUPPLIED	626	SCH
1	EA	CLOSER	7500	689	NOR
1	EA	KICK PLATE	8400 8" X 2" LDW	630	IVE
1	EA	WALL STOP	WS406CCV	630	IVE
1	SET	SEAL	188S	CL	ZER
3	EA	SILENCER	SR64-1	GRY	IVE

HARDWARE GROUP NO. 22

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PUSH/PULL LATCH	HL6 E5 9070 2 3/4" A	US32D-AM	GLY
1	EA	CLOSER	7500 CLP X DEL X TB	689	NOR
1	EA	ARMOR PLATE	8400 34" X 2" LDW	630	IVE
1	EA	MOP PLATE	8400 4" X 1" LDW	630	IVE
3	EA	SILENCER	SR64-1	GRY	IVE

HARDWARE GROUP NO. 23

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PUSH/PULL LATCH	HL6 E5 9070 2 3/4" A SFIC CYLINDER X CONSTR CORE. OWNER SUPPLIED PERMANENT CORE.	US32D-AM	GLY

1	EA	CLOSER	7500 PA DEL HO TB	689	NOR
1	EA	ARMOR PLATE	8400 34" X 2" LDW	630	IVE
1	EA	MOP PLATE	8400 4" X 1" LDW	630	IVE
1	EA	WALL STOP	WS406CCV	630	IVE
3	EA	SILENCER	SR64-1	GRY	IVE

HARDWARE GROUP NO. 25 UNEQUAL PAIR

PROVIDE EACH PR DOOR(S) WITH THE FOLLOWING:

5	EA	HW HINGE	5BB1HW 5 X 4.5 NRP	652	IVE
1	EA	ELECTRIC HW HINGE	5BB1HW 5 X 4.5 TW8	652	IVE
1	SET	CONST LATCHING BOLT	FB52	630	IVE
1	EA	DUST PROOF STRIKE	DP2	626	IVE
1	EA	EU STOREROOM LOCK	RX-LV9080BDEU 03A	626	SCH
1	EA	PERMANENT CORE	OWNER SUPPLIED	626	SCH
1	EA	COORDINATOR	COR X FL	628	IVE
2	EA	MOUNTING BRACKET	MB	689	IVE
2	EA	CLOSER	7500 ACTIVE LEAF SHALL BE HAVE DELAYED ACTION. PA X TB	689	NOR
2	EA	KICK PLATE	8400 8" X 2" LDW	630	IVE
2	EA	DOOR CONTACT	7764	628	SCE
1	EA	POWER SUPPLY	PS902	LGR	SCE

OPERATIONAL DESCRIPTION

VANDLGARD LEVER. OUTSIDE KNOB/LEVER UNLOCKED BY 24V AC OR DC. LATCHBOLT RETRACTED BY KEY OUTSIDE OR KNOB/LEVER INSIDE. AUXILIARY LATCH DEADLOCKS LATCHBOLT WHEN DOOR IS LOCKED. INSIDE KNOB/LEVER ALWAYS FREE FOR IMMEDIATE EXIT. INSIDE LEVER IS ALWAYS FREE FOR IMMEDIATE EGRESS. THE RX SWITCH SIGNALS THE USE OF THAT OPENING TO SECURITY SYSTEMS. DOOR POSITION SWITCH MONITORS WHETHER THE DOOR IS OPEN OR CLOSED.

DOOR FUNCITON: ENTRY BY CREDENTIAL TO WALL-MOUNTED READER FOR UNLOCK
OUTSIDE TRIM. FREE EGRESS.

CARDREADER, CREDENTIALS, CLIENT SOFTWARE, AND ALL ELECTRICAL WORK FOR THE
ACCESS CONTROL SYSTEM, SHALL BE FURNISHED BY THE OWNER'S SECURITY
CONTRACTOR.

HARDWARE GROUP NO. 26

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	POWER TRANSFER	EPT10	695	VON
1	EA	ELEC FIRE EXIT HARDWARE	LX-RX-LC-98-L-F-E996-03-FS-SNB	626	VON
1	EA	SFIC CONST. CORE	80-035 OWNER SUPPLIED PERMANENT CORE		SCH
1	EA	SFIC RIM CYLINDER	80-129	626	SCH
1	EA	CLOSER	7500 CLP TB	689	NOR
1	EA	KICK PLATE	8400 8" X 2" LDW	630	IVE
1	SET	SEAL	188S	CL	ZER
3	EA	SILENCER	SR64-1	GRY	IVE
1	EA	DOOR CONTACT	7764	628	SCE
1	EA	POWER SUPPLY	PS902 900-4RL	LGR	SCE

OPERATIONAL DESCRIPTION

FREE EGRESS AT ALL TIMES. PRESSING PUSH BAR RETRACTS LATCHBOLTS. CONTROL
CONTACT ELECTRICALLY CONTROLS THE LOCKING OR UNLOCKING OF THE OUTSIDE TRIM.
THE OUTSIDE TRIM CYLINDER RETRACTS THE LATCHBOLT FOR MECHANICAL OVERRIDE. .
ONE INTERNAL SPDT SWITCH MONITORS THE LATCHBOLT POSITION. A SECOND INTERNAL
SPDT SWITCH MONITORS THE DEPRESSION OF THE PUSHBAR OR CROSSBAR. ELECTRICALLY
LOCKED.

DOOR POSITION SWITCH MONITORS WHETHER THE DOOR IS OPEN OR CLOSED.

DOOR FUNCTION: ENTRY BY CREDENTIAL TO WALL-MOUNTED CARDREADER TO UNLOCK THE
OUTSIDE TRIM. FREE EGRESS.

CARDREADER, CREDENTIALS, CLIENT SOFTWARE, AND ALL ELECTRICAL WORK FOR THE
ACCESS CONTROL SYSTEM SHALL BE FURNISHED BY THE OWNER'S SECURITY CONTRACTOR.

HARDWARE GROUP NO. 27

PROVIDE EACH PR DOOR(S) WITH THE FOLLOWING:

5	EA	HW HINGE	5BB1HW 5 X 4.5 NRP	652	IVE
1	EA	ELECTRIC HW HINGE	5BB1HW 5 X 4.5 TW8	652	IVE
1	SET	CONST LATCHING BOLT	FB52	630	IVE
1	EA	DUST PROOF STRIKE	DP2	626	IVE
1	EA	EU STOREROOM LOCK	RX-LV9080BDEU 03A	626	SCH
1	EA	PERMANENT CORE	OWNER SUPPLIED	626	SCH
1	EA	COORDINATOR	COR X FL	628	IVE
2	EA	MOUNTING BRACKET	MB	689	IVE
2	EA	CLOSER	7500 ACTIVE LEAF SHALL BE HAVE DELAYED ACTION. PA X TB	689	NOR
2	EA	KICK PLATE	8400 16" X 2" LDW	630	IVE
2	EA	WALL STOP	WS406CCV	630	IVE
1	SET	SEAL	188S	CL	ZER
2	EA	DOOR CONTACT	7764	628	SCE
1	EA	POWER SUPPLY	PS902 900-4RL	LGR	SCE

OPERATIONAL DESCRIPTION

VANDLGARD LEVER. OUTSIDE KNOB/LEVER UNLOCKED BY 24V AC OR DC. LATCHBOLT RETRACTED BY KEY OUTSIDE OR KNOB/LEVER INSIDE. AUXILIARY LATCH DEADLOCKS LATCHBOLT WHEN DOOR IS LOCKED. INSIDE KNOB/LEVER ALWAYS FREE FOR IMMEDIATE EXIT. INSIDE LEVER IS ALWAYS FREE FOR IMMEDIATE EGRESS. THE RX SWITCH SIGNALS THE USE OF THAT OPENING TO SECURITY SYSTEMS. DOOR POSITION SWITCH MONITORS WHETHER THE DOOR IS OPEN OR CLOSED.

DOOR FUNCTION: ENTRY BY CREDENTIAL TO WALL-MOUNTED CARDREADER TO UNLOCK OUTSIDE TRIM. FREE EGRESS.

CARDREADER, CREDENTIALS, CLIENT SOFTWARE, AND ALL ELECTRICAL WORK FOR THE ACCESS CONTROL SYSTEM SHALL BE FURNISHED BY THE OWNER'S SECURITY CONTRACTOR.

HARDWARE GROUP NO. 28

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

DOOR HARDWARE

3	EA	HW HINGE	5BB1HW 5 X 4.5	652	IVE
1	EA	PANIC HARDWARE	LD-98-L-BE-996-03	626	VON
1	EA	CLOSER	7500 PA X TB	689	NOR
1	EA	ARMOR PLATE	8400 34" X 2" LDW	630	IVE
1	EA	WALL STOP	WS406CCV	630	IVE
3	EA	SILENCER	SR64-1	GRY	IVE

HARDWARE GROUP NO. 30

PROVIDE EACH PR DOOR(S) WITH THE FOLLOWING:

6	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	CONST LATCHING BOLT	FB61T	630	IVE
1	EA	CLASSROOM LOCK	L9070BD 03A	626	SCH
1	EA	PERMANENT CORE	OWNER SUPPLIED	626	SCH
2	EA	WALL STOP	WS406CCV	630	IVE
2	EA	DOOR CONTACT	7764	628	SCE

OPERATIONAL DESCRIPTION

LATCHBOLT RETRACTED BY KNOB/LEVER FROM EITHER SIDE UNLESS OUTSIDE IS LOCKED BY KEY. UNLOCKED FROM OUTSIDE BY KEY. INSIDE KNOB/LEVER ALWAYS FREE FOR IMMEDIATE EXIT. AUXILIARY LATCH DEADLOCKS LATCHBOLT WHEN DOOR IS LOCKED. INSIDE LEVER IS ALWAYS FREE FOR IMMEDIATE EGRESS.

DOOR POSITION SWITCH MONITORS WHETHER THE DOOR IS OPEN OR CLOSED.

HARDWARE GROUP NO. 31

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	CLASSROOM LOCK	L9070BD 03A	626	SCH

1	EA	PERMANENT CORE	OWNER SUPPLIED	626	SCH
1	EA	CLOSER	7500 REG/PA ARM X TB	689	NOR
1	EA	KICK PLATE	8400 8" X 2" LDW	630	IVE
1	EA	COAT AND HAT HOOK	582	626	IVE
3	EA	SILENCER	SR64-1	GRY	IVE

HARDWARE GROUP NO. 32

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	L9080BD 03A	626	SCH
1	EA	PERMANENT CORE	OWNER SUPPLIED	626	SCH
1	EA	WALL STOP	WS406CCV	630	IVE
3	EA	SILENCER	SR64-1	GRY	IVE

HARDWARE GROUP NO. 33

PROVIDE EACH PR DOOR(S) WITH THE FOLLOWING:

6	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	CONST LATCHING BOLT	FB51T	630	IVE
1	EA	CYLINDER DEAD LOCK	L464BDC	626	SCH
1	EA	PERMANENT CORE	OWNER SUPPLIED	626	SCH
2	EA	OH STOP	410S	630	GLY
2	EA	SILENCER	SR64-1	GRY	IVE

HARDWARE GROUP NO. 34

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

2	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	ELECTRIC HINGE	5BB1 4.5 X 4.5 TW-8	652	IVE
1	EA	EU STOREROOM LOCK	RX-LV9080BDEU 03A	626	SCH
1	EA	PERMANENT CORE	OWNER SUPPLIED	626	SCH
1	EA	CLOSER	7500 REG ARM X TB	689	NOR
1	EA	KICK PLATE	8400 8" X 2" LDW	630	IVE
1	EA	WALL STOP	WS406CCV	630	IVE
3	EA	SILENCER	SR64-1	GRY	IVE
1	EA	DOOR CONTACT	7764	628	SCE
1	EA	POWER SUPPLY	PS902 900-4RL		SCE

OPERATIONAL DESCRIPTION

VANDLGDARD LEVER. OUTSIDE KNOB/LEVER UNLOCKED BY 24V AC OR DC. LATCHBOLT RETRACTED BY KEY OUTSIDE OR KNOB/LEVER INSIDE. AUXILIARY LATCH DEADLOCKS LATCHBOLT WHEN DOOR IS LOCKED. INSIDE KNOB/LEVER ALWAYS FREE FOR IMMEDIATE EXIT. INSIDE LEVER IS ALWAYS FREE FOR IMMEDIATE EGRESS. THE RX SWITCH SIGNALS THE USE OF THAT OPENING TO SECURITY SYSTEMS.

DOOR POSITION SWITCH MONITORS WHETHER THE DOOR IS OPEN OR CLOSED.

DOOR FUNCTION: ENTRY BY CREDENTIAL TO WALL-MOUNTED CARDREADER TO UNLOCK OUTSIDE TRIM. FREE EGRESS.

CARDREADER, CREDENTIALS, CLIENT SOFTWARE, AND ALL ELECTRICAL WORK FOR THE ACCESS CONTROL SYSTEM SHALL BE FURNISHED BY THE OWNER'S SECURITY CONTRACTOR.

END OF SECTION

SECTION 08 80 00 - GLAZING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Glass.
- B. Glazing compounds and accessories.

1.2 RELATED REQUIREMENTS

- A. Section 08 11 13 - Hollow Metal Doors and Frames: Glazed doors and borrowed lites.
- B. Section 08 14 16 - Wood Doors: Glazed doors.

1.3 REFERENCE STANDARDS

- A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials.
- B. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers.
- C. ASTM C920 - Standard Specification for Elastomeric Joint Sealants.
- D. ASTM C1036 - Standard Specification for Flat Glass.
- E. ASTM C1048 - Standard Specification for Heat-Treated Flat Glass--Kind HS, Kind FT Coated and Uncoated Glass.
- F. ASTM C1193 - Standard Guide for Use of Joint Sealants.
- G. GANA (SM) - FGMA Sealant Manual; Glass Association of North America.

1.4 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data on Glass Types: Provide physical characteristics and installation requirements.

PART 2 - PRODUCTS

2.1 GLAZING TYPES

- A. Single Vision Glazing:
 - 1. Applications: All interior glazing unless otherwise indicated.
 - 2. Type: Fully tempered float glass.
 - 3. Tint: Clear.
 - 4. Thickness: 1/4 inch.
 - 5. Glazing Method: Interior wet method, glazing compound.
- B. Fire-Rated Safety Glazing:
 - 1. Applications: Provide this type of glazing in the following locations:
 - a. Glazed lites in fire doors.
 - 2. Type: Laminated wired glass.
 - 3. Thickness: 1/4 inch.
 - 4. Glazing Method: As required for fire rating.

2.2 GLASS MATERIALS

A. Float Glass Manufacturers:

1. AGC Flat Glass North America, Inc: www.na.agc-flatglass.com.
2. Guardian Industries Corp: www.sungardglass.com.
3. Pilkington North America Inc: www.pilkington.com/na.
4. PPG Industries, Inc: www.ppgideascape.com.
5. Substitutions: Refer to Section 01 60 00 - Product Requirements.

B. Float Glass: All glazing is to be float glass unless otherwise indicated.

1. Annealed Type: ASTM C1036, Type I, transparent flat, Class 1 clear, Quality Q3 (glazing select).
2. Heat-Strengthened and Fully Tempered Types: ASTM C1048.
3. Tinted Types: Color and performance characteristics as indicated.
4. Thicknesses: As indicated; for exterior glazing comply with specified requirements for wind load design regardless of specified thickness.

C. Laminated Wired Glass: UL- or WH-listed as fire-protection-rated glazing and complying with 16 CFR 1201 test requirements for Category II with or without the use of a surface-applied film.

1. Manufacturers:
 - a. O'Keeffe's Inc. SAFTI Division; SAFTIFIRST SuperLite I-W: www.safti.com.
 - b. Technical Glass Products; Wirelite NT: www.fireglass.com.
 - c. Substitutions: Refer to Section 01 60 00 - Product Requirements.

2.3 GLAZING COMPOUNDS

A. Manufacturers:

1. Momentive Performance Materials, Inc (formerly GE Silicones): www.momentive.com.
2. Pecora Corporation: www.pecora.com.
3. BASF Construction Chemicals-Building Systems: www.buildingsystems.basf.com.
4. Substitutions: Refer to Section 01 60 00 - Product Requirements.

B. Silicone Sealant: Single component; chemical curing; non-bleeding, non-staining; ASTM C 920, Type S, Grade NS, Class 25, Uses M, A, and G; cured Shore A hardness of 15 to 25; color as selected.

2.4 GLAZING ACCESSORIES

A. Setting Blocks: Neoprene, 80 to 90 Shore A durometer hardness, ASTM C864 Option I. Length of 0.1 inch for each square foot of glazing or minimum 4 inch x width of glazing rabbet space minus 1/16 inch x height to suit glazing method and pane weight and area.

B. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness, ASTM C 864 Option I. Minimum 3 inch long x one half the height of the glazing stop x thickness to suit application, self adhesive on one face.

C. Glazing Tape: Preformed butyl compound with integral resilient tube spacing device; 10 to 15 Shore A durometer hardness; coiled on release paper; size as required; black color.

D. Glazing Clips: Manufacturer's standard type.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that openings for glazing are correctly sized and within tolerance.
- B. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and ready to receive glazing.

3.2 PREPARATION

- A. Clean contact surfaces with solvent and wipe dry.
- B. Prime surfaces scheduled to receive sealant.
- C. Install sealants in accordance with ASTM C1193 and FGMA Sealant Manual.
- D. Install sealant in accordance with manufacturer's instructions.

3.3 INSTALLATION - INTERIOR WET METHOD (COMPOUND AND COMPOUND)

- A. Install glazing resting on setting blocks. Install applied stop and center pane by use of spacer shims at 24 inch centers, kept 1/4 inch below sight line.
- B. Locate and secure glazing pane using glazers' clips.
- C. Fill gaps between glazing and stops with glazing compound until flush with sight line. Tool surface to straight line.

3.4 CLEANING

- A. Remove glazing materials from finish surfaces.
- B. Remove labels after Work is complete.
- C. Clean glass and adjacent surfaces.

END OF SECTION

SECTION 08 87 16 - SPECIALTY FILM FOR GLAZING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Section includes film products applied to glass surfaces to impart aesthetic characteristics

1.2 REFERENCES

- A. ASTM E-84 - Test Method for Surface Burning Characteristics of Building Materials.
- B. ASTM E 903 - Test Method for Solar Absorptance, Reflectance, and Transmittance of Materials Using Integrating Spheres.
- C. ASTM D 3330 - Standard Test Methods for Peel-Adhesion at 180 Degree Angle.

1.3 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data (on 1/8 inch clear glass): For each film product indicated.
- C. Samples for Color Selection: Manufacturer's standard sample sets showing the full range of colors available for each type of product indicated.
- D. Samples for Verification: 12-inch square samples of each glazing film, of each product color specified.
- E. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- F. Closeout Submittals: Upon completion of the Work, submit the following:
 - 1. Executed warranty.
 - 2. Maintenance (cleaning) and replacement instructions.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Engage a firm experienced in manufacturing systems similar to those indicated for this Project and meeting the standards of the International Standards Organization (ISO), ISO 9001 Quality Assurance in Production and Installation.
- B. Installer Qualifications: Engage an experienced installer certified, licensed, or otherwise qualified by film manufacturer as having the necessary experience, staff, and training to install manufacturer's products according to specified requirements.
- C. Mockups: Apply glazing films in locations as directed to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution.
 - 1. Obtain approval of field samples before continuing with remainder of installation.
 - 2. Maintain field samples during remainder of installation in an undisturbed condition as a standard for judging the completed Work.
 - 3. Approved field samples may become part of the completed Work.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing films according to manufacturer's written instructions and as needed to prevent damage condensation, temperature changes, direct exposure to sun, or other causes.

1.6 WARRANTY

- A. Manufacturer's Warranty: Fully executed warranty, written in favor of the Owner, agreeing to replace films that deteriorate as defined in "Definitions" Article, within 5 years from date of original installation.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Pro-Tint, Inc. (Basis of Design)
- B. Other Acceptable Manufacturers:
 - 1. Decorative Films, LLC.
 - 2. 3M.
- C. Substitutions: See Section 01 60 00 - Product Requirements.
- D. Color: As selected by Architect from manufacturer's full range.

2.2 GLAZING FILM ACCESSORIES

- A. General: Provide products complying with requirements of glazing film manufacturer for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Adhesive: As recommended by manufacturer.
- C. Cleaners, Primers, and Sealers: Types recommended by glazing film manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine glass and surrounding adjacent surfaces for conditions affecting installation.
 - 1. Report conditions that may adversely effect installation. In report, include description of any glass that is broken, chipped, cracked, abraded, or damaged in any way.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. Beginning of installation means acceptance of conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions for surface preparation.
- B. Immediately before beginning installation of films, clean glass surfaces of substances that could impair glazing film's bond, including mold, mildew, oil, grease, dirt and other foreign materials.
- C. Protect window frames and surrounding conditions from damage during installation.

3.3 INSTALLATION

- A. General: Comply with glazing film manufacturers' written installation instructions applicable to products and applications indicated, except where more stringent requirements apply.
 - 1. Install film continuously. Install with no gaps or overlaps.
 - 2. No seams allowed.
 - 3. Do not remove release liner from film until just before each piece of film is cut and ready for installation.
 - 4. Install film with mounting solution and custom cut to the glass with neat, square comers and edges to within 1/16 inch of the window frame.
 - 5. Remove air bubbles, wrinkles, blisters, and other defects.
- B. After installation, view film from a distance of 6 feet against a bright uniform sky or background. Film shall appear uniform in appearance with no visible streaks, banding, thin spots or pinholes.
 - 1. If installed film does not meet this criteria, remove and replace with new film.

3.4 CLEANING

- A. Remove excess mounting solution at finished seams, perimeter edges, and adjacent surfaces.
- B. Use cleaning methods recommended by glazing film manufacturer.
- C. Replace films that cannot be cleaned.

END OF SECTION

SECTION 09 05 61 - COMMON WORK RESULTS FOR FLOORING PREPARATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. This section applies to all floors identified in the contract documents as to receive the following types of floor coverings:
 - 1. Resilient tile.
 - 2. Broadloom carpet.
 - 3. Carpet tile.
 - 4. Thin-set ceramic tile.
- B. Testing of concrete floor slabs for moisture and pH.
- C. Remediation of concrete floor slabs due to unsatisfactory moisture or pH conditions.
 - 1. Contractor shall perform all specified remediation of concrete floor slabs. If such remediation is indicated by testing agency's report and is due to a condition not under Contractor's control or could not have been predicted by examination prior to entering into the contract, a contract modification will be issued.

1.2 REFERENCES

- A. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens).
- B. ASTM C472 - Standard Test Methods for Physical Testing of Gypsum, Gypsum Plasters and Gypsum Concrete.
- C. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.
- D. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
- E. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.

1.3 SUBMITTALS

- A. Floor Covering and Adhesive Manufacturers' Product Literature: For each specific combination of substrate, floor covering, and adhesive to be used; showing:
 - 1. Moisture and pH limits and test methods.
 - 2. Manufacturer's required bond/compatibility test procedure.
- B. Testing Agency's Report: Include:
 - 1. Description of areas tested; include floor plans and photographs if helpful.
 - 2. Summary of conditions encountered.
 - 3. Moisture and pH test reports.
 - 4. Copies of specified test methods.
 - 5. Recommendations for remediation of unsatisfactory surfaces.
 - 6. Submit report to Architect.
 - 7. Submit report not more than two business days after conclusion of testing.
- C. Adhesive Bond and Compatibility Test Report.

1.4 QUALITY ASSURANCE

- A. Moisture and pH testing will be performed by an independent testing agency employed and paid by Owner.
- B. Contractor's Responsibility Relating to Independent Agency Testing:
 - 1. Provide access for and cooperate with testing agency.
 - 2. Confirm date of start of testing at least 10 days prior to actual start.
 - 3. Allow at least 4 business days on site for testing agency activities.
 - 4. Achieve and maintain specified ambient conditions.
 - 5. Notify Owner when specified ambient conditions have been achieved and when testing will start.

1.5 FIELD CONDITIONS

- A. Maintain ambient temperature in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 65 degrees F or more than 85 degrees F.
- B. Maintain relative humidity in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 40 percent and not more than 60 percent.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Patching Compound: Floor covering manufacturer's recommended product, suitable for conditions, and compatible with adhesive and floor covering. In the absence of any recommendation from flooring manufacturer, provide a product with the following characteristics:
 - 1. Cementitious moisture, mildew, and alkali-resistant compound, compatible with floor, floor covering, and floor covering adhesive, and capable of being feathered to nothing at edges.
 - 2. Latex or polyvinyl acetate additions are permitted; gypsum content is prohibited.
 - 3. Compressive Strength: 3000 psi, minimum, after 28 days, when tested in accordance with ASTM C109/C109M or ASTM C472, whichever is appropriate.
- B. Alternate Flooring Adhesive: Floor covering manufacturer's recommended product, suitable for the moisture and pH conditions present; low-VOC. In the absence of any recommendation from flooring manufacturer, provide a product recommended by adhesive manufacturer as suitable for substrate and floor covering and for conditions present.
- C. Remedial Floor Coating: Single- or multi-layer coating or coating/overlay combination intended by its manufacturer to resist water vapor transmission to degree sufficient to meet flooring manufacturer's emission limits, resistant to the level of pH found, and suitable for adhesion of flooring without further treatment.
 - 1. Thickness: 1/8 inch, maximum.
 - 2. If testing agency recommends any particular products, use one of those.

PART 3 - EXECUTION

3.1 CONCRETE SLAB PREPARATION

- A. Perform following operations in the order indicated:
1. Existing concrete slabs with coatings or penetrating sealers/hardeners/dustproofers:
 - a. Do not abrade surface.
 2. Preliminary cleaning.
 3. Moisture vapor emission tests; 3 tests in the first 1000 square feet and one test in each additional 1000 square feet, unless otherwise indicated or required by flooring manufacturer.
 4. Internal relative humidity tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
 5. pH tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
 6. Specified remediation, if required.
 7. Patching, smoothing, and leveling, as required.
 8. Other preparation specified.
 9. Adhesive bond and compatibility test.
 10. Protection.
- B. Remediations:
1. Active Water Leaks or Continuing Moisture Migration to Surface of Slab: Correct this condition before doing any other remediation; re-test after correction.
 2. Excessive Moisture Emission or Relative Humidity: If an adhesive that is resistant to the level of moisture present is available and acceptable to flooring manufacturer, use that adhesive for installation of the flooring; if not, apply remedial floor coating over entire suspect floor area.
 3. Excessive pH: If remedial floor coating is necessary to address excessive moisture, no additional remediation is required; if not, if an adhesive that is resistant to the level present is available and acceptable to the flooring manufacturer, use that adhesive for installation of the flooring; otherwise, apply a skim coat of specified patching compound over entire suspect floor area.

3.2 PRELIMINARY CLEANING

- A. Clean floors of dust, solvents, paint, wax, oil, grease, asphalt, residual adhesive, adhesive removers, film-forming curing compounds, sealing compounds, alkaline salts, excessive laitance, mold, mildew, and other materials that might prevent adhesive bond.
- B. Do not use solvents or other chemicals for cleaning.

3.3 MOISTURE VAPOR EMISSION TESTING

- A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
- B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.
- C. Test in accordance with ASTM F1869 and as follows.

- D. Plastic sheet test and mat bond test may not be substituted for the specified ASTM test method, as those methods do not quantify the moisture content sufficiently.
- E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if test values exceed 3 pounds per 1000 square feet per 24 hours.
- F. Report: Report the information required by the test method.

3.4 INTERNAL RELATIVE HUMIDITY TESTING

- A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
- B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.
- C. Test in accordance with ASTM F2170 Procedure A and as follows.
- D. Testing with electrical impedance or resistance apparatus may not be substituted for the specified ASTM test method, as the values determined are not comparable to the ASTM test values and do not quantify the moisture content sufficiently.
- E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if any test value exceeds 75 percent relative humidity.
- F. Report: Report the information required by the test method.

3.5 pH TESTING

- A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
- B. Note: This procedure is the equivalent of that described in ASTM F710, repeated here for the Contractor's convenience.
- C. Use a wide range pH paper, its associated chart, and distilled or deionized water.
- D. Place several drops of water on a clean surface of concrete, forming a puddle approximately 1 inch in diameter. Allow the puddle to set for approximately 60 seconds, then dip the pH paper into the water, remove it, and compare immediately to chart to determine pH reading.
- E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if any test value is over 10.

3.6 PREPARATION

- A. See individual floor covering section(s) for additional requirements.
- B. Comply with requirements and recommendations of floor covering manufacturer.
- C. Fill and smooth surface cracks, grooves, depressions, control joints and other non-moving joints, and other irregularities with patching compound.

D. Do not fill expansion joints, isolation joints, or other moving joints.

3.7 ADHESIVE BOND AND COMPATIBILITY TESTING

A. Comply with requirements and recommendations of floor covering manufacturer.

3.8 APPLICATION OF REMEDIAL FLOOR COATING

A. Comply with requirements and recommendations of coating manufacturer.

3.9 PROTECTION

A. Cover prepared floors with building paper or other durable covering.

END OF SECTION

SECTION 09 21 16 - GYPSUM BOARD ASSEMBLIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Performance criteria for gypsum board assemblies.
- B. Metal stud wall framing.
- C. Metal channel ceiling framing.
- D. Acoustic insulation.
- E. Gypsum wallboard.
- F. Joint treatment and accessories.
- G. Sound attenuation.

1.2 RELATED REQUIREMENTS

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 06 10 00 - Rough Carpentry: Wood blocking product and execution requirements.
- C. Section 07 90 05 - Joint Sealers: Acoustic sealant.

1.3 REFERENCE STANDARDS

- A. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
- B. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members.
- C. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.
- D. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board.
- E. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
- F. ASTM C1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.
- G. ASTM C1278/C1278M - Standard Specification for Fiber-Reinforced Gypsum Panel.
- H. ASTM C1396/C1396M - Standard Specification for Gypsum Board.
- I. ASTM C1629/C1629 - Standard Classification for Abuse-Resistant Nondecorated Interior Gypsum Panel Products and Fiber-Reinforced Cement Panels.
- J. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.
- K. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.

- L. ASTM E413 - Classification for Rating Sound Insulation.
- M. GA-216 - Application and Finishing of Gypsum Board; Gypsum Association.

1.4 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Provide data on metal framing, gypsum board, accessories, joint finishing system, and acoustical insulation.
- C. LEED Submittals:
 - 1. For gypsum wallboard, submit documentation of recycled content and location of manufacture.
 - 2. For steel products, submit documentation of steel mill process, location of mill, and location of manufacture.

PART 2 - PRODUCTS

2.1 GYPSUM BOARD ASSEMBLIES

- A. Provide completed assemblies complying with ASTM C840 and GA-216.
 - 1. See PART 3 for finishing requirements.
- B. Interior Partitions Indicated as Acoustic: Provide completed assemblies with the following characteristics:
 - 1. Acoustic Attenuation: STC of 50-54 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.
- C. Shaft Walls at HVAC Shafts: Provide completed assemblies with the following characteristics:
 - 1. Air Pressure Within Shaft: Sustained loads of 5 lbf/sq ft with maximum mid-span deflection of L/240.
 - 2. Acoustic Attenuation: STC of 35-39 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.
- D. Fire Rated Assemblies: Provide completed assemblies complying with applicable code.

2.2 METAL FRAMING MATERIALS

- A. Manufacturers - Metal Framing, Connectors, and Accessories:
 - 1. Clarkwestern Dietrich Building Systems LLC: www.clarkdietrich.com.
 - 2. Marino\Ware: www.marinoware.com.
 - 3. Phillips Manufacturing Company: www.phillipsmfg.com.
- B. Non-Loadbearing Framing System Components: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/240 at 5 psf.
 - 1. Studs: "C" shaped with flat or formed webs with knurled faces.
 - 2. Runners: U shaped, sized to match studs.
 - 3. Ceiling Channels: C shaped.

- C. Shaft Wall Studs and Accessories: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 and specified performance requirements.
 - 1. Manufacturers - Shaft Wall Studs and Accessories:
 - a. Same manufacturer as other framing materials.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- D. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.
- E. Slip-Type Head Joints:
 - 1. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.
 - a. Acceptable Manufacturers:
 - 1) Fire Trak Corporation.
 - 2) Metal-Lite, Inc.
 - 3) Total Steel Solutions.
 - 4) Steel Network; Product VertiClip SLD.

2.3 BOARD MATERIALS

- A. Manufacturers - Gypsum-Based Board:
 - 1. CertainTeed Corporation: www.certainteed.com.
 - 2. Georgia-Pacific Gypsum LLC: www.gp.com/gypsum.
 - 3. Lafarge North America Inc: www.lafargenorthamerica.com.
 - 4. National Gypsum Company: www.nationalgypsum.com.
 - 5. USG Corporation: www.usg.com.
 - 6. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
 - 1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
 - 2. At Assemblies Indicated with Fire-Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
 - 3. Thickness:
 - a. Vertical Surfaces: 5/8 inch.
 - b. Ceilings: 5/8 inch.
 - 4. Paper-Faced Products:
 - a. CertainTeed Corporation; ProRoc Brand Gypsum Board.
 - b. Georgia-Pacific Gypsum LLC; ToughRock Gypsum Wallboard.
 - c. National Gypsum Company; Gold Bond Brand Gypsum Wallboard.
 - d. USG Corporation; Sheetrock Brand Gypsum Panels.
 - e. Substitutions: See Section 01 60 00 - Product Requirements.
 - 5. Mold-Resistant Paper-Faced Products:
 - a. CertainTeed Corporation; ProRoc Brand Moisture & Mold Resistant Gypsum Board.
 - b. Lafarge North America Inc; Mold Defense Drywall.
 - c. National Gypsum Company; Gold Bond Brand XP Gypsum Board.
 - d. USG Corporation; Sheetrock Brand Mold Tough Gypsum Panels.
 - e. Substitutions: See Section 01 60 00 - Product Requirements.

- C. Impact-Rated Wallboard: Tested to Level 3 soft-body and hard-body impact in accordance with ASTM C1629.
1. Application: High-traffic areas indicated.
 2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 3. Paper-Faced Type: Gypsum wallboard as defined in ASTM C1396/C1396M.
 4. Unfaced Type: Interior fiber-reinforced gypsum panels as defined in ASTM C1278/C1278M.
 5. Type: Fire-resistance rated Type X, UL or WH listed.
 6. Thickness: 5/8 inch.
 7. Edges: Tapered.
 8. Products:
 - a. National Gypsum Company; Gold Bond Hi-Impact Brand XP Wallboard.
 - b. USG Corporation; Fiberock Brand Panels--VHI Abuse-Resistant.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.
- D. Shaftwall and Coreboard: Type X; 1 inch thick by 24 inches wide, beveled long edges, ends square cut.
1. Paper Faced Type: Gypsum shaftliner board or gypsum coreboard as defined ASTM C1396/C1396M; water-resistant faces.
 2. Products:
 - a. CertainTeed Corporation; ProRoc Brand Shaftliner Type X.
 - b. Georgia-Pacific Gypsum LLC; DensGlass Ultra Shaftliner (mold-resistant).
 - c. National Gypsum Company; Gold Bond Brand 1" Fire-Shield Shaftliner.
 - d. National Gypsum Company; Gold Bond Brand 1" Fire-Shield Shaftliner XP (mold-resistant).
 - e. Pacific Coast Building Products, Inc; PABCORE Gypsum Shaftliner Board type X.
 - f. USG Corporation; Sheetrock Gypsum Liner Panels.
 - g. USG Corporation; Sheetrock Gypsum Liner Panels--Enhanced (mold-resistant).
 - h. Substitutions: See Section 01 60 00 - Product Requirements.

2.4 ACCESSORIES

- A. Acoustic Insulation: ASTM C 665; preformed mineral fiber batt; friction fit, conforming to the following:
1. Surface Burning Characteristics: Flame spread index of 0; smoke developed index of 0, when tested in accordance with ASTM E 84.
 2. Combustibility: Non-combustible, when tested in accordance with ASTM E 136.
 3. Formaldehyde Content: Zero.
 4. Thermal Resistance: R of 11.
 5. Thickness: 3-1/2 inches.
 6. Facing: Unfaced.
 7. Manufacturers:
 - a. CertainTeed Corporation: www.certainteed.com.
 - b. Johns Manville Corporation: www.jm.com.
 - c. Owens Corning Corp: www.owenscorning.com.
 - d. Thermafiber; Product SAFB: www.thermafiber.com. (Basis of Design)
 8. Substitutions: See Section 01 60 00 - Product Requirements.

- B. Acoustic Sealant: As specified in Section 07 90 05.
- C. Finishing Accessories: ASTM C1047, galvanized steel or rolled zinc, unless otherwise indicated.
 - 1. Types: As detailed or required for finished appearance.
 - 2. Manufacturers - Finishing Accessories:
 - a. Same manufacturer as framing materials.
- D. Joint Materials: ASTM C475 and as recommended by gypsum board manufacturer for project conditions.
 - 1. Tape: 2 inch wide, coated glass fiber tape for joints and corners, except as otherwise indicated.
 - 2. Ready-mixed vinyl-based joint compound.
- E. Screws for Attachment to Steel Members Less Than 0.03 inch In Thickness, to Wood Members, and to Gypsum Board: ASTM C1002; self-piercing tapping type; cadmium-plated for exterior locations.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that project conditions are appropriate for work of this section to commence.

3.2 SHAFT WALL INSTALLATION

- A. Shaft Wall Framing: Install in accordance with manufacturer's installation instructions.
 - 1. Install studs at spacing required to meet performance requirements.
- B. Shaft Wall Liner: Cut panels to accurate dimension and install sequentially between special friction studs.
 - 1. Seal perimeter of shaft wall and penetrations with acoustical sealant.

3.3 FRAMING INSTALLATION

- A. Metal Framing: Install in accordance with ASTM C754 and manufacturer's instructions.
- B. Suspended Ceilings and Soffits: Space framing and furring members as indicated.
 - 1. Level ceiling system to a tolerance of 1/1200.
- C. Studs: Space studs as permitted by standard.
 - 1. Extend partition framing to structure where indicated and to ceiling in other locations.
 - 2. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.
- D. Openings: Reinforce openings as required for weight of doors using not less than double studs at jambs.
- E. Blocking: Install wood blocking for support of:
 - 1. Wall mounted cabinets.
 - 2. Wall mounted door hardware.
 - 3. Movable tackboard tracks.

3.4 ACOUSTIC ACCESSORIES INSTALLATION

- A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.
- B. Acoustic Sealant: Install in accordance with manufacturer's instructions.

3.5 BOARD INSTALLATION

- A. Comply with ASTM C 840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.
- B. Single-Layer Non-Rated: Install gypsum board parallel to framing, with ends and edges occurring over firm bearing.
- C. Fire-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.
- D. Installation on Metal Framing: Use screws for attachment of all gypsum board.

3.6 INSTALLATION OF TRIM AND ACCESSORIES

- A. Control Joints: Place control joints consistent with lines of building spaces and as directed.
 - 1. Not more than 30 feet apart on walls and ceilings over 50 feet long.
- B. Corner Beads: Install at external corners, using longest practical lengths.
- C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials.

3.7 JOINT TREATMENT

- A. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
 - 1. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
 - 2. Level 1: Wall areas above finished ceilings, whether or not accessible in the completed construction.
- B. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
 - 1. Feather coats of joint compound so that camber is maximum 1/32 inch.

3.8 TOLERANCES

- A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

END OF SECTION

SECTION 09 51 00 - ACOUSTICAL CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes acoustical panels and exposed suspension systems for ceilings.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Coordination Drawings: Reflected ceiling plans, 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. Ceiling suspension system members.
 2. Method of attaching hangers to building structure.
 - a. Furnish layouts for cast-in-place anchors, clips, and other ceiling attachment devices whose installation is specified in other Sections.
 3. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
 4. Minimum Drawing Scale: 1/4 inch = 1 foot.
- C. Samples for Verification: For each component indicated and for exposed finish required, prepared on Samples of size indicated below.
1. Acoustical Panel: Full size Sample of color, pattern, and texture.
 2. Exposed Suspension System Members, Moldings, and Trim: Set of 12 inch long Samples of finish, and color.
- D. LEED Submittals:
1. Credit EQ 4.1: Manufacturers' product data for sealants, including printed statement of VOC content and material safety data sheets.
- E. Maintenance Data: For finishes to include in maintenance manuals.

1.3 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of acoustical ceiling panel and supporting suspension system through one source from a single manufacturer.
- B. Seismic Standard: Provide acoustical panel ceilings designed and installed to withstand the effects of earthquake motions according to the following:
1. Standard for Ceiling Suspension Systems Requiring Seismic Restraint: Comply with ASTM E 580.
 2. CISCA's Recommendations for Acoustical Ceilings: Comply with CISCA's "Recommendations for Direct-Hung Acoustical Tile and Lay-in Panel Ceilings--Seismic Design Category C."
 3. UBC Standard 25-2, "Metal Suspension Systems for Acoustical Tile and for Lay-in Panel Ceilings."
 4. ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 9, "Earthquake Loads."

1.4 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.

1.5 COORDINATION

- A. Coordinate layout and installation of acoustical panels and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1.6 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. Acoustical Ceiling Panels: Full-size panels equal to 2.0 percent of quantity installed.

PART 2 - PRODUCTS

2.1 ACOUSTICAL PANELS, GENERAL

- A. 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 away from test surface per ASTM E 795.
- B. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.

2.2 ACOUSTICAL PANELS FOR ACOUSTICAL PANEL CEILING: SEE FINISH SCHEDULE

2.3 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.
- B. Finishes and Colors, General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Provide manufacturer's standard factory-applied finish for type of system indicated.
- C. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
- D. 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 3 times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106 inch diameter wire.
- E. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.
 - F. Angle Hangers: Angles with legs not less than 7/8 inch wide; formed with 0.04 inch thick, galvanized steel sheet complying with ASTM A 653/A 653M, G90 coating designation; with bolted connections and 5/16 inch
 - G. Seismic Stabilizer Bars: Manufacturer's standard perimeter stabilizers designed to accommodate seismic forces.
 - H. Seismic Clips: Manufacturer's standard seismic clips designed and spaced to secure acoustical panels in-place.
 - I. Hold-Down Clips: Where indicated, provide manufacturer's standard hold-down clips spaced 24 inches o.c. on all cross tees.

2.4 METAL SUSPENSION SYSTEM FOR ACOUSTICAL PANEL CEILING

- A. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/A 653M, not less than G30 coating designation, with prefinished 15/16 inch wide metal caps on flanges.
 1. Structural Classification: Intermediate-duty system.
 2. End Condition of Cross Runners: Override (stepped) type.
 3. Face Design: Flat, flush.
 4. Cap Material: Steel cold-rolled sheet.
 5. Cap Finish: Painted white.

2.5 METAL EDGE MOLDINGS AND TRIM

- A. Products: Subject to compliance with requirements, provide products by one of the following:
 1. Armstrong World Industries, Inc.
 2. BPB USA.
 3. Chicago Metallic Corporation.
- 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.

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.

1. 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 and seismic design requirements indicated, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
 1. Where required, provide larger panels cut to size required to eliminate additional grid. Comply with Coordination Drawing requirement stated in Paragraph 1.2.B.
- 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 to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 3. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 4. 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.
 5. 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.
 6. 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 structure to which hangers are attached and 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.
 7. 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.
 8. 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.
 9. Do not attach hangers to steel deck tabs.
 10. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 11. Space hangers not more than 48 inches o.c. along each member supported directly from hangers, unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
 12. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.

- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.
- D. 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 o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.
 - 3. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- E. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. 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. Arrange directionally patterned acoustical panels as follows:
 - a. As indicated on reflected ceiling plans.
 - 2. For reveal-edged panels on suspension system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
 - 3. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
 - 4. Install hold-down clips in areas indicated or in areas required by authorities having jurisdiction; space as recommended by panel manufacturer's written instructions, unless otherwise indicated.
 - 5. Protect lighting fixtures and air ducts to comply with requirements indicated for fire-resistance-rated assembly.

3.4 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

SECTION 09 65 00 - RESILIENT FLOORING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Resilient sheet flooring.
- B. Resilient tile flooring.
- C. Resilient base.
- D. Installation accessories.

1.2 RELATED REQUIREMENTS

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 09 05 61 - Common Work Results for Flooring Preparation: Independent agency testing of concrete slabs, cleaning, and preparation.

1.3 REFERENCE STANDARDS

- A. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.
- B. ASTM F1861 - Standard Specification for Resilient Wall Base.
- C. ASTM F2034 - Standard Specification for Sheet Linoleum Floor Covering.
- D. BAAQMD 8-51 - Bay Area Air Quality Management District Regulation 8, Rule 51, Adhesive and Sealant Products; www.baaqmd.gov.
- E. SCAQMD 1168 - South Coast Air Quality Management District Rule No.1168; www.aqmd.gov.

1.4 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
- C. Verification Samples: Submit two samples, 6 x 6 inches in size illustrating color and pattern for each resilient flooring product specified.
- D. Concrete Testing Standard: See Section 09 05 61 for concrete testing requirements for pH, moisture vapor emission and relative humidity.
- E. Maintenance Data: Include three (3) copies of maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.
- F. LEED Report: Report recycled content and VOC emission of flooring; VOC content of adhesives.
 - 1. For linoleum flooring, report rapidly-renewable content and urea-formaldehyde content.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 - 2. Extra Flooring Material: 20 square feet of each type and color.

3. Extra Wall Base: 20 linear feet of each type and color.

H. LEED Submittal: Documentation of recycled content and location of manufacture.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect roll materials from damage by storing on end.

1.6 FIELD CONDITIONS

A. Maintain temperature in storage area between 55 degrees F and 90 degrees F.

B. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F.

PART 2 - PRODUCTS

2.1 SHEET FLOORING

A. Welded Seam Sheet Vinyl:

1. Heat welded seams.
2. Integral coved base with cap strip. Provide where indicated on the Room Finish Schedule.
3. Pattern: See Finish Schedule.
4. Manufacturers: See Finish Schedule.
 - a. Substitutions: See Section 01 60 00 - Product Requirements.

B. Linoleum:

1. Minimum Requirements: Comply with ASTM F2034, Type corresponding to type specified.
2. Backing: Jute fabric.
3. Wear Layer Thickness: 0.098 inch, minimum, excluding backing.
4. Sheet Width: 79 inch, minimum.
5. Pattern: See Finish Schedule.
6. Seams: Heat welded.
7. Manufacturers: See Finish Schedule.
 - a. Substitutions: See Section 01 60 00 - Product Requirements.

C. Vinyl Welding Rod: Solid vinyl bead produced by manufacturer of vinyl flooring for heat welding seams, in color matching field color.

D. Linoleum Welding Rod: Solid color linoleum produced by flooring manufacturer for heat welding seams, in color in color matching predominant flooring color.

2.2 TILE FLOORING

A. Vinyl Composition Tile: Homogeneous, with color extending throughout thickness.

1. Size: See Finish Schedule.
2. Pattern: See Finish Schedule.
3. Manufacturers: See Finish Schedule.
 - a. Substitutions: See Section 01 60 00 - Product Requirements.

2.3 RESILIENT BASE

- A. Millwork Resilient Base: ASTM F 1861, Type TS rubber, vulcanized thermoset; Group 1, and as follows:
 - 1. Finish: See Finish Schedule.
 - 2. Length: Roll.
 - 3. Color: See Finish Schedule.
 - 4. Manufacturers:
 - a. Armstrong World Industries: www.armstrong.com
 - b. Burke Flooring: www.burkemercer.com.
 - c. Nora: www.nora.com
 - d. Johnsonite, Inc: www.johnsonite.com. (Basis of Design)
 - e. Roppe Corp: www.roppe.com.
 - f. Substitutions: See Section 01 60 00 - Product Requirements.

2.4 ACCESSORIES

- A. Subfloor Filler: White premix latex; type recommended by adhesive material manufacturer.
- B. Primers, Adhesives, and Seaming Materials: Waterproof; types recommended by flooring manufacturer.
 - 1. Provide only products having lower volatile organic compound (VOC) content than required by the more stringent of the South Coast Air Quality Management District Rule No.1168 and the Bay Area Air Quality Management District Regulation 8, Rule 51.
- C. Moldings and Edge Strips: Metal or Rubber: See Finish Schedule.
- D. Filler for Coved Base: Plastic fillet strip 1 inch radius.
- E. Sealer and Wax: Types recommended by flooring manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.
- B. Cementitious Sub-floor Surfaces: Verify that substrates are dry enough and ready for resilient flooring installation by testing for moisture, relative humidity and pH.
 - 1. Test in accordance with Section 09 05 61.
 - 2. Obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.
- C. Verify that required floor-mounted utilities are in correct location.

3.2 PREPARATION

- A. Prepare floor substrates for installation of flooring in accordance with Section 09 05 61.

3.3 INSTALLATION

- A. Starting installation constitutes acceptance of sub-floor conditions.

- B. Install in accordance with manufacturer's instructions.
- C. Spread only enough adhesive to permit installation of materials before initial set.
- D. Fit joints tightly.
- E. Set flooring in place, press with heavy roller to attain full adhesion.
- F. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.
- G. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.
 - 1. Metal Strips: Attach to substrate before installation of flooring using stainless steel screws.
 - 2. Resilient Strips: Attach to substrate using adhesive.
- H. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

3.4 SHEET FLOORING

- A. Lay flooring with joints and seams in accordance with seaming plan. Lay out seams to avoid widths less than 1/3 of roll width; match patterns carefully at seams.
- B. Double cut sheet at seams.
- C. Lay flooring with tightly butted seams, without any seam sealer unless otherwise indicated.
- D. Finish seams in sheet vinyl by heat welding.
- E. Finish seams in linoleum by heat welding.
- F. Double cut sheet; provide heat welded seams where indicated on Room Finish Schedule.
- G. Coved Base: Install as detailed on drawings, using coved base filler as backing at floor to wall junction. Extend sheet flooring vertically to height indicated, and cover top edge with metal cap strip.

3.5 TILE FLOORING

- A. Install in accordance with manufacturer's instructions.
- B. Mix tile from container to ensure shade variations are consistent when tile is placed, unless manufacturer's instructions say otherwise.
- C. Spread only enough adhesive to permit installation of materials before initial set.
- D. Set flooring in place, press with heavy roller to attain full adhesion.
- E. Lay flooring with joints and seams parallel to building lines to produce symmetrical tile pattern.

3.6 RESILIENT BASE

- A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches between joints.
- B. Field miter internal and external corners.

C. Install base on solid backing. Bond tightly to wall and floor surfaces.

D. Scribe and fit to door frames and other interruptions.

3.7 CLEANING

A. Remove excess adhesive from floor, base, and wall surfaces without damage.

B. Clean, seal, and wax in accordance with manufacturer's instructions.

3.8 PROTECTION

A. Prohibit traffic on resilient flooring for 48 hours after installation.

END OF SECTION

SECTION 09 67 23 - RESINOUS FLOORING

PART 1 - GENERAL

1.1 SUMMARY

- A. Definition (Animal Holding Floors): Resinous flooring includes penetrating, moisture tolerant, two-component epoxy primer, a high performance, three-component mortar consisting of epoxy resin, curing agent and selected, graded aggregates blended with inorganic pigments, a two-component, general service epoxy coating and a two component high performance aliphatic polyurethane coating.
- B. Definition (Cagewash): Resinous flooring includes a high performance, four-component mortar consisting of urethane resin, curing agent, selected, graded aggregates and inorganic pigments, quartz silica broadcast and sealed with a two-component, urethane coating.
- C. Related Work
 - 1. Section 07 90 05 – Joint Sealers.

1.2 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Submit manufacturer's technical data, installation instructions, and general recommendations for each resinous flooring material required. Include certification indicating compliance of materials with requirements.
- C. Samples: Submit, for verification purposes, 4-inch square samples of each type of resinous flooring required, applied to a rigid backing, in color and finish indicated.
 - 1. For initial selection of colors and finishes, submit manufacturer's color charts showing full range of colors and finishes available.

1.3 QUALITY ASSURANCE

- A. Single Source Responsibility: Obtain primary resinous flooring materials including primers, resins, hardening agents, finish or sealing coats from a single manufacturer with not less than ten years of successful experience in manufacturing and installing principal materials described in this section. Contractor shall have completed at least five projects of similar size and complexity; Stonhard or approved equal. Provide secondary materials only of type and from source recommended by manufacturer of primary materials.
- B. Pre-Installation Conference
 - 1. General contractor shall arrange a meeting not less than thirty days prior to starting work.
 - 2. Attendance:
 - a. General Contractor.
 - b. Architect/Owner's Representative.
 - c. Manufacturer/Installer's Representative.
- C. ISO 9002: All materials, including primers, resins, curing agents, finish coats, aggregates and sealants are manufactured and tested under an ISO 9002 registered quality system.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Material shall be delivered to job site and checked by flooring contractor for completeness and shipping damage prior to job start.
- B. All materials used shall be factory pre-weighed and pre-packaged in single, easy to manage batches to eliminate on site mixing errors. No on site weighing or volumetric measurements allowed.
- C. Material shall be stored in a dry, enclosed area protected from exposure to moisture. Temperature of storage area shall be maintained between 60 and 85 deg.F/16 and 30 deg. C.

1.5 PROJECT CONDITIONS

- A. Concrete substrate shall be properly cured for a minimum of 30 days. A vapor barrier must be present for concrete subfloors on or below grade. Otherwise, an osmotic pressure resistant grout must be installed prior to the resinous flooring.
- B. Utilities, including electric, water, heat (air temperature between 60 and 85 deg. F/16 and 30 deg. C) and finished lighting to be supplied by General Contractor.
- C. Job area to be free of other trades during, and for a period of 24 hours, after floor installation.
- D. Protection of finished floor from damage by subsequent trades shall be the responsibility of the General Contractor.

1.6 WARRANTY

- A. Manufacturer shall furnish a single, written warranty covering both material and workmanship for a period of one (1) full year from date of installation.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Stonhard, 1000 East Park Avenue, Maple Shade, NJ 08052, Phone: (800) 257-7953, Fax: (856) 321-7525; www.stonhard.com
- B. Other Acceptable Manufacturers provided they meet the intent of the specification as interpreted by the Architect:
 - 1. Crossfield Products Corp.
 - 2. BASF Construction Chemicals-Building Systems.

2.2 COLORS

- A. Colors: See Finish Schedule.

2.3 RESINOUS FLOORING (EPOXY FLOORING AT ANIMAL HOLDING FLOORS)

- A. Stonclad GS coated with Stonkote GS4 and Stonseal GS6 as manufactured by Stonhard, Inc., Maple Shade, NJ, (800) 257-7953 is a nominal 1/4"/6mm thick system comprised of a penetrating, moisture tolerant, two-component epoxy primer, a high performance, three-component mortar consisting of epoxy resin, curing agent and selected, graded aggregates blended with inorganic pigments, a two-component, 100% solids, general service, epoxy coating and a two component high performance aliphatic polyurethane coating.

1. Physical Properties: Provide flooring system in which physical properties of topping including aggregate, when tested in accordance with standards or procedures referenced below, are as follows:

Compressive Strength (ASTM C-579)	10,000 psi
Tensile Strength (ASTM C-307)	1,750 psi
Flexural Strength (ASTM C-580)	4,000 psi
Hardness (ASTM D-2240/Shore D Durometer)	85-90
Bond Strength (ASTM D-4541)	>400 psi (100% concrete failure)
Impact Resistance (ASTM D-4226)	>160 in. lbs.
Abrasion Resistance (ASTM D-4060, Taber Abrader CS-17 wheel)	0.08 gm max. weight loss
Coefficient of Friction (ASTM D-2047)	0.75
Flexural Modulus of Elasticity (ASTM C-580)	2.0 x 10 ⁶ psi
Flammability (ASTM D-635)	Self Extinguishing Extent of burning 0.25 inches max.
Thermal Coefficient of Linear Expansion (ASTM C-531)	1.5 x 10 ⁻⁵ in/inC
Water Absorption (ASTM C-413)	0.2%
Heat Resistance Limitation	140 deg. F/60 deg. C (for continuous exposure) 200 deg. F/93 deg. C (for intermittent spills)
Cure Rate allow (at 77oF/25oC)	8 hours for foot traffic 24 hours for normal operations

2.4 RESINOUS FLOORING (CAGEWASH)

- A. Stonclad UT coated with Stonseal UT7 Sealer as manufactured by Stonhard, Inc., Maple Shade, NJ, (800) 257-7953 is a nominal 1/4 inch thick system comprised of a high performance, four-component mortar consisting of urethane resin, curing agent, selected, graded aggregates and inorganic pigments quartz silica broadcast and sealed with a two-component, 100% solids, urethane coating.

1. Physical Properties: Provide flooring system in which physical properties of topping including aggregate, when tested in accordance with standards or procedures referenced below, are as follows:

Compressive Strength (ASTM C-579)	7,700 psi
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Tensile Strength (ASTM C-307)	1,000 psi
Flexural Strength (ASTM C-580)	2,400 psi
Hardness (ASTM D-2240/Shore D Durometer)	80-84
Bond Strength (ASTM D-4541)	>400 psi (100% concrete failure)
Impact Resistance (ASTM D-4226)	>160 in. lbs.
Abrasion Resistance (ASTM D-4060, Taber Abrader CS-17 wheel)	0.08 gm max. weight loss
Coefficient of Friction: (ASTM D-2047)	Dependent upon broadcast texture selection

2.5 JOINT SEALANT MATERIALS

- A. Type produced by manufacturer of resinous flooring system for type of service and joint condition indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.
- B. Cementitious Sub-floor Surfaces: Verify that substrates are dry enough and ready for resilient flooring installation by testing for moisture and pH.
 1. Test in accordance with Section 09 05 61.
 2. Obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.
- C. Verify that required floor-mounted utilities are in correct location.

3.2 PREPARATION

- A. Substrate: Concrete preparation shall be by mechanical means and include use of a scabber, scarifier or shot blast machine for removal of bond inhibiting materials such as curing compounds or laitance.

3.3 APPLICATION (ANIMAL HOLDING FLOORS)

- A. General: Apply each component of resinous flooring system in compliance with manufacturer's directions to produce a uniform monolithic wearing surface of thickness indicated, uninterrupted except at divider strips, sawn joints or other types of joints (if any), indicated or required.
- B. Primer: Mix and apply primer over properly prepared substrate with strict adherence to manufacturer's installation procedures and coverage rates. Coordinate timing of primer

application with application of troweled mortar to ensure optimum adhesion between resinous flooring materials and substrate.

- C. Troweled Mortar: Mix mortar material according to manufacturer's recommended procedures. Uniformly spread mortar over substrate using manufacturer's specially designed screed box adjusted to manufacturer's recommended height. Hand trowel apply mixed material over freshly primed substrate using stainless steel finishing trowels.
- D. Coating: Remove any surface imperfections by lightly abrading and vacuuming the floor surface. Mix, squeegee apply and backroll coating with strict adherence to manufacturer's installation procedures and coverage rates.
- E. Sealer: Mix polyurethane sealer according to manufacturer's recommended procedures. Roller apply (do not squeegee) with a medium nap roller according to manufacturer's installation procedures and coverage rates.
- F. Base: Provide 6 inch high base at all floor areas.
- G. Sealer: Remove excess unbonded granules by lightly brushing and vacuuming the floor surface. Mix and apply sealer with strict adherence to manufacturer's installation procedures.

3.4 APPLICATION (CAGEWASH)

- A. General: Apply each component of resinous flooring system in compliance with manufacturer's directions to produce a uniform monolithic wearing surface of thickness indicated, uninterrupted except at divider strips, sawn joints or other types of joints (if any), indicated or required.
- B. Troweled Mortar: Mix mortar material according to manufacturer's recommended procedures. Uniformly spread mortar over substrate at manufacturer's recommended height using specially designed trowel. Broadcast desired texture directly into mortar base.
- C. Coating: Vacuum the floor surface. Mix and roller apply Stonseal UT7 Sealer with strict adherence to manufacturer's installation procedures and coverage rates.

3.5 FIELD QUALITY CONTROL

- A. The right is reserved to invoke the following material testing procedure at any time, and any number of times during period of flooring application.
- B. The Owner will engage service of an independent testing laboratory to sample materials being used on the job site. Samples of material will be taken, identified and sealed, and certified in presence of Contractor.
- C. Testing laboratory will perform tests for any of characteristics specified, using applicable testing procedures referenced herein, or if none referenced, in manufacturer's product data.
- D. If test results show materials being used do not comply with specified requirements, Contractor may be directed by Owner to stop work; remove non-complying materials; pay for testing; reapply flooring materials to properly prepared surfaces which had previously been coated with unacceptable materials.

3.6 CURING, PROTECTION AND CLEANING

- A. Cure resinous flooring materials in compliance with manufacturer's directions, taking care to prevent contamination during stages of application and prior to completion of curing process. Close area of application for a minimum of 24 hours.
- B. Protect resinous flooring materials from damage and wear during construction operation. Where temporary covering is required for this purpose, comply with manufacturer's recommendations for protective materials and method of application. General Contractor is responsible for protection and cleaning of surfaces after final coats.
- C. Cleaning: Remove temporary covering and clean resinous flooring just prior to final inspection. Use cleaning materials and procedures recommended by resinous flooring manufacturer.

END OF SECTION

SECTION 09 68 13 - TILE CARPETING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes modular, tufted carpet tile.
- B. Related Sections include the following:
 - 1. Division 01 Section "LEED Requirements" for additional LEED requirements.
 - 2. Division 09 Section "Common Work Results for Flooring Preparation" for removing existing floor coverings and testing of existing concrete slabs.
 - 3. Division 09 Section "Resilient Flooring" for resilient wall base and accessories installed with carpet tile.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated. Include manufacturer's written data on physical characteristics, durability, and fade resistance. Include installation recommendations for each type of substrate.
- B. Shop Drawings: Show the following:
 - 1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
 - 2. Carpet tile type, color, and dye lot.
 - 3. Type of subfloor.
 - 4. Type of installation.
 - 5. Pattern of installation.
 - 6. Pattern type, location, and direction.
 - 7. Pile direction.
 - 8. Type, color, and location of edge, transition, and other accessory strips.
 - 9. Transition details to other flooring materials.
- C. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.
 - 1. Carpet Tile: Full-size Sample.
- D. LEED Submittals:
 - 1. Credit EQ 4.3: Manufacturers' product data for carpet tile, including printed statement of VOC content.
- E. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:
 - 1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
 - 2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.
- F. Warranty: Special warranty specified in this Section.

1.3 QUALITY ASSURANCE

- A. **Installer Qualifications:** An experienced installer who is certified by the Floor Covering Installation Board or who can demonstrate compliance with its certification program requirements.
- B. **Preinstallation Conference:** Conduct conference at Project site to comply with requirements in Division 01 Section "Administrative Requirements." Review methods and procedures related to carpet tile installation including, but not limited to, the following:
 - 1. Review delivery, storage, and handling procedures.
 - 2. Review ambient conditions and ventilation procedures.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Comply with CRI 104, Section 5, "Storage and Handling."

1.5 PROJECT CONDITIONS

- A. Comply with CRI 104, Section 7.2, "Site Conditions; Temperature and Humidity" and Section 7.12, "Ventilation."
- B. **Environmental Limitations:** Do not install carpet tiles until wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.
- D. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

1.6 WARRANTY

- A. **Special Warranty for Carpet Tiles:** Manufacturer's standard form in which manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.
 - 1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
 - 2. Failures include, but are not limited to, more than 10 percent loss of face fiber, edge raveling, snags, runs, loss of tuft bind strength, and delamination.
 - 3. **Warranty Period:** 10 years from date of Substantial Completion.

1.7 EXTRA MATERIALS

- A. **Furnish extra materials** described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. **Carpet Tile:** Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd..

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:
 - 1. Basis-of-Design Product: The design for each carpet type is based on the product named. Subject to compliance with requirements, provide either the named product or a comparable product approved by the Architect.

2.2 CARPET TILE

- A. Provide carpet tile indicated in the Finish Schedule.

2.3 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.
- B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet tile and is recommended by carpet tile manufacturer for releasable installation.
 - 1. VOC Limits: Provide adhesives that comply with the following limits for VOC content when tested according to ASTM D 5116:
 - a. Total VOCs: 10.00 mg/sq. m x h.
 - b. Formaldehyde: 0.05 mg/sq. m x h.
 - c. 2-Ethyl-1-Hexanol: 3.00 mg/sq. m x h.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that sub-floor surfaces are smooth and flat within tolerances specified for that type of work and are ready to receive carpet tile.
- B. Verify that sub-floor surfaces are dust-free and free of substances that could impair bonding of adhesive materials to sub-floor surfaces.
- C. Cementitious Sub-floor Surfaces: Verify that substrates are dry enough and ready for flooring installation by testing for moisture and pH.
 - 1. Test in accordance with Section 09 05 61.
 - 2. Obtain instructions if test results are not within limits recommended by flooring material manufacturer and adhesive materials manufacturer.

3.2 PREPARATION

- A. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch wide or wider and protrusions more than 1/32 inch, unless more stringent requirements are required by manufacturer's written instructions.

3.3 INSTALLATION

- A. General: Comply with CRI 104, Section 14, "Carpet Modules," and with carpet tile manufacturer's written installation instructions.
- B. Installation Method: As recommended in writing by carpet tile manufacturer.
- C. Maintain dye lot integrity. Do not mix dye lots in same area.
- D. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.
- E. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.
- G. Stagger joints of carpet tiles so carpet tile grid is offset from access flooring panel grid. Do not fill seams of access flooring panels with carpet adhesive; keep seams free of adhesive.

3.4 CLEANING AND PROTECTION

- A. Perform the following operations immediately after installing carpet tile:
 - 1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet tile manufacturer.
 - 2. Remove yarns that protrude from carpet tile surface.
 - 3. Vacuum carpet tile using commercial machine with face-beater element.
- B. Protect installed carpet tile to comply with CRI 104, Section 16, "Protection of Indoor Installations."
- C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION

SECTION 09 90 00 - PAINTING AND COATING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Surface preparation.
- B. Field application of paints.
- C. Scope: Finish all interior surfaces exposed to view, unless fully factory-finished
- D. Do Not Paint or Finish the Following Items:
 - 1. Items fully factory-finished unless specifically so indicated; materials and products having factory-applied primers are not considered factory finished.
 - 2. Items indicated to receive other finishes.
 - 3. Items indicated to remain unfinished.
 - 4. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
 - 5. Floors, unless specifically so indicated.
 - 6. Glass.
 - 7. Concealed pipes, ducts, and conduits.

1.2 RELATED REQUIREMENTS

- A. Section 01 35 15 - LEED Certification Procedures: LEED rating system definition.
- B. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
- C. Section 05 50 00 - Metal Fabrications: Shop-primed items.

1.3 REFERENCE STANDARDS

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency.
- B. USGBC LEED-NC - LEED Green Building Rating System for New Construction and Major Renovations; U.S. Green Building Council.

1.4 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Provide complete list of all products to be used, with the following information for each:
 - 1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
 - 2. MPI product number (e.g. MPI #47).
 - 3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.
 - 4. Manufacturer's installation instructions.
 - 5. If proposal of substitutions is allowed under submittal procedures, explanation of all substitutions proposed.

- C. Samples: Submit three paper "drop" samples, 8-1/2 by 11 inches in size, illustrating range of colors available for each finishing product specified.
 - 1. Where sheen is specified, submit samples in only that sheen.
- D. Certification: By manufacturer that all paints and coatings comply with VOC limits specified.
- E. LEED Report: VOC content of all interior opaque coatings actually used.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 - 2. Extra Paint and Coatings: 1 gallon of each color; store where directed.
 - 3. Label each container with color in addition to the manufacturer's label.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.6 FIELD CONDITIONS

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
- B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
- C. Minimum Application Temperatures for Latex Paints: 45 degrees F for interiors; unless required otherwise by manufacturer's instructions.
- D. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Provide all paint and coating products used in any individual system from the same manufacturer; no exceptions.
- B. Paints:
 - 1. Base Manufacturer: Sherwin Williams: www.sherwin-williams.com.
 - 2. Glidden Professional: www.gliddenprofessional.com.
 - 3. Benjamin Moore & Co: www.benjaminmoore.com.
 - 4. PPG Architectural Finishes, Inc: www.ppgaf.com.
 - 5. Pratt & Lambert Paints: www.prattandlambert.com.
- C. Primer Sealers: Same manufacturer as top coats.
- D. Substitutions: See Section 01 60 00 - Product Requirements.

2.2 PAINTS AND COATINGS - GENERAL

- A. Paints and Coatings: Ready mixed, unless intended to be a field-catalyzed coating.
 - 1. Where MPI paint numbers are specified, provide products listed in Master Painters Institute Approved Product List, current edition available at www.paintinfo.com, for specified MPI categories, except as otherwise indicated.
 - 2. Provide paints and coatings capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
 - 3. For opaque finishes, tint each coat including primer coat and intermediate coats, one-half shade lighter than succeeding coat, with final finish coat as base color.
 - 4. Supply each coating material in quantity required to complete entire project's work from a single production run.
 - 5. Do not reduce, thin, or dilute coatings or add materials to coatings unless such procedure is specifically described in manufacturer's product instructions.
- B. Primers: Where the manufacturer offers options on primers for a particular substrate, use primer categorized as "best" by the manufacturer.
- C. Volatile Organic Compound (VOC) Content:
 - 1. Provide coatings that comply with the most stringent requirements specified in the following:
 - a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.
 - b. Ozone Transport Commission (OTC) Model Rule, Architectural, Industrial, and Maintenance Coatings; www.otcair.org; specifically:
 - 1) Opaque, Flat: 50 g/L, maximum.
 - 2) Opaque, Nonflat: 150 g/L, maximum.
 - 3) Opaque, High Gloss: 250 g/L, maximum.
 - 4) Varnishes: 350 g/L, maximum.
 - c. Architectural coatings VOC limits of South Carolina.
 - d. USGBC LEED Rating System, edition as stated in Section 01 35 15; for interior wall and ceiling finish (all coats), anti-corrosive paints on interior ferrous metal, clear wood stains and finishes, sanding sealers, other sealers, shellac, and floor coatings.
 - 2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.
- D. Colors: As indicated on drawings
 - 1. In finished areas, finish pipes, ducts, conduit, and equipment the same color as the wall/ceiling they are mounted on/under.

2.3 PAINT SYSTEMS - INTERIOR

- A. All Interior Ceiling Surfaces Indicated to be Painted: Including gypsum board.
 - 1. Two top coats and one coat primer.
 - 2. Top Coat(s): MPI Institutional Low Odor/VOC Interior Latex; MPI #143-148.
 - 3. Flat: MPI gloss level 1; use this sheen for ceilings and other overhead surfaces.

4. Top Coat Product(s):
 - a. Sherwin-Williams Harmony Low Odor Interior Latex.
 5. Primer(s): As follows unless other primer is required or recommended by manufacturer of top coats:
 - a. All Substrates: MPI #149, Institutional Low Odor/VOC Primer Sealer, unless a different primer is specified.
- B. Medium Duty Vertical Surfaces: Including gypsum board, concrete masonry, uncoated steel, shop primed steel, and galvanized steel.
1. Two top coats and one coat primer.
 2. Top Coat(s): MPI High Performance Architectural Interior Latex; MPI #138-141.
 3. Eggshell: MPI gloss level 3; use this sheen at gypsum board walls.
 4. Semi-Gloss: MPI gloss level 5; use this sheen at all metal surfaces.
 5. Top Coat Product(s):
 - a. Sherwin-Williams Harmony Low Odor Interior Latex.
 6. Primer(s): As recommended by manufacturer of top coats.
- C. Epoxy Surfaces: Including gypsum board.
1. Applications: See Finish Schedule.
 2. Two top coats and one coat primer; primer may be omitted if top coat manufacturer approves.
 3. Top Coat(s): MPI High-Build Epoxy, Gloss; MPI #98.
 4. Gloss: MPI gloss level 6; use this sheen at epoxy locations.
 5. Top Coat Product(s):
 - a. Sherwin-Williams Tile-Clad HS Epoxy.
 6. Primer(s): As recommended by manufacturer of top coats.

2.4 ACCESSORY MATERIALS

- A. Accessory Materials: Provide all primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials required to achieve the finishes specified whether specifically indicated or not; commercial quality.
- B. Patching Material: Latex filler.
- C. Fastener Head Cover Material: Latex filler.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.
- C. Test shop-applied primer for compatibility with subsequent cover materials.
- D. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
 1. Gypsum Wallboard: 12 percent.
 2. Concrete Unit Masonry: 12 percent.

3.2 PREPARATION

- A. Clean surfaces thoroughly and correct defects prior to coating application.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.
- D. Seal surfaces that might cause bleed through or staining of topcoat.
- E. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
- F. Unit Masonry Surfaces to be Painted: Remove dirt, loose mortar, scale, salt or alkali powder, and other foreign matter. Remove oil and grease with a solution of tri-sodium phosphate; rinse well and allow to dry. Remove stains caused by weathering of corroding metals with a solution of sodium metasilicate after thoroughly wetting with water. Allow to dry.
- G. Gypsum Board Surfaces to be Painted: Fill minor defects with filler compound. Spot prime defects after repair.
- H. Galvanized Surfaces to be Painted: Remove surface contamination and oils and wash with solvent. Apply coat of etching primer.
- I. Corroded Steel and Iron Surfaces to be Painted: Prepare using at least SSPC-PC 2 (hand tool cleaning) or SSPC-SP 3 (power tool cleaning) followed by SSPC-SP 1 (solvent cleaning).
- J. Uncorroded Uncoated Steel and Iron Surfaces to be Painted: Remove grease, mill scale, weld splatter, dirt, and rust. Where heavy coatings of scale are evident, remove by hand or power tool wire brushing or sandblasting; clean by washing with solvent. Apply a treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Prime paint entire surface; spot prime after repairs.
- K. Shop-Primed Steel Surfaces to be Finish Painted: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.

3.3 APPLICATION

- A. Apply products in accordance with manufacturer's instructions.
- B. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- C. Apply each coat to uniform appearance.
- D. Sand wood and metal surfaces lightly between coats to achieve required finish.
- E. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

- F. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

END OF SECTION

SECTION 09 97 26 - SPECIAL COATINGS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Resinous wall system includes two-component epoxy primer, two-component, epoxy saturant, a woven fiberglass engineering fabric, and a two-component, high performance, high solids epoxy glaze coating.

1.2 RELATED SECTIONS

- A. Section 07 90 05 - Joint Sealers.

1.3 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Submit manufacturer's technical data, installation instructions, and general recommendations for each resinous wall material required. Include certification indicating compliance of materials with requirements.
- C. Samples: Submit, for verification purposes, 4-inch square samples of each type of resinous wall system required, applied to a rigid backing, in color and finish indicated.
 - 1. For initial selection of colors and finishes, submit manufacturer's color charts showing full range of colors and finishes available.

1.4 QUALITY ASSURANCE

- A. Single Source Responsibility: Obtain primary resinous wall materials including primers, resins, hardening agents, finish or sealing coats from a single manufacturer with not less than ten years of successful experience in manufacturing and installing principal materials described in this section. Contractor shall have completed at least five projects of similar size and complexity; Stonhard or approved equal. Provide secondary materials only as provided by manufacturer of primary materials.
- B. Pre-Installation Conference
 - 1. General contractor shall arrange a meeting not less than thirty days prior to starting work.
 - 2. Attendance:
 - a. General Contractor
 - b. Architect/Owner's Representative
 - c. Manufacturer/Installer's Representative
 - 3. ISO 9002: All materials, including primers, resins, curing agents, finish coats, aggregates and sealants are manufactured and tested under an ISO 9002 registered quality system.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Material shall be delivered to job site and checked by wall contractor for completeness and shipping damage prior to job start.
- B. All materials used shall be factory pre-weighed and pre-packaged in single, easy to manage batches to eliminate on site mixing errors. Manufacturer's information must be printed on each individual component to insure against re-packaging by someone other than the original manufacturer. No on site weighing or volumetric measurements allowed.

- C. Material shall be stored in a dry, enclosed area protected from exposure to moisture. Temperature of storage area shall be maintained between 60 and 85 deg. F/16 and 30 deg. C.

1.6 PROJECT CONDITIONS

- A. Drywall, including joint work, must be completely finished at least 3 days prior to wall system installation.
- B. Utilities, including electric, water, heat (air temperature between 60 and 85 deg. F/16 and 30 deg. C) and finished lighting to be supplied by General Contractor.
- C. Job area to be free of other trades during, and for a period of 24 hours, after wall installation.
- D. Protection of finished walls from damage by subsequent trades shall be the responsibility of the General Contractor.

1.7 WARRANTY

- A. Manufacturer shall furnish a single, written warranty covering both material and workmanship for a period of one (1) full year from date of installation. In the event it is a manufacturer's material warranty only, the applicator must provide a warranty covering workmanship for the same duration as the manufacturer's material warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Special Coatings:
 - 1. Dexotex: www.dex-o-tex.com.
 - 2. Dudick Inc.: www.dudick.com
 - 3. Stonhard, Inc.: www.stonhard.com. (Basis of Design)
 - 4. Substitutions: Section 01 60 00 - Product Requirements.

2.2 COLORS

- A. Colors: As indicated in the Finish Schedule.

2.3 EPOXY COATING

- A. Stonglaze VSD as manufactured by Stonhard, Inc., Maple Shade, NJ, (800) 257-7953 is a nominal 25 mils/635 microns thick system comprised of a two-component, epoxy saturant, a woven fiberglass engineering fabric and a two-component, high performance, high solids, epoxy glaze coating.
 - 1. Physical Properties: Provide wall system in which physical properties of topping when tested in accordance with standards or procedures referenced below, are as follows:

Percent Solids	92 percent
Hardness (ASTM D-2240/Shore D Durometer)	85-90
Bond Strength (ASTM D-4541)	>400 psi (100% concrete failure)
Impact Resistance (ASTM D-2794)	Exceeds 70 in. lbs. No cracking, crazing or loss of adhesion.

Abrasion Resistance (ASTM D-4060, Taber Abrader CS-17 wheel)	0.08 gm max. weight loss
Fire Resistance of Dry Film Heat Resistance Limitation	Self-Extinguishing 140 deg. F/60 deg. C (for continuous exposure) 200 deg. F/93 deg. C (for intermittent spills) 24 hours for normal operations
Cure Rate allow (at 77 deg.F/25 deg. C)	
VOC (ASTM D-2364)	0.4 lbs/gal

2.4 JOINT SEALANT MATERIALS

- A. Type produced by manufacturer of resinous wall system for type of service and joint condition indicated.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Substrate: Drywall shall be clean and free of bond inhibiting materials such as previously applied coatings and shall be taped and spackled to a level 3 finish. Preparation of existing coatings shall be by mechanical means and may include light sanding.

3.2 APPLICATION

- A. General: Apply each component of resinous wall system in compliance with manufacturer's directions to produce a uniform monolithic wearing surface of thickness indicated, uninterrupted except at divider strips, sawn joints or other types of joints (if any), indicated or required.
- B. Saturant: Mix and apply material according to manufacturer's recommended procedures.
- C. Fiberglass Engineering Fabric: Pre-cut and apply woven fiberglass engineering fabric according to manufacturer's recommended procedures.
- D. Coating: Mix material according to manufacturer's recommended procedures. Please note that solvent reduction of any kind is strictly prohibited. Apply material immediately after mixing using high quality rollers or an airless sprayer. Strict adherence to manufacturer's coverage rates is imperative.

3.3 FIELD QUALITY CONTROL

- A. The right is reserved to invoke the following material testing procedure at any time, and any number of times during period of wall application.
- B. The Owner will engage service of an independent testing laboratory to sample materials being used on the job site. Samples of material will be taken, identified and sealed, and certified in presence of Contractor.

- C. Testing laboratory will perform tests for any of characteristics specified, using applicable testing procedures referenced herein, or if none referenced, in manufacturer's product data.
- D. If test results show materials being used do not comply with specified requirements, Contractor may be directed by Owner to stop work; remove non-complying materials; pay for testing; reapply wall materials to properly prepared surfaces which had previously been coated with unacceptable materials.

3.4 CURING, PROTECTION AND CLEANING

- A. Cure resinous wall materials in compliance with manufacturer's directions, taking care to prevent contamination during stages of application and prior to completion of curing process. Close area of application for a minimum of 24 hours.
 - 1. Protect resinous wall materials from damage and wear during construction operation. Where temporary covering is required for this purpose, comply with manufacturer's recommendations for protective materials and method of application. General Contractor is responsible for protection and cleaning of surfaces after final coats.
 - 2. Cleaning: Remove temporary covering and clean resinous wall system just prior to final inspection. Use cleaning materials and procedures recommended by resinous wall system manufacturer.

END OF SECTION

SECTION 10 11 01 - VISUAL DISPLAY BOARDS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Markerboards and Tackboards.

1.2 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Blocking and supports.

1.3 REFERENCE STANDARDS

- A. ANSI A208.1 - American National Standard for Particleboard.
- B. ASTM A424 - Standard Specification for Steel, Sheet, for Porcelain Enameling.

1.4 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Provide manufacturer's data on markerboard, trim, and accessories.
- C. Shop Drawings: Indicate wall elevations, dimensions, joint locations, special anchor details.
- D. Samples: Submit color charts for selection of color and texture of markerboard and trim.

1.5 WARRANTY

- A. See Section 01 77 00 - Closeout Procedures, for additional warranty requirements.
- B. Provide five year warranty for markerboard to include warranty against discoloration due to cleaning, crazing or cracking, and staining.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Visual Display Boards:
 - 1. MooreCo, Inc\Best-Rite: www.moorecoinc.com.
 - 2. Claridge Products and Equipment, Inc: www.claridgeproducts.com. (Basis of Design)
 - 3. Ghent Manufacturing: www.ghent.com
 - 4. Polyvision Corporation (Nelson Adams): www.polyvision.com.
 - 5. Substitutions: See Section 01 60 00 - Product Requirements.

2.2 VISUAL DISPLAY BOARDS

- A. Markerboards: Porcelain enamel on steel, laminated to core.
 - 1. Color: As selected from manufacturer's full range.
 - 2. Metal Face Sheet Thickness: 0.024 inch (24 gage).
 - 3. Core: Particleboard, manufacturer's standard thickness, laminated to face sheet.
 - 4. Backing: Aluminum foil, laminated to core.
 - 5. Size: As indicated on drawings.
 - 6. Frame: Extruded aluminum, with concealed fasteners.
 - 7. Frame Profile: 5/8 inch mitered corner profile
 - 8. Frame Finish: Anodized, natural.

9. Accessories: Provide display rail and chalk tray.
 10. Use the following or any equivalent made by one of the listed manufacturers: "LCS" Series manufactured by Claridge.
- B. Tackboards: Fabric laminated to cork.
1. Cork Thickness: 7/32 inch.
 2. Fabric: Vinyl coated fabric.
 3. Frame: Extruded aluminum, with concealed fasteners.
 4. Frame Profile: Standard 5/8 inch mitered corner profile
 5. Frame Finish: Anodized, natural.
 6. Use the following or any equivalent made by one of the listed manufacturers: "Fabricork" as manufactured by Claridge.

2.3 MATERIALS

- A. Porcelain Enameled Steel Sheet: ASTM A424, Type I, Commercial Steel, with fired-on vitreous finish.
- B. Particleboard: ANSI A208.1; wood chips, set with waterproof resin binder, sanded faces.
- C. Foil Backing: Aluminum foil sheet, 0.005 inch thick.

2.4 ACCESSORIES

- A. Chalk Tray: Aluminum, manufacturer's standard profile one length piece for markerboard; molded ends; concealed fasteners, same finish as frame.
- B. Mounting Brackets: Concealed.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that internal wall blocking is ready to receive work and positioning dimensions are as indicated on shop drawings.

3.2 INSTALLATION

- A. Install boards in accordance with manufacturer's instructions.
- B. Secure units level and plumb.

3.3 CLEANING

- A. Clean board surfaces in accordance with manufacturer's instructions.

END OF SECTION

SECTION 10 22 26 - AUTOMATIC VERTICALLY FOLDING ACOUSTIC PARTITION

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Supply and installation of Automatic Vertically Folding Acoustical Wall(s) as shown on the architectural drawings. All necessary hardware, seals, lifting machinery, electrical controls are included.

1.2 RELATED WORK

- A. The main support steel beam for the wall, as well as the miscellaneous support steel for the lifting machinery for the Automatic Vertically Folding Acoustical Wall – Section 05 50 00.
- B. Bulkheads and sound insulation above, below, and in the fixed walls at both ends of the Automatic Vertically Folding Acoustical Wall, as per ASTM E557-77 - Section 07 21 00.
- C. All site wiring and connections for main power, including disconnect switches at each motor location. All site wiring and connections for control, including installation of key switches – Division 26.

1.3 SYSTEM DESCRIPTION

- A. Definition:
 1. Automatic Vertically Folding Acoustical Wall (from here on called Operable Wall) shall refer specifically to acoustical partitions that, when in the down position (closed) are hard, rigid, flat, plumb walls, made of a grid of rectangular acoustical panels, and when are lifted (opened), fold upward (vertically) without the use of any manual labor, in a manner similar to an accordion, into a pocket in the ceiling, between roof joists, or up between built in bulkheads. In the down (closed) position, the wall shall be comprised of two vertical planes of acoustical panels, separated by an acoustical air space.
 2. The operable wall shall open and close in a manner similar to an accordion, in that all wall panels fold and unfold at the exact same time, at the exact same rate.
 3. Compact Drive System:
 - a. The motor assembly is mounted directly above the centre line of the operable wall. Support steel is only required at one location.
 4. The operable wall shall be opened and closed using two spring return, 3 position key switches wired in series. Simultaneously turning the keys from the “off” position shall cause the wall to move in the designated direction “up” or “down”. When hand pressure is removed, the wall shall immediately stop. The operable wall shall stop in a quick and positive fashion without coasting. As a normal part of the operation, it shall be possible to partially open (or close) the wall, stop it and then reverse the operation. There shall be 2 key switches per operable wall, located on opposite sides of the wall at opposite ends of the wall, wired in series.
 5. From a fully open position, the wall shall be able to go through its entire cycle of closing and/or opening without any manual intervention.
 6. When the operable wall is being lowered (closed) it shall come automatically to rest once it has reached the fully down (closed) position.
 7. When the operable wall is being lifted (opened) it shall come automatically to rest once it has reached the fully up (open) position.

8. The operable wall shall automatically and acoustically seal against the floor without the need for any manual intervention. The floor seals shall leave a joint between the floor and the bottom acoustical panels of not more than approximately 2 inches.
9. The operable wall shall automatically and acoustically seal against the two end walls without the need for any manual intervention. The end seals shall act in such a way as not to come into contact with the end walls while the operable wall is in motion. The end seals shall leave a joint between the acoustical panels and the end walls of no more than approximately 1 inch. Seals that rub or brush against the end walls are not acceptable. Once the wall reaches the full down position, the end seals shall activate automatically. The key switch must be held for the duration of the operation.
10. The operable wall shall automatically and acoustically seal against the ceiling without any manual intervention. The top seals shall leave a joint between the top acoustical panels and the ceiling of the pocket of not more than approximately 2 inches.
11. The operable wall shall open and close at a constant nominal speed of approximately 5 to 10 vertical feet per minute.
12. When the operable wall is being lowered (closed), it shall stop if the leading (bottom) edge comes into firm contact with any object between it and the floor. The regular operation of the wall shall resume once the key switch has been released and the direction of the wall has been reversed and the obstruction removed.
13. The operable wall shall be visibly flat and rigid in the down (closed) position.
14. There shall be no exposed hinges, brackets, screws, and no part of the mechanical system shall be visible when the operable wall is in the down (closed) position.
15. All of the panel edges shall be right angled, with a minimum radius not more than 1/16 inch.
16. All of the panels shall be rectangular, nominally of the same size, unless requested otherwise by the architect.
17. Joints between panel, vertical and horizontal, shall be no more than approximately ½ inch wide.
18. For operable walls using the Compact Drive System, the operable wall shall stack in the up (open) position into a space no greater than 65 inches wide. The operable wall shall have a stacking height ratio in the range of 1:5 to 1:10, depending on the height of the wall.
19. Each acoustical panel shall be individually removable using only a screw driver. No special tools or equipment shall be required. The removal of a single acoustical panel shall not affect, dislocate or cause the removal of any adjacent panels or other acoustical panels.
20. The operable wall shall be mechanically operable with a few of the acoustical panels removed from one, or both sides of the operable wall.
21. The operable wall shall not weigh more than 8 lbs per square foot (39.1 kg per square meter), not including the lifting equipment and the architectural finish on the acoustical panels.
22. A completely functioning operable wall, tested in full accordance and compliance with ASTM E90-90 shall achieve a Laboratory Sound Transmission Class all (STC) rating of not less than 51.
23. The operable wall shall be designed to have a design life of at least 10,000 complete closed to opened to closed cycles.

1.4 QUALITY ASSURANCE

- A. The products herein specified established the standard of quality for the Automatic Vertically Folding Acoustical Walls based on Skyfold Classic powerlift partitions by Railtech Ltd. of Baie d'Urfe (Montréal), Québec, Canada.
- B. All work and materials specified herein, shall be installed only by qualified representatives and/or installers and/or distributors of the manufacturer, according to the manufacturers written instructions.
- C. The operable wall must be manufactured by a certified ISO-9001-2000 company or an equivalent quality control system.

1.5 REFERENCES

- A. ASTM E90-90, Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions.
- B. ASTM E413-87, Classification for Rating Sound Insulation.
- C. ASTM E557-77, Standard Practice for Architectural Application and Insulation of Operable Partitions.

1.6 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Submit manufacturers' technical data for each type of operable wall specified herein.
- C. Submit shop drawings showing complete layout of operable wall system based on field verified dimensions. The drawings shall include dimensional relationship to adjoining work. Include details indicating materials, finishes, tolerances, and methods of attachment to building steel and electrical requirements.
- D. Submit certified test reports evidencing compliance to acoustical STC requirements as specified herein.

1.7 SITE CONDITIONS

- A. The floor underneath the operable wall along its axis, shall be flat to within +/- ¼ inch over the entire length of an operable wall. Existing floor shall be leveled to the following specifications: The peak to valley undulation of +/- ¼ inch shall not be closer together than 24 inches and a peak to valley undulation of +/- 1/8 inch shall not be closer than 12 inches.
- B. Support steel above the operable wall along its axis shall be parallel to the floor within +/-1/2 inch for the entire length of the operable wall. This includes loaded deflection. The beam must also be parallel to the centre line of the wall within + 1/8 inch, left to right.
- C. The fixed walls at either end of the operable wall shall be within +1/4 inch, from plumb vertical.
- D. The fixed walls at either end of the operable wall shall be flat to within +0 inch, -1/4 inch.

1.8 WARRANTY

- A. The operable wall shall be warranted free from defects in material and workmanship for a period of two years or five thousand cycles and the parts only will be free from defect for a period of ten years or five thousand cycles, whichever occurs first from date of shipment.
- B. Parts and labor required to maintain the operable wall and part subject to normal wear and tear are not covered under the warranty and are the owner's responsibility. (Refer to Maintenance Program).

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Skyfold Classic Custom powerlift partitions, Model 51, as manufactured by Railtech Ltd. of Baie d'Urfe (Montréal), Québec, Canada and Railtech Composites Inc., Plattsburgh, New York, USA (514) 457-4767.
 - 1. E-mail: skyfold@skyfold.com
 - 2. Web-site: www.skyfold.com
- B. Substitutions: See Section 01 60 00 - Product Requirements.

2.2 MATERIALS

- A. Acoustical Panels:
 - 1. Acoustical panels shall be faced with steel that is compatible with scheduled panel finish.
 - 2. Acoustical panels, together with all of the sound insulation, shall be, as much as possible, made of non-combustible or fire-treated materials.
 - 3. Acoustical panels shall be fabricated to be as stiff as possible in order to satisfy the rigid criteria when the operable wall is down (closed) and to ensure that there is no interference between panels when the wall is in motion.
 - 4. Acoustical panels shall be architecturally flat with no bowing, oil canning, warping, waviness or any other surface deformation and discontinuity.
 - 5. Acoustical panels shall have manufacturer's standard fabric finish as selected by the Architect from manufacturer's full range.
- B. Folding Mechanism:
 - 1. The hanging, folding and extension mechanism shall be, as much as possible, made from structural grade aluminum extrusions and structural shapes, in order to minimize the weight of the system.
 - 2. All wear surfaces, such as bushings, spacers, pins, discs, bearings, and sleeves shall be designed to function quietly and with minimum wear, over the 10,000 cycle design life of the operable wall.
 - 3. The hangers, which fasten the lifting mechanism to the support steel, shall be fabricated from steel and shall be welded or bolted to the support steel supplied by others.
- C. Lifting Equipment:
 - 1. The lifting equipment shall be sized properly so that it can open and close the wall effectively over the 10,000 cycle design life of the wall, at the minimum design speed specified.

2. The lifting mechanism shall be designed to function as smoothly, quietly and safely as possible. Wherever possible, ball bearings shall be used instead of bushings and wear surfaces. In no circumstance shall chain or belt drive systems be acceptable.
3. There shall be a wire rope cable for every set of lifting mechanisms. This cable shall be of 6 x 31 construction aircraft cable and shall be made of galvanized steel. The diameter of the cables shall be sized so that they shall be able to hold the entire weight of the wall, with the appropriate safety factor.
4. For the remote drive system, each wire rope cable shall wind and unwind on its own cable drum. The cable drums shall be grooved to accept a single layer of cable and shall have a minimum pitch diameter of 20 times the cable diameter. Length of drums shall be sufficient to accommodate 3 cable safety wraps. Cable drums shall be keyed to the line shaft. For the micro and compact drive systems, the cable wraps on yoyo drums with 2 safety wraps and multiple layers of cable.
5. The line shaft, sized to deliver the required torque with minimum deflection, shall support and rotate the cable drums.
6. Pillow block bearings (for the remote drive system), of appropriate size, support the line shaft and shall be located immediately on either side of each cable drum. Flange bearings shall be used for the compact drive system, located immediately on both sides of the drum assembly.
7. For the remote drive system, the line shaft shall be connected directly to the power drive through properly sized, load rated couplings, keyed to the line shaft.
8. The power drive shall be sized to deliver sufficient amount of torque to safely and effectively raise and lower the operable wall over its design life.
9. The lifting equipment shall use the latest in industry standards in thermal protection, overload protection, quick acting fuses, etc., in order to ensure the safety and reliability of the system.

D. Safety Equipment:

1. The operable wall shall employ an electromagnetic type of brake which shall activate firmly, without hesitation, when power is lost to the system. This brake shall have a minimum retarding torque rating equal to 200% of the power drive full load torque. A manual break release lever is supplied on the motor.
2. The operable wall shall employ a dynamic brake, distinct and separate from the brake specified above, in order to lower the wall at a controlled speed of no more than approximately 150% of the normal down speed, in the case of a catastrophic failure in the power train. Alternately, the operable wall shall employ a brake, distinct and separate from the brake specified above, in order to completely halt the downward motion of the wall in the case of a catastrophic failure in the power train.
3. The operable wall shall employ electrical or other limit switches in order to stop the wall at its up and down travel limits.
4. The operable wall shall employ an over torque detector in order to sense a jam in the system and to act as an over travel limit in the up direction should the primary limit switch fail to act in 1.3.2.4. This over torque sensor shall be mechanical, using the motor's torque arm in its over torque detection.
5. The entire length of the bottom edge of the operable wall shall be equipped with a continuous pressure sensing strip which shall cut power to the lifting equipment and shall activate the brake outlined in 2.2.4.1, if the sensing edge comes in firm contact with an

object, before the wall is in the full down (closed) position. The power shall remain cut to the lifting equipment until the key switch has been released or the direction of the wall has been reversed and the obstruction is removed.

2.3 FABRICATION

- A. Factory assemble all components, assemblies and systems into the largest possible assemblies in order to minimize the amount of assembly on site.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Inspect the relevant aspects of the site such as the evenness of the floor, walls, structural steel, etc., and ensure that these are within the tolerances stated in Part – 1 of this specification.
- B. Confirm in writing to the General Contractor or contract manager any deviations from these tolerances. Do not proceed until these conditions are made good.
- C. Carry out all appropriate field measurements before manufacturing any components or assemblies.

3.2 INSTALLATION

- A. Install operable walls in accordance with the manufacturer's printed instructions.
- B. The operable wall supplier shall not deliver or install this product until the General Contractor can ensure in writing safe storage and protection for the wall for the duration of the project.

3.3 ADJUSTING AND CLEANING

- A. Adjust and fine-tune the operable walls to ensure that all seals are operating and sealing properly and that the walls are in correct and smooth operation.
- B. Clean up any dirt, oil, grime, etc., that may have found its way onto the acoustical panels. Leave the wall in a state of architectural cleanliness.

3.4 SPARE PARTS

- A. Ensure the manufacturer has ample stock available for repairs.

END OF SECTION

SECTION 10 26 01 - IMPACT-RESISTANT WALL PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Wall guards.
 - 2. Corner guards.
 - 3. Jamb guards.
- B. Related Sections include the following:
 - 1. Division 08 Section "Door Hardware" for metal armor, kick, mop, and push plates.

1.2 PERFORMANCE REQUIREMENTS

- A. Structural Performance of Handrails: Provide handrails capable of withstanding the following structural loads without exceeding the allowable design working stress of materials for handrails, anchors, and connections:
 - 1. Concentrated load of 200 lbf (890 N) applied at any point and in any direction.
 - 2. Uniform load of 50 lbf/ft. (730 N/m) applied in any direction.

1.3 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Include construction details, material descriptions, impact strength, dimensions of individual components and profiles, and finishes for each impact-resistant wall-protection unit.
- C. Shop Drawings: For each impact-resistant wall-protection unit showing locations and extent. Include sections, details, and attachments to other work.
- D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below. Include Samples of accent strips to verify color selected.
 - 1. Wall and Corner Guards: 12 inches long. Include examples of joinery, corners, end caps, top caps, and field splices.
 - 2. Door-Edge Protectors: 12 inches long.
- E. Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
- B. Source Limitations: Obtain impact-resistant wall-protection units through one source from a single manufacturer.
- C. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store impact-resistant wall-protection units in original undamaged packages and containers inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of walls, columns, and other construction contiguous with impact-resistant wall-protection units by field measurements before fabrication and indicate measurements on Shop Drawings.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of impact-resistant wall-protection units that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures.
 - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Basis-of-Design Product: The design for each impact-resistant wall-protection unit is based on the product named. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified.

2.2 MATERIALS

- A. Aluminum Extrusions: Alloy and temper recommended by manufacturer for type of use and finish indicated but with not less than strength and durability properties specified in ASTM B 221 (ASTM B 221M) for Alloy 6063-T5.
- B. Stainless-Steel Sheet: ASTM A 240/A 240M.
- C. Fasteners: Aluminum, nonmagnetic stainless-steel, or other noncorrosive metal screws, bolts, and other fasteners compatible with items being fastened. Use security-type fasteners where exposed to view.

2.3 WALL GUARDS

- A. Wall Protection System:
 - 1. Provide "Sani-Rail" Aluminum Double Rail Wall Protection System manufactured by Life Science Products or approved equal.
 - 2. Material: 1/4 x 4 inch 6061-T611 extruded rectangular aluminum bar with 1/8 inch radius edge.
 - 3. Finish: Clear sulfuric anodized to military specification A8625 Type II.

4. Each rail component shall be stamped with its own unique identification number on the back of the component which will match the numbered section on the installation drawings which must be maintained on file with the manufacturer for future reference.
5. Bracket Material: 6061-T6511 extruded aluminum with .200 radius vertical flange to eliminate 90 degree edges at points of possible hand contact. Finish shall match rail.
6. Hardware and Accessories: Provide all hardware and accessories required for a complete installation.

2.4 CORNER GUARDS

- A. Surface-Mounted, Metal Corner Guards: Fabricated from 1-piece, formed or extruded metal with formed edges; with 90- or 135-degree turn to match wall condition.
 1. Available Manufacturers:
 - a. ARDEN Architectural Specialties, Inc.
 - b. Balco, Inc.
 - c. Construction Specialties, Inc.
 - d. IPC Door and Wall Protection Systems; Division of InPro Corporation.
 - e. Pawling Corporation.
 2. Material: Stainless steel, Type 304.
 - a. Thickness: 16 gage.
 - b. Finish: Directional satin, No. 4.
 3. Wing Size: Nominal 2-1/2 by 2-1/2 inches.
 4. Corner Radius: 1/8 inch.
 5. Mounting: Flat-head, countersunk screws through factory-drilled mounting holes.

2.5 JAMB GUARDS

- A. Jamb guards shall be manufactured by Life Science Products, Inc and in accordance with the following:
 1. Outer Tube: Type T304 18 ga. stainless steel, Tig welded round tube, 1 inch o.d with .049 inch wall, 180 grit polish.
 2. Inner Tube: Type T304 18 ga. stainless steel, .875 inch o.d with .049 inch wall type C1010/1020 per ASTM A 513, mill finish.
 3. Brackets: 1 x 1.25 x .125 inch with .313 inch diameter mounting holes, 3 sets of 2 each, 304 stainless steel spot welded to stainless steel outer tube.
 4. End Caps: Black polyethylene, annular fined, compression fit, hole plugs.
 5. Fasteners: 1/4 x 1/2 inch phillips pan head, type A tapping screw, stainless steel.
 6. Length: 48 inches.
 7. Mounting: Mechanically fastened to exposed corner of door frame on push side of door frame.

2.6 FABRICATION

- A. Fabricate impact-resistant wall-protection units to comply with requirements indicated for design, dimensions, and member sizes, including thicknesses of components.
- B. Assemble components in factory to greatest extent possible to minimize field assembly. Disassemble only as necessary for shipping and handling.

- C. Fabricate components with tight seams and joints with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
 - 1. Examine walls to which impact-resistant wall protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.
 - 2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Complete finishing operations, including painting, before installing impact-resistant wall-protection system components.
- B. Before installation, clean substrate to remove dust, debris, and loose particles.

3.3 INSTALLATION

- A. General: Install impact-resistant wall-protection units level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.
 - 1. Provide splices, mounting hardware, anchors, and other accessories required for a complete installation.
 - a. Provide anchoring devices to withstand imposed loads.
 - b. Adjust end caps as required to ensure tight seams.

3.4 CLEANING

- A. Immediately after completion of installation, clean plastic covers and accessories using a standard, ammonia-based, household cleaning agent.

END OF SECTION

SECTION 10 44 00 - FIRE PROTECTION SPECIALTIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Fire extinguishers.
- B. Fire extinguisher cabinets.
- C. Accessories.

1.2 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Wood blocking product and execution requirements.

1.3 REFERENCE STANDARDS

- A. NFPA 10 - Standard for Portable Fire Extinguishers.

1.4 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. 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. Provide extinguisher operational features, and color and finish.
- C. Shop Drawings: Indicate cabinet physical dimensions, rough-in measurements for recessed cabinets, and location.
- D. Product Data: Provide extinguisher operational features and color and finish.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Fire Extinguisher Cabinets and Accessories:
 - 1. JL Industries, Inc: www.jlindustries.com.
 - 2. Larsen's Manufacturing Co; Product 2409-R4 and FS 2409-R4: www.larsensmfg.com. (Basis of Design)
 - 3. Potter-Roemer: www.potterroemer.com.
- B. Substitutions: See Section 01 60 00 - Product Requirements.

2.2 FIRE EXTINGUISHERS

- A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.
- B. Multi-Purpose Dry Chemical Type Fire Extinguishers: Carbon steel tank, with pressure gage.
 - 1. Class: A:B:C.
 - 2. Size: 10 pound

3. Finish: Baked polyester powder coat, color as selected.

2.3 FIRE EXTINGUISHER CABINETS

- A. Metal: Formed stainless steel sheet; 0.036 inch thick base metal.
- B. Cabinet Configuration: Semi-recessed type.
 1. Trim: Returned to wall surface, with 3-1/2 inch projection, 1-1/2 inch wide face with rolled edges.
- C. Door: 0.036 inch thick, reinforced for flatness and rigidity; latch. Hinge doors for 180 degree opening with two butt hinge. Provide nylon catch.
- D. Door Glazing: Glass, clear, 1/8 inch thick tempered. Set in resilient channel gasket glazing.
- E. Cabinet Mounting Hardware: Appropriate to cabinet. Pre-drill for anchors.
- F. Weld, fill, and grind components smooth.
- G. Finish of Cabinet Exterior Trim and Door: No. 4.
- H. Finish of Cabinet Interior: Match exterior finish.
- I. Size: As required to hold the specified size extinguisher.

2.4 ACCESSORIES

- A. Extinguisher Brackets: Formed steel, chrome-plated.
- B. Cabinet Signage:
 1. Location: Applied to cabinet glazing.
 2. Application Process: Silk-screened or pressure-sensitive vinyl letters.
 3. Lettering Color: Red.
 4. Orientation: Vertical.
 5. Words: "FIRE EXTINGUISHER".

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify rough openings for cabinet are correctly sized and located.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install cabinets plumb and level in wall openings, 48 inches from finished floor to the centerline of the cabinet handle, unless otherwise indicated.
- C. Install fire rated cabinets in fire rated walls where required.
- D. Place extinguishers in cabinets and on wall brackets.

END OF SECTION

SECTION 11 52 13 - PROJECTION SCREENS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Front projection screen assemblies.

1.2 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Wood blocking in walls and ceilings.
- B. Section 09 21 16 - Gypsum Board Assemblies: Suspended gypsum board ceilings for recessed screens, and openings in gypsum board partitions for fixed and rear projection screens.
- C. Division 26 - Equipment Wiring: Electrical supply, conduit, and wiring for electric motor operated projection screens.

1.3 SUBMITTALS

- A. See Section 01 33 00 Submittal Procedures, for submittal procedures.
- B. Product Data: Manufacturer's catalog cuts and descriptive information on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
- C. Shop Drawings: For custom installations, indicate dimensions, verified field measurements, mounting details, and interface with adjacent construction.
- D. Samples: For case and frame finishes, submit two 2 by in size, illustrating color and texture of finish.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver projection screens to project site in manufacturer's original unopened packaging. Inspect for damage and size before accepting delivery.
- B. Store in a protected, clean, dry area with temperature maintained above 50 degrees F. Stack according to manufacturer's recommendations.
- C. Acclimate screens to building temperatures for 24 hours prior to installation, or in accordance with manufacturer's recommendations.

PART 2 - PRODUCTS

2.1 FRONT PROJECTION SCREENS

- A. Manufacturers:
 - 1. Bretford: www.bretford.com.
 - 2. Da-Lite Screen Company, Model Tensioned Advantage Deluxe Electrol: www.da-lite.com. (Basis of Design)
 - 3. Draper, Inc: www.draperinc.com.
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.

- B. Front Projection Screens: Factory assembled unless otherwise indicated.
 - 1. Dimensions: As indicated on drawings.
 - 2. In Scheduled Rooms: Motorized, matte light diffusing fabric screen, horizontally tensioned, ceiling recessed.
 - a. Screen Dimensions: As indicated.
- C. Matte Light Diffusing Fabric: Light diffusing screen fabric; washable, flame retardant and mildew resistant.
 - 1. Material: Matte white vinyl on fiberglass backing, with nominal gain of 1.0 over viewing angle not less than 80 degrees from axis, horizontally and vertically. Provide Cinema Vision manufactured by Da-Lite or approved equal.
- D. Concealed-in-Ceiling Screen Cases: Steel; integral roller brackets.
 - 1. Door Slat: Self trim; self-closing and -opening.
 - 2. Case Finish: Baked enamel.
 - 3. Case Color: White.
 - 4. End Caps: Steel; finished to match case.
- E. Electrically-Operated Screens:
 - 1. Roller: 2 inch aluminum, with locking device.
 - 2. Vertical Tensioning: Screen fabric weighted at bottom with steel bar with plastic end caps.
 - 3. Horizontal Tensioning: Tab-guided cable system.
- F. Provide mounting hardware, brackets, supports, fasteners, and other mounting accessories required for a complete installation, in accordance with manufacturer's recommendations for specified substrates and mountings.

2.2 ELECTRICAL COMPONENTS

- A. Electrical Components: Listed and classified by UL as suitable for the purpose specified and indicated.
- B. Motors: Direct drive, 110 V, 60 Hz.
 - 1. Screen Motor: Mounted inside roller; three wire with ground; quick reverse type; equipped with thermal overload cut-off.
 - a. Electrical Characteristics: 1.2 amps.
 - b. Motor mounted on sound absorber.
- C. Controls: 3 position control switch with plate.
 - 1. Provide 2 control stations to screen, with internal override to prevent more than one signal reaching the screen.
 - 2. Remote Control: Infrared; provide one transmitter.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that substrate is finished and ready to accept screen installation.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- C. Verify that openings for recessed screens are correctly sized.

- D. Verify type and location of electrical connections.
- E. Do not install projection screens until climate control systems are in place and interior painting and other finishes are completed.

3.2 PREPARATION

- A. Coordinate screen installation with installation of projection systems.
- B. Coordinate installation with adjacent construction and fixtures, including ceilings, walls, lighting, fire suppression, and registers and grilles.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions, using manufacturer's recommended hardware for relevant substrates.
- B. Do not field cut screens.
- C. Install screens in mountings as specified and as indicated on drawings.
- D. Install plumb and level.
- E. Install electrically operated screens ready for connection to power and control systems by others.
- F. Adjust projection screens and related hardware in accordance with manufacturer's instructions for proper placement and operation.
- G. Test electrical screens for proper working condition. Adjust as needed.

3.4 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch up, repair, or replace damaged products before Substantial Completion.

END OF SECTION

FIXED VIVARIUM EQUIPMENT

SECTION 11601

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract: including General and Supplementary Conditions and Division Specifications, apply to work of this section.

1.2 WORK INCLUDED

- A. Furnish all labor, materials, tools, equipment and services for all equipments as indicated in accord with provisions of Contract Documents.
- B. Completely coordinate with work of all other trades.
- C. Although such work is not specifically shown or specified, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation. Installation will include all required assembly.
- D. Equipment listed in this specification is Contractor furnishes, contractor installed.
- E. Equipment in this section:

<u>Sect</u>	<u>Equipment Description</u>
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2.1	ST-2: Vivarium Steam Sterilizer
2.2	CRW: Cage & Rack Washer
2.3	TW: Tunnel Washer
2.4	BFS: Bottle Fill Station
2.5	BD: Bedding Dispenser
2.6	MW: Modular Wall System
2.7	RO: RO Water System
2.8	MT: Misting Decontamination Tunnel

1.3 SPECIAL REQUIRMENTS

- A. All equipment specified in this section is subject to a maximum allowable effluent discharge to drain temperature of 140°F. Effluent cooling shall be by building chilled water loop only; Clean potable water may not be used for effluent cooling.
- B. All equipment specified in this section shall meet local seismic restraint requirements.

1.4 RELATED WORK

- A. Relevant trade contractors will provide all rough openings, pits, substrate preparation and blocking for all equipment installations.
- B. Mechanical contractor will provide exhaust rough-ins and final connections for all equipment installations.
- C. Plumbing contractor will provide all supply/return service line, drain and vent rough-ins and final connections for all equipment installations.
- D. Electrical contractor will provide all electrical service rough-ins, receptacles and final connections for all equipment installations.

1.5 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in necessary crafts and who are completely familiar with specified requirements and methods needed for proper performance of the work of this section.
- B. Dimensions, voltages, electrical power requirements, and utility connections are base on items specified. Relevant trade contractor is responsible for all costs associated with service or dimensional adjustments.
- C. Equipment may be inspected by Owner at manufacturer's plant prior to shipment. Equipment found not in accord with specifications and approved drawings may be rejected. Replace rejected equipment at no cost to Owner. Provide Owner's Representative two (2) week prior notice to all factory testing.
- D. Electric operated and/or heated equipment will comply with applicable standards of National Electrical Manufacturer's Association (NEMA), National Electric Code (NEC) and Underwriters' Laboratories, Inc. (UL) or Electrical Testing Lab (ETL).
- E. **Manufacturer Qualifications:** Manufacturer is a firm having an established organization and factory, with production facilities specializing in type of equipment specified, having an experienced engineering department and an established history of similar installations of equal scope and complexity. Manufacturer will demonstrate ability to produce specified equipment of required quality and a proven capacity to complete an installation of this size and type within required time limits. Manufacturer will have at least 3 years/5 installations of experience, at least 3 current references from the last 3 years and a service response time, as described below, to be considered eligible to bid. Service response time to a telephone inquiry will be same day followed up by a factory trained technician at site within 24 hours of telephone inquiry; all serviceable components warehoused or readily available to service personnel; and fast access to shop drawings of all equipment in field. Any misrepresentations or negative references will be considered grounds for bid rejection.
- F. **Acceptable Manufacturers:** Each piece of equipment listed includes manufacturer's name and catalog number, establishing levels of quality, specific construction features, operating conditions and desired features and accessories. By indicating other manufacturer's names does not relieve perspective bidders of their obligation to prove that their submissions are equal to specified equipment in size, construction, performance, basic features, options and accessories prior to award.

- G. Installer Qualifications: Manufacturer, or approved in writing by manufacturer.

1.6 SUBMITTALS

- A. Specification Compliance: Submit copy of relevant item specification section (from this document) and clearly note in bold print any substitutions, modifications or objections.
- B. Product Data: Submit manufacturer's specifications and installation instructions for each item of laboratory equipment furnished. Indicate on product data which optional devices and operations are proposed for inclusion with equipment. Where substitutions for specified items of laboratory equipment are proposed, submit data substantiating the proposed equipment is equal to that specified. Manufacturer's specifications must contain a full, detailed explanation of all variations in operating and/or performance requirements.
- C. Shop Drawings: In addition to work shown on manufacturer's printed product data, submit dimensional roughing-in drawing, at minimum scale of $\frac{1}{2}'' = 1'-0''$, showing equipment placed in actual project site conditions adjacent to other equipment and relationship to the work of other trades, as well as mechanical and electrical requirements. Rough-in drawings will clearly indicate where equipment connection varies from relevant trade contractor supply source. Submit dimensioned fabrication drawings for custom fabricated equipment, including plans, elevations, and sections, at minimum scale of $\frac{3}{4}'' = 1'-0''$, showing materials and gauges used.
- D. Operational and Maintenance Data: Submit operating and maintenance instructions and parts listing for each item of fixed laboratory equipment. Include this data, product data, shop drawings, wiring diagrams, and any other data required by Owner, in three-ring maintenance manual. Prepare draft copy of operation and maintenance manual for Owner's review. Submit four (4) copies of final, accepted manual for Owner's use.
- E. Manufacturer's Qualifications: Letter confirming required minimum experience, references and service response time.
- F. Applicable standards approval from NEMA, NEC, UL, ETL or as specified with the individual equipment items.

1.7 PRODUCT DELIVERY, STORAGE, HANDLING AND INSTALLATION REQUIREMENTS

- A. General. All equipment in this specification is Contractor furnished, Contractor supplied. Certain equipment items will include MA, MAS and/or MED.
- B. Contractor Furnished/Contractor Installed (CFCI): Relevant trade contractor (the "contractor") will purchase, deliver, receive, unload, store, unpack, assemble, set-in-place, install and clean up equipment. Deliver to site in manufacturer's original labeled containers. Contractor will provide any fasteners, supports or other miscellaneous items necessary for complete installation. All rough-ins and final connections by contractor. Contractor will use all means necessary to protect materials of this section before, during and after installation and to protect installed work and materials of all other trades. Contractor will confirm in writing that installed equipment meets or exceeds manufacturer's specifications. Contractor will provide owner's representative with rough-in and installation drawings of installed equipment.
- C. Manufacturer Assembly (MA): Manufacturer will provide adequate assembly personnel for as long as it takes to complete installation to satisfaction of owner's representative.

Manufacturer's field supervision personnel may or may not be union depending on conditions of site. If schedule demands it, manufacturer will agree to have their field assembly personnel work overtime at no additional cost. Manufacturer assembly and MED (Manufacturer's Equipment Demonstration) included in equipment price.

- D. Manufacturer's Assembly Supervision (MAS): Manufacturer will provide adequate assembly supervision personnel for as long as it takes to complete installation to satisfaction of owner's representative. Manufacturer's field supervision personnel may or may not be union depending on conditions of site. If schedule demands it, manufacturer will agree to have their field supervision personnel work overtime at no additional cost. Manufacturer assembly supervision included in equipment price and provide following:

1.8 TRIP(S) TO JOB SITE OR AS REQUIRED TO COORDINATE SPECIFIC TECHNICAL PROJECT REQUIREMENTS.

- A. Manufacturer's Equipment Demonstration (MED): Manufacturer will provide one (1) one-day trip to the jobsite to instruct Owner on proper operation and maintenance of equipment. Cost of this service included in equipment price. Scheduling of on-site equipment demonstration at the convenience of Owner.

1.9 WARRANTY

- A. Except where more stringent warranty requirements are noted in individual equipment descriptions, all equipment furnished under this section guaranteed for a minimum of one (1) year, parts and labor, from date of substantial completion or specific equipment final acceptance (whichever is later) against defective materials, design and workmanship. Defects will be promptly rectified at manufacturer or contractor's expense after notification by Owner's representative.

1.10 JOB CONDITIONS

- A. Drawings show arrangement and location of items of equipment. If it is necessary to vary from arrangement shown, because of structural, mechanical, electrical or other considerations, make such variations only after approval of Owner's representative and at no additional cost to Owner.
- B. Verify all dimensions at building.
- C. Confirm that all equipment will be able to be moved through building in order to reach it designated location. Provide dimensional information of equipment showing length, width and depth of equipment (or largest component) as it is intended to be moved through building. Dimensions should include all packaging, palleting and transportation equipment dimensions so as to allow leave-out of overhead, walls, etc., to allow equipment to safely be transported to installation point. Failure to do so will result in removals and reinstallation's to be charged to manufacturer or contractor.
- D. Where applicable, all equipment equipped and programmed to meet year 2000 (Y2K) operations without the need for additional upgrades or reprogramming.
- E. If autoclaves are specified with integral steam generators using either potable or RGW water, they will be designed and constructed to allow for "in-place" acid de-scaling and flushing operation.

1.11 MANUFACTURER LISTINGS

- A. Manufacturer's listed in these specifications can be contacted via the following:
1. AES Clean Technology (215.393.6819) <http://www.airenergysystems.com>
 2. Allentown Caging Equipment Co. (800.762.2243) <http://www.acecaging.com>
 3. The Baker Company (800.992.2537) <http://www.bakerco.com/>
 4. Belimed Inc. (305.252.3338) <http://www.belimedusa.com/>
 5. Edstrom Industries, Inc. (262.534.5181)
 6. Forma Scientific (through Thermo Scientific, 866 984 3766)
 7. Getinge (800.475.9040) <http://www.GetingeUSA.com/>
 8. Gruenburg (through TPS, 800.586.2473)
 9. Hoshizaki America, Inc. (770.487.2331) <http://hoshizakiamerica.com/>
 10. Ice-O-Matic (800.423.3367) <http://www.iceomatic.com/>
 11. Lab Products, Inc. (302.628.4300)
 12. Lancer (800.332.1855) <http://www.lancer.com/>
 13. Liberty Industries, Inc. (800.828.5656)
 14. LM Air Technology, Inc. (732.381.8200) <http://www.laminaire.com/>
 15. Lynx Product Group (716.735.9857) <http://www.lynxproductgroup.com/>
 16. Miele, Inc. (800.843.7231) <http://www.miele.com/>
 17. Northwest Systems Corp./ Betterbuilt (604.777.9988)
 18. Nederman (734.729.3344) <http://www.nedermanusa.com/>
 19. NuAire Laboratory Equipment (800.328.3352)
 20. Scientek Technology Corporation (604.273.9094) <http://www.scientek.net/>
 21. Steelco USA (Process Control Solutions, Shrewsbury MA 508.366.4363)
 22. Tuttnauer USA ((800) 624-5836,)
 23. TBJ (717.261.9700) <http://www.tbjinc.com/>

PART 2 - PRODUCTS

2.1 ST-2: VIVARIUM STEAM STERILIZER

- A. Product Description:
1. Pass-through microcomputer controlled automatic steam sterilizer equipped to employ both high vacuum (accomplished by a high efficient liquid ring vacuum pump to achieve minimum 29" Hg in 5 minutes or less with an empty chamber) and gravity displacement method of air removal. Microprocessor with touch panel interface will control all system functions, monitor system operations, visually and audibly alert operator of cycle malfunctions, and, on command, visually indicate chamber temperature and pressure. Integrity of piping and door seals monitored with preprogrammed leak test. Solid state printer with clear waterproof cover shall document and record each cycle's performance with such data as time and date that unit is opened, cycle number, set points and cycle selected. Full controls, as described above, on load side. Provide partial controls, cycle selection only, on unload side. RS232 port to down load cycle data to a remote computer. All data from control system to communications port in ASCII format compatible with PC/DOS support software. Provide 0.1 amp Form C dry contacts to communicate with building DDC system and send a signal when unit is turned on or off and a door is opened or closed.
 2. Unit design shall allow for general-purpose steam sterilization of unwrapped equipment, wrapped instruments and utensils, cages, racks, water bottles, wire bar lids and liquids in vented or unsealed containers at temperatures ranging from 100-138°C (212-280°F). Cycle times for dry, wrapped goods shall not exceed a guaranteed 60 minutes from door closed to door open. Temperature uniformity within chamber +/-1.8°C (+/-2°F) during cycles. Unit designed to

meet or exceed ASME Code for Unfired Pressure Vessels, Section VIII (U-1 stamp of compliance): ASME Boiler and Pressure Vessel Code, Section IX; American Welding society (AWS); ASTM; ANSI; NEMA; NEC; OSHA.

3. Sterilizer chamber interior dimensions of 24" w x 36" h x 72" l and constructed of solid type 316L stainless steel with an internal polish of 150 grit or better and jacketing constructed of type 304 stainless steel. Chamber completely insulated with minimum 2" mineral wool encased in a rigid removable sheet aluminum housing. Unit configured per Equipment Schedule with all exposed surfaces stainless steel. Provide adjustable legs and an integral threshold plate to facilitate rack loading (gap between pit edge and chamber shall not exceed 3/4"). Chamber bottom shall align with finished floor +/- 1/32". Provide MW (Modular Wall) w/ access panel on load side MW. All serviceable components to be skid mounted on one side of chamber accessible from access panel in fascia or access door. Piping to chamber shall be brass. All installations continuously silicone caulked around perimeter of fascia. Provide stainless steel closure panel between top of unit and ceiling and all necessary ceiling and wall trim angles. Provide power operated horizontal sliding doors with automatic sealing, safety interlocks, and cross-contamination interlocks.
4. Provide with each unit, unless otherwise noted:
 - a. Chamber rub rails
 - b. Port and all related components for VHP/Chlorine dioxide decontamination.
 - c. Air differential seal at vivarium side.
 - d. Self-Cleaning drain line strainer consisting of appropriate piping to automatically flush the drain line strainer prior to completion of a sterilize cycle. Back-flushed debris should not reenter the chamber. A rough strainer can be provided within the chamber to prevent large objects from clogging the drain pipe prior to the fine strainer and/or allow casters to pass over drain.
 - e. Drain discharge cool-down system to reduce all discharges to 140°F, or less. Water conservation system will utilize building chilled water system for vacuum pump and condenser and effluent cool-down.
 - f. Two transfer carriages and two carts.
5. Unit shall carry a three (3) year warranty. Vessel and door will carry a fifteen (15) year warranty.

B. Utility Requirements:

E 1/60/115V. 6A operating load (for control)
E 3/60/208V, 18 A operating load (for Vac Pump)
CW 1", 15 gpm peak
CA 3/8" FNPT (75-95psi), 3.5 SCFM
ST 1" NPT, 435 #/hr peak @ 30-70 PSIG Dynamic Min
D Floor sink recommended
CHWS 21 GPM @ 50F Max, Recirc delta T + 7F.
CHWR As required

C. Equipment item(s) CFCI with MA.

- D. Unit(s) will be Tuttnauer Model 69D-SPD1-H Steam Sterilizer. Units manufactured by Getinge or Belimed shall be considered equal provided that they meet the requirements of this specification.

2.2 CRW: CAGE & RACK WASHER

- A. Product Description:
1. Application: Heavy duty, large capacity pass-through hydrospray batch-type washer designed for thorough, efficient cleaning of cages, racks, debris pans and miscellaneous items used in care of laboratory animals.
 2. Size:
 - a. Minimum Compartment: 46"W x 85"H x 92"L
 - b. Maximum External Size: 86"W x 104"H x 100"L
- B. Operation: Operator places items to be cleaned within compartment, closes door and presses automatic cycle push button. Machine proceeds through treatment schedule and automatically shuts off at completion of the cycle. Operator then opens opposite door and removes cleaned item.
1. "Reusable-Throwaway" Alkaline and Acid Solution System: Provide capability to automatically return alkaline and/or acid solution to their respective reservoirs or pump to drain.
 2. Treatment Schedule: A multiple cycle treatment schedule automatically programmed into washer as follows (additional wash, soak and rinse cycles can be added):
 3. Pre-Wash: Water remaining in recirculating sump from final rinse of previous cycle or fresh hot water is recirculated through jet system under pump pressure then pumped to drain upon completion. Phase time is programmable from 0-60 minutes.
 4. Alkaline Wash: Hot alkaline solution (approximately 50 gallons) from alkaline reservoir fills sump and is pumped through jet system. At end of treatment, alkaline solution is either returned to alkaline reservoir tank or pumped to drain at discretion of operator. Phase time and temperature are programmable from 0-60 minutes and to 190°F.
 5. Acid Wash: Hot acid solution fills recirculating sump and is pumped through jet system. At end of treatment, water is pumped to drain upon completion. Phase time and temperature are programmable from 0-60 minutes and to 190°F.
 6. First Rinse: Hot water from house supply fills recirculating sump and is pumped through jet system. At end of treatments, water is pumped to drain upon completion. Phase time and temperature are programmable from 0-60 minutes and to 190°F.
 7. Final Rinse: Same as first rinse except at end of treatment, water is retained in recirculating sump to be used as pre-wash water for subsequent load. Phase time and temperature are programmable from 0-60 minutes and to 190°F.
 8. Exhaust: Unit stands idle for a sufficient length of time to remove residual vapor from air with compartment. Phase time is programmable from 0-6 minutes.
- C. Construction:
1. Base, washing chamber, detergent tank and recirculating sump of welded stainless steel construction. Washing chamber sections flanged and bolted using formed channels across joints. Base shall contain integral door gutters, recirculating sump and floor grating supports.
 2. Each door of double wall construction, insulated with 2" thick rigid fiberglass insulation, and equipped with a double bulb sealing gasket, safety exit hardware, heavy duty stainless steel hinges, and a minimum 12"x12" tempered glass observation window.
 3. Compartment floor shall consist of heavy-duty stainless steel grating sections

- covering the entire floor area and pitched 1" at unload end to accommodate poor draining cages, pans and racks. Grating sections easily removable without tools..
4. Recirculating sump equipped with an automatic solution level control, automatic rinse water fill, and stainless steel steam coil heating for recirculating treatment solutions. An automatic digital temperature controller mounted in operator's panel shall display and monitor recirculating solution temperature. Recirculating sump shall have no openings beyond base of machine to emit vapor from recirculating solutions.
 5. Detergent reservoir minimum 100-gallon capacity, heated by stainless steel stem coils. Reservoir equipped with an automatic digital temperature controller, automatic water fill, automatic water level control, automatic drain valve, and overflow piping.
 6. All treatments under pressure from one (1) 10 HP full draining type pump, with no cross-contamination. Pumps are not acceptable if they employ extended shaft motors. The pump system shall be equipped with a direct reading pressure gauge.
 7. A stainless steel steam coil heating for recirculating sump complete with condensate return and steam traps. A by-pass system inter-piped into machine to remove suspended water droplets and minute particles of debris from incoming steam line and automatically flush to condensate return. Surface area of steam coils a minimum of 30 square feet for detergent tank and 60 square feet for recirculating sump. Steam coils designed to ASME Section VIII, Div 1, and Unfired Pressurized Vessel Code and be easily removable for cleaning or maintenance. Coils shall not be welded in place.
 8. Treatment pump equipped with a stainless steel automatic self cleaning screen, minimum 3-1/2" diameter x 18" long manufactured from perforated stainless steel. Screen shall have 1/16" diameter perforations and be inter-piped and inter-wired with motor operated ball valves to collect debris during treatment portion of each cycle and direct debris to sewer when draining any treatment solution. Floor screens that accumulate debris from load to load will not be allowed.
 9. Oscillating Jet System shall consist of the following:
 - a. Wash and rinse solutions are distributed throughout the wash chamber via 110 degree oscillating arms mounted horizontally along the sidewalls of the chamber. These spray jet manifolds with 160 wash nozzles and 100 rinse nozzles, plus 3 addition wash nozzles on the washer ceiling provide complete coverage.
 - b. Oscillating system driven by a minimum 1/3 HP motor through a gear reducer. A reversible motor drive system is not acceptable. Driving the oscillating carriage by a rod less air cylinder is acceptable as well.
 - c. Oil tight micro switches provided to guarantee oscillating reader system covers the entire length of the chamber.
 - d. Temperature guarantees (defeated through microprocessor with password):
 - e. 190°F final Rinse. Final rinse timer will not start timing until recirculating water temperature has reached at least 190°F (as sensed near the nozzle) thus assuring entire final rinse time 190°F minimum. Recirculating temperature to reach 190°F within 2-3 minutes after final rinse begins recirculation.
 - f. 190°F Wash Solution. Wash timer will not start timing until recirculating wash solution temperature has reached at least 190°F (as sensed near the nozzle), thus assuring entire wash time at 190°F minimum. Recirculating temperature to reach 190°F within 2-3 minutes after wash solution begins recirculation.

- 45°F chilled water system for sump and vapor condenser.
25. Effluent alkalinity monitored and neutralized prior to discharge; Controlled by microprocessor. If neutralizing agents are spent, an alarm will sound and machine will stop until neutralizing agents are replenished or system is manually overridden. Drain discharge to be between pH 6.0 and 9.0.
 26. Instantaneous steam to water heat exchanger is raising hot water supply temperature to rinse and wash temperature requirements.
 27. Stationary spray header mounted in floor of unit to ensure complete exposure of underside of load to treatment schedule.
 28. Stainless steel entry/exit pit transition plates to bridge space between unit and pit. Chamber bottom shall align with finished floor +/-1/32".
 29. Rack manifold flush system capable of flushing two (2) automatic water racks with house automatic-watering (AW) water during the final rinse cycle. Provide two (2) quick disconnect hoses in wash compartment. System shall be inter-piped and inter-wired for automatic operation.
 30. Provide the following accessories with each unit:
 - a. One (1) stainless steel feeder bottle-washing cart with a quick disconnect fitting designed to process six (6) baskets of bottles per load each. Coordinate basket size and configuration with Owner.
 - b. One (1) heavy duty, stainless steel cage wash carts designed to hold rodent cages from 5"-8" in height, on four rows per side of cart. Cart shall accommodate 80 standard mouse cages Cart shall feature automatic swivel-type retainers to secure cages rigidly in place during cleaning and four swivel casters constructed of stainless steel with neoprene wheels. Cart shall be nominally 72"L x 88"H x 32"W.

D. Materials (all stainless steel, S.S., type 304):

<u>Item</u>	<u>Material</u>
Base & Recirculating Sump	12 Gauge S.S. #2B Finish
Door Frames	2"x2"x3/16" S.S. Angle
Door Panels	16 Gauge S.S. #3 Finish
Side and Top Panels	14 Gauge S.S. #3 Finish
Recirculating Pump Piping	S.S.
Internal Water & Steam Piping	S.S.
External Steam Piping	Schedule 80 Black Iron
Steam Condensate	Schedule 80 Black Iron
External Water Piping	Brass
Spray Jets	S.S.
Grating	S.S.
Steam Coils	S.S.
Barrier Flange & Modular Wall	20 Gauge S.S. #3 Finish
Insulated Jacket	20 Gauge S.S. #3 Finish

E. Utility Requirements:

E 3/60/480, 12 HP
HW 50 gpm @ 140 F
COND 1"NPT
ST Multiple connections, 1200 lb/hr peak
D Floor sink preferred
EXH 12 inch dia, 450 CFM, saturated at vapor at 190 F, Static pressure $\frac{3}{4}$ IWC.
CHWS 1 $\frac{1}{2}$ " NPT, 30 GPM @ 55F (+/- 5F)
CHWR As required
CA 1/2"- NPT, 6 cfm, 80-100 psig
BTUH Entrance 9,000 BTUH, Exit 9,000 BTUH, Service Area 25,000 BTUH heat rejection to equipment service area. Average from Carts 5,000 BTU per side
Data Single analogue or Cat 5 min for diagnostics

F. Equipment item(s) CFCI with MA.

G. Unit(s) will be Lynx 410LX Cage and Rack Washer. Units manufactured by Northwest / Betterbuilt, Getinge, or Steelco shall be considered equal provided that they meet the requirements of this specification.

2.3 TW: TUNNEL WASHER

A. Product Description:

1. Application: Heavy duty, conveyORIZED, hydrospray washer designed for thorough, efficient cleaning of cages, debris pans, bottles, feeder bowls and miscellaneous items used in care of laboratory animals.
2. Size:
 - a. Tunnel (minimum inside clear): 36"W x 24"H
 - b. Conveyor Size: 36"W belt
 - c. Conveyor Speed: Variable 2 to 5 feet/minute
 - d. 48" Pre-washer section, 78" Washer section, 54" Rinse section, 84" dryer section, 36" discharge conveyor.

B. Operation: Items to be cleaned are loaded in inverted position on load end of conveyor belt. Items are conveyed automatically through various treatments and discharged.

1. Treatment Schedule: A treatment schedule shall be automatically programmed as follows:
2. Pre-Wash: Water recovered from the recirculated rinse tank under pump pressure flushes items to remove gross debris. Spent solution is directed to automatic drain discharge cool down system.
3. Wash: Hot detergent solution is recirculated through the jet system under pump pressure. Temperature adjustable to 190F.
4. Recirculated Rinse: Hot water is recirculated through the jet system under pump pressure. Temperature adjustable to 190F.
5. Final Rinse: Hot water from house supply is heated through a steam heat exchanger and sprayed through the jet system. Spent solution drains to recirculated rinse tank. Temperature adjustable to 195F.

C. Construction:

1. Frame, recirculating tanks, and cabinet of one piece welded stainless steel construction. Frame equipped with adjustable legs and supports for pumps,

- steam heat exchanger and drive mechanism.
2. Top and sides insulated with 2" thick rigid fiberglass insulation covered by a protective stainless steel jacket.
 3. Splash proof doors provided for access to jet systems and interior. Tempered glass, water tight windows provided in each door for observation of treatment process. Doors insulated with 2" thick rigid fiberglass insulation and equipped with silicone bulb sealing gaskets, latches and heavy-duty self-losing hinges. Doors removable for cleaning or maintenance.
 4. Each recirculating tank equipped with an automatic solution level control, safety overflow piping, manual drain valve and stainless steel steam coil heating for the recirculating treatment solutions. Automatic digital temperature controllers mounted on the operator's panel will display and monitor recirculating solution temperatures.
 5. Stainless steel steam coil heating for wash and recirculating rinse tanks complete with condensate return, steam traps and strainers. Steam coils shall be designed to ASME Section VIII, Div 1, Unfired Pressurized Vessel Code and be easily removable for cleaning or maintenance. Coils shall not be welded in place.
 6. Wash solutions under pressure from a minimum 10 HP pump and recirculated rinse and pre-wash systems shall be under pressure from a minimum 3 HP pump. Both pumps Worthington close coupled "Monobloc" type, or approved equal, with mechanical seals. Each pump system with a direct reading pressure gauge.
 7. Pre-wash, wash and recirculating rinse sections equipped with easily accessible stainless steel drawer type screens. Screens manufactured from perforated stainless steel with perforations smaller than machined jet orifices to filter solutions and prevent jets from clogging.
 8. Jet systems for pre-wash, wash and recirculating rinse sections composed of machined jets fitted into headers. Each header equipped with a quick disconnect fitting and O-ring for easy removal without use of tools. Jet properly sized and feed lines contain throttle valves to hydraulically hold down light plastic cages and steel pans to conveyor belt. Additional jets strategically placed so water bottles in baskets can be processed through washer.
 9. Electrical control system:
 - a. Within control box are transformer for 1/60/115 volt control circuit, magnetic starters with overload protection for all motors and all other electrical components required for operation.
 - b. Unload end is equipped with a drive system emergency stop button and warning lights.
 10. Safety features:
 - a. Emergency push/pull stop buttons at both load and unload ends of unit to terminate all process and conveyance functions. Processing resumed by resetting emergency stop button and activating cycle start button.
 - b. Each chamber door with a disconnect switch to terminate all process and conveyance functions upon opening of any door. Processing cannot be resumed unless all doors are fully closed. All emergency conditions are audibly and visually enunciated.
 11. Final rinse jet system consists of spray headers with machined jets and a throttle valve in the line for optimum water use. System equipped with a steam heat exchanger to raise house hot water supply temperature by 60-80F. Heat exchanger supplied with temperature gauge and steam throttle valve to adjust final rinse system temperature.
 12. Drive system shall consist of a minimum 1/3 HP DC motor, gear reducer,

- automatic safety overload clutch and variable speed drive.
13. Conveyor system shall include a stainless steel flat wire mesh belt, sprockets at both drive and idler ends for positive tracking of belt, adjustable take-up bearings on idler end, and stainless steel guides and supports along entire length. A stainless steel drain pan with a 2" drain connection under the entire length of conveyor.
 14. Three (3) detergent injection ports and dry electrical contacts for installation of automatic detergent injection. Washer sump equipped with two (2) 1" NPT fittings/couplings for connection of external devices.
 15. Water line to be protected from hammering by using slow closing valves.
 16. Low water cut-off for both recirculating that will cease operations and automatically fill tank to proper level. Status lights shall indicate which tank is low and operations will resume automatically when tank is full.
 17. Stainless steel baffles and rubber curtains between each treatment section and at both ends. Curtains manufactured from 1/8" thick slit neoprene and with the baffles minimize the carry-over of water.
 18. All serviceable components located on one side of washer inter-piped and inter-wired so that only one connection is required for each service and utility except drain.
 19. Stainless steel trim flanges to enclose opening between machine and masonry opening.
 20. Discharge of wash treatment pump equipped with a stainless steel automatic self-cleaning screen, 3-1/2" diameter X18" long manufactured from perforated stainless steel with 1/16" diameter perforations. Screen shall accumulate debris prior to jet system and be automatically flushed at time periodic intervals. Fully ported, motorized ball valves shall direct the solution flow to jet system or drain.
 21. All pumps, valves, piping and other components that come in contact with recirculating solutions shall be furnished in stainless steel.
 22. Shipped in sections for entry into building. Sections shall then be welded into place on site to eliminate any possibility of leakage
 23. Temperature guarantee for both recirculating tanks. If recirculating solution temperature drops below set temperature (190F), conveyor belt shall temporarily stop until recirculating solution reaches proper temperature. Status lights will indicate which tank is not at proper temperature.
 24. Exhaust plenum provided for exhausting all washer and dryer sections, including a canopy exhaust at unload end, to single building exhaust connection. Top of exhaust plenum shall not exceed 8' AFF at connection to building exhaust. All exhaust connections to sections shall include manual dampers for balancing exhaust system.
 25. Solid-state microcomputer control system that monitors and automatically controls all process operations and functions. Provide primary and secondary microprocessor control panels on load and unload ends of the washer, respectively. Cycle phase times, temperatures and other key process parameters are programmable and may be locked in by supervision. A 12 cycle menu of treatment processes may be programmed and retained to permit operating personnel to accommodate a wide variety of load and processing requirements. Cycle programming shall be controlled by access code to insure process integrity. Each cycle program may be reviewed and printed on demand. The highly visible color touch panel screen (OR LED screen) shall display cycle program data on demand and real time in process cycle performance. Programming may be in standard AM/PM or military time, temperature in Fahrenheit or Centigrade. Times and temperatures shall expressed in minutes/seconds and tenths of a degree increments respectively. An internal battery shall back up all cycle memory for up to one (1) year and permit completion of a cycle upon restoration of power after a power disruption. All

- cycle deviations are alarmed visually and audibly, recorded and must be acknowledged by the operator. A built-in service diagnostic program, accessible by service access code, shall be provided and displayed to permit system calibration and verification of satisfactory component operation. Provide a strip chart printer with paper take up to record all cycle programs and in process performance data. Provide an RS232 port to download cycle data to a remote computer. All data from control system to communications port shall be in ASCII format compatible with PC/DOS support software. Provide 0.1 amp Form C dry contacts to communicate with building DDC system and send a signal when unit is turned on or off.
26. Chilled water system to cool effluent from pre-wash section. System automatically activated when washer is turned on and controlled and recorded by microprocessor. In addition, a cold water tempering system mounted in line to the drain line to cool spent recirculated treatments shall be controlled by an actuated ball valve which automatically opens when sump valves are open. By building chilled water tempering, all drain discharges are cooled to a minimum of 140F, or less, before gravity draining.
 27. Effluent alkalinity monitored and neutralized prior to discharge; Controlled by microprocessor. If neutralizing agents are spent, an alarm will sound and machine will stop until neutralizing agents are replenished or system is manually overridden. Drain discharge to be between pH 6.0 and 9.0.
 28. A photoelectric switch shall be located at the end of discharge conveyor to stop powered conveyor drive when an item reaches end of conveyor. Photoelectric switch can be activated/deactivated by microprocessor and/or a control panel switch depending upon whether cage components continue through to the bedding dispenser or not.

D. Materials (all stainless steel, S.S., type 302/304):

<u>Item</u>	<u>Material</u>
Frame	2"x2" x3/16" S.S. Angle
Tanks	12 Gauge S.S. #3 Fin.
Cabinets	14 Gauge S.S. #3 Fin.
Recirculating Pump Piping	S.S.
Internal Water & Steam Piping	S.S.
External Steam Piping	Schedule 80 Black Iron
External Water Piping	Brass
Spray Jets	S.S.
Internal/External Drain Piping	S.S.
Steam Coils	7 gauge S.S. #2B Fin.
Barrier Flange/Insulated Jacket	20 Gauge S.S. #3 Fin.

E. Utility Requirements:

E 3/60/480V, 24 hp
ST Washer - Multiple (40-60 PSI dynamic, 1400 lb/hr)
ST Dryer – Multiple (40-60 PSI dynamic, 1000 lb/hr)
COND 2 @ 1" NPT
HW 1 1/2" NPT, 50 GPM fill, 12 GPM continuous, 30-60 psi
CA 1/2" NPT 80-100 PSI, 2 CFM
CHWS 1 1/2" NPT, 35 GPM max
CHWR As required
D Floor sink recommended, 50 GPM minimum
EXH 4 @ 12" dia, 2200 CFM total, Saturated vapor at 180F, Static pressure 3/4 IWC
BTUH Entrance 7,000 BTUH, Service Area 68,000 BTUH heat rejection to equipment service area.
Data Single analogue or Cat 5 min for diagnostics

F. Equipment item(s) shall be CFCI with MA, MED.

G. Unit(s) shall be equal to Lynx model 536LXi. Unit(s) manufactured by Northwest / Betterbuilt, Getinge and Steelco shall be considered equal provided that they meet requirements of this specification.

2.4 BFS: BOTTLE FILL STATION

A. Product Description:

1. Application: Semi-automatic, feeder bottle filling system utilizing manifold type fillers and transport baskets.
2. Size: 96"W x 74"H x 32"D
 - a. Basket: Vendor to confirm with Owner appropriate basket size and configuration without change in contract cost.
 - b. Bottles: 8 oz or 16 oz capacity.
 - c. Load Height: 32" AFF, adjustable.

B. Operation: Operator places an empty rack of clean bottles on the conveyor. Bottles are positioned beneath the filler manifold and operator manually opens the fill valve. Water is dispensed through a pattern of individual nozzles located in the manifold suspended above the bottles.

C. Construction:

1. Filler base, roller conveyor with basket stops, conveyor frame, track and manifold are fabricated from 304 stainless steel.
2. Automatic operation: Provide solenoid water valve and pushbutton reset timer. Electrical control panel contains main power on-off toggle switch, pushbutton reset timer, user selectable water type switch (RO/Chlorinated/Acidified) and operational lights..
3. Filler manifold height is adjustable to accommodate varying height bottle racks with identical filling patterns. Individually machined, stainless steel filling jets are provided in the filling header to fill each bottle.

D. Utility Requirements:

E 1/60/120V, 20amps

RGW ¾" IPS
D 1-1/2" IPS. Floor drain

- E. Unit (s) to carry a one (1) year parts and labor warranty.
- F. Equipment item(s) shall be CFCI with MAS.
- G. Unit(s) shall be equal to TBJ Model WP-2001-RT-1F. Unit(s) manufactured by Northwest / Betterbuilt, Lynx and Edstrom shall be considered equal provided that they meet the requirement of this specification.

2.5 BD: BEDDING DISPENSER

- A. Product Description:
 - 1. Application: Semi-automatic, indexing dosing unit designed to dispense bedding into animal cages. Dispenser capable of handling corn cob type animal bedding.
 - 2. Size:
 - a. Hopper Capacity: 15 cubic feet minimum
 - b. Hopper Loading Height: 33"
 - c. Overall machine: 40"W x 92"H x 26"D.
- B. Operation:
 - 1. Bedding is loaded into the lower hopper. Bedding is transported to the upper hopper by a mechanical screw conveyor. The operator will line two cages across the work surface, and upon activating the dispenser a pre measured 'dose' of bedding will be dropped simultaneously into the two lined cages.
- C. Construction:
 - 1. Storage-dispensing hopper 14 gauge stainless steel. All structural supports stainless steel. All sprockets, shafts and chains carbon steel. Unit supported on four adjustable legs to level unit and set conveyor height.
 - 2. Ship disassembled for entry into building with uncrated sections able to pass through a 3'-6" x 6'-8" doorway.
 - 3. Structure: All structural support is stainless steel. All sprockets, shafts, chains, etc. are carbon steel.
 - 4. Hoppers: Both the lower storage bin and the upper storage bin are 14 gauge type 304 stainless steel. Total hopper capacity is a minimum of 15 cubic feet. Upper dispensing hopper is equipped with a removable cover for cleaning or maintenance.
 - 5. Bedding Transfer System: Bedding is transferred from the lower storage bin to the upper dispensing hopper by a continuous shovel type screw conveyor. The transfer system operates automatically and is equipped with an on-off toggle switch on the control panel.
 - 6. Work Surface: The work surface consists of a stainless steel 3/8 inch diameter welded rod grid. The grid is designed to permit the dumping of bagged bedding through the grid to the storage bin. The grid provides a work surface for the operator and allows spillage to fall through to be automatically returned to the dispensing hopper above. The grid is easily removable for cleaning or maintenance.
 - 7. Dust Filtration: The unit is equipped with (2) blowers and (2) removable filters to capture and contain dust generated in the dispensing compartment. The filter is washable and reusable.

8. Controls: The operator's control panel contains a main power On/Off selector switch, a Conveyor On/Off switch to control power to screw conveyor, a 0-10 second automatic reset timer for precise metering and distribution of bedding and (2) amber indicator lights to indicate that the dust filtration blower are in the operational mode. The timer automatically resets itself after completion of a dispensing cycle.
- D. Utility Requirements:
- | | |
|----|-------------------------|
| E | 1/60/120V, 15A |
| CA | 1/4 NPT, 15 psig, 2 cfm |
- E. Equipment item(s) shall be CFCI with MA and MED.
- F. Unit(s) shall be equal to TBJ Model BD-2000 Bedding Dispenser. Unit(s) manufactured by Northwest / Betterbuilt, Lynx, Getinge shall be considered equal provided that they meet requirements of this specification.

2.6 MW: MODULAR WALL SYSTEM

- A. Product Description:
1. Modular wall panel box sections shall be finished on both sides with type 302/304 stainless steel, #3 finish, and infilled with a moisture-resistant, sound-deadening insulation. Minimum thickness for outer sheet shall be 18 gauge, minimum thickness for inner sheet shall be 24 gauge.
 2. Sectional modular wall shall be as indicated on the Drawings (length and height shall be field verified) and nominally 2" thick. Manufacturer will coordinate and provide rough openings for Cage and Rack Washer (CRW), Tunnel Washer (TW), Lab Steam Sterilizer (ST-1) and Vivarium Steam Sterilizer (ST-2). Modular wall shall completely seal openings between equipment, walls, floors and ceiling.
 3. Provide 36" x 84" stainless steel doors where noted with a 24" x 24" tempered glass vision window and 24" x 24" grille (50% free area). Provide maximum possible width x 84" door adjacent to ST-1. Door hardware to be selected by Owner and furnished and installed by manufacturer.
 4. Where shown on Drawings, coordinate with canopy hood on non-service side of wall. Provide louvers in wall above each appliance to capture vapor and steam and allow them to be drawn into the enclosure created by walls.
 5. Provide all necessary ceiling and wall trim angels, integral leveling devices (attached to vertical panels and concealed by base: shims will not be acceptable), vertical panels, horizontal panels and sanitary bases (at floor/wall intersection) for a complete and tight installation. All components to be 302/304 stainless steel.
 6. Unit to meet local seismic design requirements.
 7. Coordinate all equipment cutouts with selected vendor's submittal data.
- B. Equipment item(s) shall be CF/CI with MAS.
- C. Unit(s) shall be equal to Getinge Modular Wall. Unit(s) manufactured by Steris will be considered as equal provided that they meet the requirements of this specification.

2.7 RO: REVERSE OSMOSIS WATER SYSTEM

- A. Basis of Design: Manufacturer: Milipore Corporation

Model: RiOs 30 Laboratory Water production unit

- B. Unit to be a Water Production Unit suitable for converting tap water to Reverse Osmosis Filtered water
- C. Standard model to include:
 - 1. Reverse Osmosis water production at 30 liter / hour.
 - 2. Feed water: Tap Water
 - 3. Production RO water quality:
 - a. Ion rejection > 95%
 - b. Organic rejection > 99%
 - c. Particle rejection > 99%
 - d. Bacteria count < 10cfu/ml
 - 4. Primary production unit to be 67 cm w x 74 cm hi x 44 cm d.
 - 5. Unit to be wall mounted - Include wall mounting bracket.
 - 6. Unit to include 100 liter reservoir with UV light and mixer appropriate for RO water storage. This unit shall be housed below the BFS. Coordinate with BFS supplier.
 - 7. This contractor shall supply all tubing , mounting brackets, etc from the tap supply to the reservoir.
- D. Utility Requirements:
 - 1. Elect: 1/60/115V/ 10 amp operating load
 - 2. CW: ½" copper
 - 3. Drain: Floor or adjacent wall drain, Rejection water drains at a rate of 5 liter / minute.
- D. Equipment item(s) shall be CFCI.
- E. Acceptable Manufacturers: Millipore Corporation.

2.8 MT: MISTING DECONTAMINATION TUNNEL

- A. Product Description:
 - 1. Pass through tunnel with conveyer for the application of chemical disinfection mist to incoming vivarium materials.
 - 2. Size:
 - a. Chamber interior dimensions: 20" wide x 20" high.
 - b. Chamber length 48"
 - c. Loading section length 12".
 - d. Collapsible roller extension at output end expands from 24" to 48"
 - e. Overall size 33"w x 60" l x 58.5" high.
- B. Operation: Operator selects operating speed and dispense rate, then places material to be decontaminated into the facility onto the loading section. The conveyer moves the material through the misting tunnel chamber, where spray nozzles mist the material with recirculated disinfecting solution. Plastic curtains at the load and unload end prevent overspray. The motorized conveyer moves the material out onto a collapsible roller extension for post decontamination retrieval.
- C. Construction:
 - 1. Fabricated from 304 stainless steel
 - 2. Piping to be PVS or Acetal plastic appropriate for use with aqueous disinfecting

- 3. solution.
 - 3. Motorized stainless steel link belt for conveyance over load and chamber sections.
 - 4. Control panel at load end. Pump and drive to shut off after a preset time if no load is detected.
 - 5. Stainless steel rollers on output end for material travel. Stainless steel casters at floor for section collapsibility.
 - 6. Fixed chamber installation with modular wall and Hinged Bio-door at load end.
 - 7. 2 gallon disinfectant tank with in-line filter located below loading section.
- D. Capacities:
- 1. Belt speed: 0 to 50 feet per minute, infinitely adjustable.
 - 2. Material to be decontaminated include shipping containers, bagged feed and bedding.
- E. Utility Requirements:
- E 1/60/115V
- F. Unit(s) will be SaniMaster Frontline Misting Tunnel model CS2020 by Viking Medical. Unit(s) manufactured by Viratek Inc. shall be considered equal provided that they meet the requirements of this specification.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Check for shipping damage. Reject units with scratches, dents or other defects that cannot be readily corrected.
- B. Check job site to insure that rough-ins and substrates are correct and that equipment will fit as indicated on Equipment Drawings.
- C. Do not proceed with installation until defects or oversights are corrected.

3.2 INSTALLATION

- A. Deliver equipment to the job site freight paid.
- B. Uncrate all equipment and place in locations shown on Equipment Drawings. Remove all crating materials and packing debris.
- C. Install all items in accordance with Manufacturer's standards. Provide all accessories necessary for a complete installation.
- D. Verify plumbing, ventilation and electrical connection requirements for all equipment and coordinate connections with work of Division 22, 23 & 26.

3.3 ADJUST AND CLEAN

- A. Check operation and installation of equipments as necessary to meet Manufacturer's or

these specifications (whichever is more stringent).

- B. Installer shall replace items, which do not operate properly, have defacing marks or damage, which cannot be satisfactorily repaired as determined by the Owner's Representative. Replace parts at no cost to Owner.
- C. Clean and polish equipment in accordance with Manufacturer's recommendation before and after demonstration for Owner. Leave ready for use with copy of instruction manual attached to equipment in a manner to be specified by Owner's Representative.
- D. Each manufacturer shall submit with his Contract Price proposal an itemized list of available accessories for Owner's selection as part of this work. Provide unit prices for these accessory items; unit price cost shall be valid through entire construction period of project and for an additional 90 days after substantial completion.

3.4 SERVICE CONTRACT

- A. Each manufacturer shall submit a service contract for his piece of equipment and cost of same. Owner shall determine if contracts are to be accepted.

END OF SECTION

SECTION 11 61 00 - LABORATORY FUME HOODS

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. This Section includes the following:
 - 1. Bench-top laboratory fume hoods
 - 2. Perchloric Acid fume hoods
 - 3. Canopy fume hoods at Autoclaves and where otherwise indicated
 - 4. Fittings for piped services and electrical service fittings in fume hoods
 - 5. Piping and wiring within fume hoods for service fittings, light fixtures, blower switches and other electrical devices.
 - 6. Shop and field testing of fume hoods.
 - 7. Extractor Arms and snorkels
- B. Related Sections include the following:
 - 1. Division 9 Section for reinforcements in metal-framed gypsum board partitions for anchoring fume hoods.
 - 2. Division 12 Section "Wood Laboratory Casework for fume hood base cabinets".
 - 3. Division 23 Section "Testing, Adjusting, and Balancing".
 - 4. Division 23 Sections for fume hood duct connections, including ducts.
 - 5. Division 22, 23 and 26 Sections for connecting service utilities at back of fume hoods. Piping and wiring within fume hoods are specified in this Section.

1.3 DEFINITIONS

- A. "Service Fixtures" are defined as gas, air, and vacuum cocks, hot, cold, reagent grade water faucets, remote control valves, electrical receptacles with necessary flush mounting boxes, conduits or pedestals and plates, fluorescent and/or incandescent light fixtures, light switches and/or motor switches for hoods and other items which serve as a functional part of the equipment.
- B. "Service Lines" are defined as gas, air, vacuum, hot, cold, reagent grade and reference grade water piping, drain lines, fittings and shut off valves necessary to carry respective services from building roughing-in floors or walls through equipment to "service fixture".
- C. "Service Lines" also include conduit, junction boxes, conduit fitting, wire disconnect switches and fuse or circuit breakers necessary to carry electrical services from building roughing-in outlets in floors or walls through equipment to "service fixtures."

1.4 EXCEPTIONS TO DRAWINGS AND SPECIFICATION

- A. All exceptions shall be subject to written approval prior to receipt of bid. If no written communication is received prior to receipt of bid and approval indicated in an addendum, it is assumed that bidder will be in total compliance with specifications and will be held responsible for default or delay, regardless of any statement to the contrary in their written proposal.
- B. Requests for a substitution must be made directly to the Owner's Representative's office for consideration no later than fifteen (15) working days prior to bid receipt date. Fume Hood ASHRAE Test Reports and confirmation of load performance for stands certified by an independent nationally recognized testing laboratory shall be submitted along with the request for a substitution.
- C. Requests for a substitution following the bid opening will be rejected.
- D. Substitutions approved prior to bid date will be handled as an addendum and be sent to all bidders.

1.5 PERFORMANCE REQUIREMENTS

- A. Containment: Provide fume hoods that comply with the following when tested according to ASHRAE 110 at a release rate of 4.0 L/min.:
 - 1. Average Face Velocity: 100 fpm plus or minus 10 percent with sashes at 18" position.
 - 2. Face Velocity Variation: Not more than 10 percent of average face velocity.
 - 3. Sash Position: Fully open.
 - a. Test hoods with horizontal sashes with maximum opening on one side, with maximum opening in the center, and with one opening at each side equal to half of maximum opening.
 - b. Test hoods with combination sashes fully raised, with maximum opening on one side, with maximum opening in the center, and with one opening at each side equal to half of maximum opening.
 - 4. As-Manufactured (AM) Rating: AM 0.05 (0.05ppm).
 - 5. As-Installed (AI) Rating: AI 0.05 (0.05ppm).
- B. Static-Pressure Loss: Not more than 1/4-inch wg at 100-fpm face velocity when tested according to Paragraph 6.4.2.4 in SEFA 1.2, "Laboratory Fume Hoods--Recommended Practices."
- C. Seismic Performance: Provide fume hood anchorages capable of withstanding the effects of earthquake motions determined according to ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 9, "Earthquake Loads."
- D. Electrical Performance: UL 1805 Classified

1.6 SUBMITTALS

- A. Product Data: For each type of product indicated.

- B. Shop Drawings: For laboratory fume hoods. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Indicate details for anchoring fume hoods to permanent building construction including locations of blocking and other supports. Include calculations demonstrating that anchorages comply with seismic performance requirements.
 - 2. Indicate locations and types of service fittings together with associated service supply connection required.
 - 3. Indicate duct connections, electrical connections, and locations of access panels.
 - 4. Include roughing-in information for mechanical, plumbing, and electrical connections.
 - 5. Show adjacent walls, doors, windows, other building components, laboratory casework, and other laboratory equipment. Indicate clearances from above items.
 - 6. Include layout of fume hoods in relation to lighting fixtures and air-conditioning registers and grilles.
 - 7. Include coordinated dimensions for laboratory equipment specified in other Sections.
- C. Samples: for Initial Selection: For factory-applied finishes epoxy countertops and stainless steel countertops.
- D. Samples for Verification: For factory-applied finishes, interior lining and countertop material, in manufacturer's standard sizes.
- E. Product Test Reports: Based on evaluation of comprehensive tests according to SEFA 1.2, "Laboratory Fume Hoods--Recommended Practices" and ASHRAE 110 performed by manufacturer and witnessed by a qualified independent testing agency, for fume hoods.

1.7 QUALITY ASSURANCE

- A. Source Limitations: Obtain laboratory fume hoods through one source from a single manufacturer.
 - 1. Obtain through same source as laboratory casework specified in Division 12.
- B. Product Standard: Comply with SEFA 1.2, "Laboratory Fume Hoods--Recommended Practices."
- C. Safety Glass: Products complying with testing requirements in 16 CFR 1201 for Category II materials.

1.8 DELIVERY, STORAGE AND HANDLING

- A. Protect finished surfaces during handling and installation with protective covering of polyethylene film or other suitable material.

1.9 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install fume hoods until building is enclosed, wet work and utility roughing-in are complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
- B. It is the fume hood manufacturer's responsibility to verify field measurements and that equipment will fit through entryways, corridors and door openings enabling a smooth flow of equipment to its proper location in the building.

1.10 COORDINATION

- A. Coordinate installation of fume hoods with laboratory casework, fume hood exhaust ducts, and plumbing and electrical work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Kewaunee Scientific Corporation; Laboratory Division
 - 2. Labconco Corporation
 - 3. Bedcolab

2.2 MATERIALS

- A. Steel Sheet: Cold-rolled commercial steel sheet, complying with ASTM A 1008/A 1008M; matte finish; suitable for exposed applications.
- B. Stainless-Steel Sheet: ASTM A 666, Type 304; stretcher-leveled standard of flatness.
- C. Glass-Fiber-Reinforced Polyester: Polyester laminate complying with ASTM D 4357, with a chemical-resistant gel coat on the exposed face, and having a flame-spread index of 25 or less per ASTM E 84.
- D. Epoxy: Factory molded of modified epoxy-resin formulation complying with Division 12 Section Wood Laboratory Casework and having a flame-spread index of 25 or less per ASTM E 84.
- E. Laminated Safety Glass: ASTM C 1172, Kind LT, Condition A, Type I, Class I, Quality q3 with clear, polyvinyl butyl interlayer.
- F. Fasteners: Interior fastenings are to be concealed. Exposed screws or screw head caps as not acceptable.

2.3 RESTRICTED BYPASS FUME HOODS

- A. Provide fume hoods with partial compensating bypass above sash, which opens after sash is closed to less than 40 percent open. Design partial bypass to maintain sufficient exhaust air volume through hood to adequately dilute hazardous fumes regardless of sash position. Restricted bypass shall be configured as hereinafter specified.
 - 1. Variable-Air-Volume Control: Fume hoods shall be variable volume. All controls and alarms shall be furnished and installed by other sections of this specification.

2.4 FABRICATION

- A. General: Pre-assemble fume hoods in factory to greatest extent possible. Disassemble fume hoods only as necessary for shipping and handling limitations. Fume hoods shall be capable of movement through a 41" x 83" door opening.
- B. Steel Exterior: Fabricate from steel sheet, not less than 0.0478 inch thick, with component parts screwed together to allow removal of end panels, front fascia, and airfoil and to allow access to plumbing lines and service fittings. Apply chemical-resistant finish to interior and exterior surfaces of component parts before assembly.
- C. Ends: Fabricate with double-wall end panels without projecting corner posts or other obstructions to interfere with smooth, even airflow. Close area between double walls at front of fume hood and as needed to house sash counterbalance weights, utility lines, and remote-control valves.
 - 1. Access to fixture valves concealed in the wall shall be provided by exterior removable access panels and gasketed access panels on the inside liner walls. Exterior side panel member fastening devices to be exposed corrosion resistant, non-metallic material creating a positive mechanical latch. Exposed connectors to match hood body in color.
- D. Access Opening Perimeter: Airfoil or streamlined shape with all right angle corners radiused or angled. Bottom horizontal foil shall provide a nominal one inch bypass when the sash is in the closed position. The bottom foil shall not be removable without the use of special tools. Bottom foil shall provide access area sufficient in size to pass through hospital grade electrical plugs. The bottom foil shall be steel with urethane powder coating to increase acid and abrasions resistance, except type 316 stainless steel, #4 finish and coated with PVDF at radioisotope hoods. The airfoil and sill shall be flush with the height of the interior work surface. A secondary containment trough shall be located in front of the work surface and extend below the airfoil sill.
- E. Fume hood liner: Reinforced polyester panel; smooth finish and white color in final appearance. Flexural strength: 14,000 psi. Flame spread: 15 or less per U.L. 723 and ASTM E84-80. Baffle must be same material as liner. Metallic baffles, brackets or supports on hood interior – not acceptable
- F. Stainless-Steel Lining Assembly: Welded unit consisting of end panels, back panel, top, and countertop; reinforced to form a rigid assembly to which exterior is attached.

1. For radioisotope fume hood linings, cove corners and weld seams completely, grind smooth, and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
- G. Baffles: Baffles providing controlled air vectors into and through the fume hood must be fabricated of the same material as the liner. Provide minimal exhaust slots full height on vertical sides of the baffle. High performance 2-piece baffle will be used. Baffle shall incorporate exhaust slots located to purge the upper and lower area of the hood. Baffle to be non-adjustable. Baffles with manual or automatic adjustment are not acceptable. Minimum depth of 19" for interior workspace is required at the extreme upper portion of the fume hood to provide maximum interior work area. All baffles, supports, and brackets to be non-metallic.
- H. Exhaust Plenum: Full width of fume hood and with adequate volume to provide uniform airflow from hood, of same material as hood lining, and with duct stub for exhaust connection.
1. Duct-Collar Material: 4" high stainless steel type 316 collar spun to create a bell mouth configuration. Provide stainless steel transition if manufacturer's standard exhaust collar does not meet this requirement. Engineer shall determine the specific outlet diameter.
- I. Restricted bypass shall enter hood through top of bypass chamber and enter the hood in a down-flow direction. The chamber shall protect the user from expelled particulate in the event of an adverse internal reaction.
- J. Sashes: Provide operable sashes of type indicated.
1. Vertical sash access with a 35" high sight line. Sash shall be top hung on nylon-tired stainless steel ball bearing wheels. Sash frame on bottom and sides must be no more than 1.5" thick and radiused to minimize turbulence. Area above the 28" high vertical sash opening shall be glazed with 3/8" thick laminated safety glass.
 2. Counter balance system: Single weight, sprocket and chain, counter balance system which prevents sash tilting and permits ease of operation at any point along full width pull. Maximum 7 pounds pull required to raise or lower sash throughout its full length of operating sash opening. Design system to hold sash at any position without creep and to prevent sash drop in the event of cable failure. Open and close sash against rubber bumper stops.
 3. Airfoil: The airfoil will be flush to the work surface with ample room for electrical hospital grade cords to fit beneath the airfoil. Sill to be ergonomically radiused on front edge. Sill must pivot forward to provide cord and trough access. Airfoil sills that are not flush with the top plane of the work surface are not acceptable.

- K. Auto-Sash: Sash shall be designed to promote usage as an upper body and face shield. Face velocities and volumes shall be based on an 18” operating opening. Sash shall have the capability to be raised to full 28.5” vertical opening for loading or unloading of large apparatus. A lock-open shall be provided. Sash shall lower automatically to the operating position when released from any position above 18”. Auto-sash function shall be life cycle tested and not incorporate the need for motor drives.
1. Fabricate from 0.0500-inch- (1.3-mm-) nominal thickness stainless steel. Form into four-sided frame with bottom corners welded and finished smooth. Make top member removable for glazing replacement. Set glazing in chemical-resistant, U-shaped gaskets.
 2. Glaze with 7/32” thick laminated safety glass.
 3. Counterbalance vertical sliding sash with sash weight and stainless steel cable system. Provide ball-bearing sheaves, plastic glides in stainless-steel guides, and stainless-steel lift handles. Provide rubber bumpers at top and bottom of each sash unit.
- L. Light Fixtures: Provide vapor proof, two-tube, rapid-start, fluorescent light fixtures, of longest practicable length; complete with tubes at each fume hood. Shield tubes from hood interior with 1/4-inch- (6.35-mm-) thick laminated glass or 3-mm-thick tempered glass, sealed into hood with chemical-resistant rubber gaskets. Provide units with fluorescent tubes easily replaceable from outside of fume hood.
- M. Base Cabinets: Shall be furnished under Division 12 Section “Wood Laboratory Casework”.
- N. Countertops:
1. Resin Countertops: Fabricate with front overhang of 1 inch (25 mm) over base cabinets, continuous drip groove on underside 1/2 inch (13 mm) from edge, and factory cutouts for sinks.
 - a. Countertop Material: Epoxy Resin, uniform throughout full thickness.
 - b. Countertop Configuration: Raised (marine) edge, 1-1/4 inches (32 mm) thick at raised edge, with rounded edge and corners.
 2. Stainless-Steel Countertops: Made from Type 316 stainless-steel sheet, not less than 0.0625-inch (1.6-mm) nominal thickness, with No. 4 satin finish. Provide raised (marine) edge around perimeter and extend top down 1-1/4 inch (25 mm) at edges with a 1/2-inch (13-mm) return flange under frame. Reinforce underside of countertop with channels or use thicker metal sheet where necessary to insure rigidity without deflection. Apply heavy coating of heat-resistant, sound-deadening mastic to undersurface.
- O. Filler Strips: Provide as needed to close spaces between fume hoods and adjacent building construction. Fabricate from same material and with same finish as fume hoods. Filler strips shall match in size any fillers associated with base cabinetry furnished under Section 12345.

- P. Comply with requirements in Divisions 22,23 and 26 Sections for installing laboratory gas service fittings, piping, electrical devices, and wiring. Install according to Shop Drawings. Securely anchor fittings, piping, and conduit to fume hoods, unless otherwise indicated. Electrical devices shall be GFI.

2.5 CHEMICAL-RESISTANT FINISH

- A. Preparation: Clean steel surfaces, other than stainless steel, of mill scale, rust, oil, and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it.
- B. Chemical-Resistant Finish: Immediately after cleaning and pre-treating, apply fume hood manufacturer's standard two-coat, chemical-resistant, 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. Chemical and Physical Resistance of Finish System: Finish complies with acceptance levels of cabinet surface finish tests in SEFA 8. Acceptance level for chemical spot test shall be no more than four Level 3 conditions.
 - 2. Colors for Fume Hood Finish: As selected by Architect

2.6 ACCESSORIES

- A. Service Fittings: Comply with requirements in Division 12 Section Wood Laboratory Casework
 - 1. Provide service fittings with exposed surfaces, including fittings, escutcheons, and trim, finished with acid- and solvent-resistant, baked-on clear coating.
 - 2. Service Valves shall be direct, front-loaded, Watersaver series L740 or equal per Division 22 specification.
- B. Volume Controls, Airflow Indicators and Alarms shall be furnished by other trades and installed in the field. Review Divisions 23 and 25 for requirements. Provide cutouts and wiring access as required for installation by respective trades.
- C. Sash Stops: Provide fume hoods with sash stops to limit hood opening to 50 percent of sash height. Sash stops can be manually released to open sash fully for cleaning fume hood and for placing large apparatus within fume hood.

2.7 SOURCE QUALITY CONTROL

- A. Certify fume hood performance in compliance with ASHRAE 110, as manufactured, before shipment.

2.8 PERCHLORIC FUME HOODS

- A. Perchloric Acid fume hood to be a modified fume hood with all features specified above except:
 - 1. Interior linings, vertically sliding sash, adjustable baffle and working surface are of type 316 stainless steel with #4 finish.

2. Sides, back and work surface are integrally welded with all interior corners having a 1/2" radius, as well as top liner, without any cracks, openings, crevices or seams anywhere.
3. Work surfaces to be type 316 stainless steel, water tight, dished 1/2" and integrally welded with interior lining.
4. Integral full width stainless steel trough shall be welded into the rear of the counter top and be pitched to one end. At the low end of the trough provide a 2" drain outlet.
5. Provide a cold water wash down mechanism and locate it at the top end of the baffle structure. It shall consist of either a full width perforated stainless steel pipe or 4 stainless steel spray nozzles properly spaced for full coverage and remote control valve mounted on the face of the hood. Coordinate wash down control valve with mechanical trades to include wash down of fan and duct system.
6. Vent pipes from acid storage cabinets below counter top (no solvent unit can be used) shall be type 302/304 stainless steel, welded to the counter top and extend behind the baffle, penetrate the chamber roof and enter the duct collar at an angle to avoid any wash down water entering it. Provide a transition tube to connect the base cabinet vent to tube welded into the counter top.

2.9 EXTRACTOR ARMS

- A. Vapor Extractor Assembly. Model design similar to Nederman type BT-2 Extractor Arm or similar by Plimovent, 3" ID. The arm must extend down from the header to the counter top. In addition, provide multipurpose hood with each unit. Unit to be wall mounted, connected to ceiling point exhaust. Arm sections-thin-walled aluminum with corrosion resistant finish
2. Swivel assembly – cast aluminum, 360 degree rotation
 3. Elbows, external rings, axial locking rings, adjusting knobs and mini-hood shall be polypropylene with glass fiber reinforcements.
 4. Damper adjustment handle – anodized aluminum.
 5. Internal components – stainless steel.

2.10 CANOPY HOODS

- A. Furnish canopy fume hoods as detailed in the drawings. Furnish of 16 Ga. Stainless steel in #4 finish. Provide with baffles to increase air speed. Edges shall be formed to provide a drip trough around lower perimeter. Drip edge shall be drained to floor drain in adjacent service space.

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 fume hoods.
1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install fume hoods according to Shop Drawings and manufacturer's written instructions. Install level, plumb, and true; shim as required, using concealed shims, and securely anchor to building and adjacent laboratory casework. Securely attach access panels, but provide for easy removal and secure reattachment. Where fume hoods abut other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical.
- B. Comply with requirements in Division 12 Section Wood Laboratory Casework for installing fume hood base cabinets, countertops, and sinks.

3.3 FIELD QUALITY CONTROL

- A. Field test installed fume hoods according to ASHRAE 110 Section 6: 'Flow Visualization and Velocity Procedure' to verify compliance with performance requirements.
1. Adjust fume hoods, hood exhaust fans, and building's HVAC system, or replace hoods and make other corrections until tested hoods perform as specified.
 2. After making corrections, retest fume hoods that failed to perform as specified.

3.4 ADJUSTING AND CLEANING

- A. Adjust moving parts for smooth, near silent, accurate sash operation with one hand. Adjust sashes for uniform contact of rubber bumpers. Verify that counterbalances operate without interference.
- B. Clean finished surfaces, including both sides of glass; touch up as required; and remove or refinish damaged or soiled areas to match original factory finish, as approved by Architect.
- C. Furnish complete touchup kit for each type and color of fume hood finish provided. Include fillers, primers, paints, and other materials necessary to perform permanent repairs to damaged fume hood finish.

3.5 WARRANTY

- A. In accordance with Division 1 General and Supplementary General Conditions, furnish a written warranty the Work performed under this section to be and remain free from defects as to materials and workmanship for a period of one (1) year from date of acceptance. Defects in materials and workmanship that may develop within this time are to be replaced without expense to the Owner.

END OF SECTION 11610

SECTION 11 70 00 - HEALTHCARE EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Owner furnished, Contractor installed healthcare equipment.
- B. Connection to utilities.

1.2 REGULATORY REQUIREMENTS

- A. Conform to applicable code for healthcare equipment.
- B. Conform to UL requirements for fabrication and installation of healthcare equipment.

PART 2 - PRODUCTS

2.1 COMPONENTS

- A. Equipment: As provided by the Owner and indicated in the Equipment Schedule.
- B. Installation Accessories: Provide all rough-in frames, anchors, supports, accessories and closure trim required for complete installation.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that rough-in frames, anchors and supports are accurately placed.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with standards required by authority having jurisdiction.
- C. Anchor equipment securely in place.
- D. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.

3.3 SCHEDULE - See Drawings

END OF SECTION

FIXED LABORATORY EQUIPMENT

SECTION 11710

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Drawings and general provisions of Contract: including General and Supplementary Conditions and Division 1 Specifications, apply to work of the section.

1.2 WORK INCLUDED

Furnish all labor, materials, products, accessories, tools, equipment, scaffolding, ladders, transportation, supervision, labor, product protection, and services necessary for the fabrication and installation for all equipments as indicated in accordance with provisions of Contract Documents.

- A. Completely coordinate with work of all other trades.
- B. Although such work is not specifically shown or specified, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation. Installation will include all required assembly.
- C. All items in this specification shall be Contractor furnished and contractor installed.
- D. Equipment in this section:

<u>Sect</u>	<u>Equipment Description</u>
2.1	ST1: Lab Steam Sterilizer
2.2	ICE-UC: Under-counter Flaked Ice Maker
2.3	CP: Cable Pass through
2.4	CMT: Camera Mount Track
2.5	BSC4: Biological Safety Cabinet, 4' Class II, A2
2.6	PL Procedure Light
2.7	WP Water Polisher
2.8	CDR Cylinder Restraint

1.3 RELATED WORK

Relevant trade contractors will provide all rough openings, pits, substrate preparation and blocking for all equipment installations.

- A. Mechanical contractor will provide exhaust rough-ins and final connections for all equipment installations.
- B. Plumbing contractor will provide all supply/return service line, drain and vent rough-ins and final connections for all equipment installations.
- C. Electrical contractor will provide all electrical service rough-ins, receptacles and final connections for all equipment installations.

- D. Related Sections include the following:
1. Division 1, Section “LEED Requirements” for additional LEED requirements
 2. Division 1, Section 01524 – Construction Waste Management
 3. Division 6 Section “Rough Carpentry” for blocking for anchoring equipment
 4. Division 9 Section “Gypsum Wallboard Assemblies” for reinforcements in gypsum board partitions for anchoring miscellaneous equipment
 5. Division 12 Section “Laboratory Casework” for service fixtures, including base cabinets and countertops under fume hoods
 6. Divisions 22, 23 and 26 for connecting service utilities at indicated points

1.4 REFERENCE STANDARDS

- A. Builders Hardware Manufacturers Association (BHMA)
- B. National Electrical Manufacturers Association (NEMA)
- C. National Fire Protection Association (NFPA) 30 Flammable Liquid Storage
- D. National Fire Protection Association (NFPA) 70 Electrical Components, Devices and Accessories
- E. American Society of Mechanical Engineers (ASME)
- F. Underwriter’s Laboratories Inc.
- G. National Board of Boiler and Pressure Vessels (NBIC)
- H. American Society for Testing and Materials (ASTM) – Various Sections
- I. Scientific Equipment & Furniture Association (SEFA)

1.5 QUALITY ASSURANCE

Use adequate numbers of skilled workmen who are thoroughly trained and experienced in necessary crafts and who are completely familiar with specified requirements and methods needed for proper performance of the work of this section.

- A. Dimensions, voltages, electrical power requirements, and utility connections are base on items specified. Relevant trade contractor is responsible for all costs associated with service or dimensional adjustments.
- B. Electric operated and/or heated equipment will comply with applicable standards of National Electrical Manufacturer’s Association (NEMA), National Electric Code (NEC) and Underwriters’ Laboratories, Inc. (UL) or Electrical Testing Lab (ETL).

- C. **Manufacturer Qualifications:** Manufacturer is a firm having an established organization and factory, with production facilities specializing in type of equipment specified, having an experienced engineering department and an established history of similar installations of equal scope and complexity. Manufacturer will demonstrate ability to produce specified equipment of required quality and a proven capacity to complete an installation of this size and type within required time limits. Manufacturer will have at least 3 years/5 installations of experience, at least 3 current references from the last 3 years and a service response time, as described below, to be considered eligible to bid. Service response time to a telephone inquiry will be same day followed up by a factory trained technician at site within 24 hours of telephone inquiry; all serviceable components warehoused or readily available to service personnel; and fast access to shop drawings of all equipment in field. Any misrepresentations or negative references will be considered grounds for bid rejection. Manufacturer shall have a service network capable of response to service requirements, including availability of parts within 24 hours
- D. **Acceptable Manufacturers:** Each piece of equipment listed includes basis of design manufacturer's name and catalog number, establishing levels of quality, specific construction features, operating conditions and desired features and accessories. By indicating other manufacturer's names does not relieve perspective bidders of their obligation to prove that their submissions are equal to specified equipment in size, construction, performance, basic features, options and accessories prior to award.
- E. **Installer Qualifications:** Manufacturer, or approved in writing by manufacturer.

1.6 SUBMITTALS

Specification Compliance: Submit copy of relevant item specification section (from this document) and clearly note in bold print any substitutions, modifications or objections.

- A. **Product Data:** Submit manufacturer's specifications and installation instructions for each item of laboratory equipment furnished including optional devices and substantiation of variations if substitutions are proposed. Indicate on product data which optional devices and operations are proposed for inclusion with equipment. Where substitutions for specified items of laboratory equipment are proposed, submit data substantiating the proposed equipment is equal to that specified. Manufacturer's specifications must contain a full, detailed explanation of all variations in operating and/or performance requirements.
- B. **Shop Drawings:** In addition to work shown on manufacturer's printed product data, submit dimensional roughing-in plan, elevation and section drawings, at minimum scale of $\frac{1}{2}'' = 1'-0''$, showing equipment placed in actual project site conditions adjacent to other equipment and relationship to the work of other trades, as well as mechanical and electrical requirements. Rough-in drawings will clearly indicate where equipment connection varies from relevant trade contractor supply source. Submit dimensioned fabrication drawings for custom fabricated equipment, including plans, elevations, and sections, at minimum scale of $\frac{3}{4}'' = 1'-0''$, showing materials and gauges used.
- C. **Operational and Maintenance Data:** Submit operating and maintenance instructions and parts listing for each item of fixed laboratory equipment. Include this data, product data, shop drawings, wiring diagrams, and any other data required by Owner, in three-ring maintenance manual. Prepare draft copy of operation and maintenance manual for Owner's review. Submit four (4) copies of final, accepted manual for Owner's use.

- D. Manufacturer's Qualifications: Letter confirming required minimum experience, references and service response time.
- E. Applicable standards approval from NEMA, NEC, UL, ETL or as specified with the individual equipment items.
- F. Any finish, stains, or coatings applied on-site must comply with Section 01450, Part 2, 2.3 Paints and Coatings.

1.7 PRODUCT DELIVERY, STORAGE, HANDLING AND INSTALLATION REQUIREMENTS

- A. General: All equipment in this specification is Contractor furnished, contractor installed. Certain equipment items will include MA, MAS and/or MED.
- B. Contractor Furnished/Contractor Installed (CFCI): Relevant trade contractor (the "contractor") will purchase, deliver, receive, unload, store, unpack, assemble, set-in-place, install and clean up equipment. Deliver to site in manufacturer's original labeled containers. Contractor will provide any fasteners, supports or other miscellaneous items necessary for complete installation. All rough-ins and final connections by contractor. Contractor will use all means necessary to protect materials of this section before, during and after installation and to protect installed work and materials of all other trades. Contractor will confirm in writing that installed equipment meets or exceeds manufacturer's specifications. Contractor will provide owner's representative with rough-in and installation drawings of installed equipment.
- C. Manufacturer Assembly (MA): Manufacturer will provide adequate assembly personnel for as long as it takes to complete installation to satisfaction of owner's representative. Manufacturer's field supervision personnel may or may not be union depending on conditions of site. If schedule demands it, manufacturer will agree to have their field assembly personnel work overtime at no additional cost. Manufacturer assembly and MED included in equipment price.
- D. Manufacturer's Assembly Supervision (MAS): Manufacturer will provide adequate assembly supervision personnel for as long as it takes to complete installation to satisfaction of owner's representative. Manufacturer's field supervision personnel may or may not be union depending on conditions of site. If schedule demands it, manufacturer will agree to have their field supervision personnel work overtime at no additional cost. Manufacturer assembly supervision included in equipment price and provide following:
 - 1. Trip(s) to job site to coordinate specific technical project requirements
 - 2. Trip(s) to job site to instruct equipment assembly and installation crews
 - 3. Trip(s) to job site to check final assembly and installation, trouble-shoot and start-up equipment
 - 4. One (1) one-day trip to job site to instruct Owner on proper operation and maintenance of equipment. Scheduling of on-site equipment demonstration to be at convenience of Owner
 - 5. Manufacturer's Equipment Demonstration (MED): Manufacturer will provide one(1) one-day trip to the jobsite to instruct Owner on proper operation and maintenance of equipment. Cost of this service included in equipment price. Scheduling of on-site equipment demonstration at the convenience of Owner

1.8 WARRANTY

Except where more stringent warranty requirements are noted in individual equipment descriptions, all equipment furnished under this section guaranteed for a minimum of one (1) year, parts and labor, from date of substantial completion or specific equipment final acceptance (whichever is later) against defective materials, design and workmanship. Defects will be promptly rectified at manufacturer or contractor's expense after notification by Owner's representative.

- A. Defects include, but are not limited to:
 - 1. Ruptured, cracked, or stained coating
 - 2. Discoloration or lack of finish integrity
 - 3. Cracking or peeling of finish
 - 4. Slippage, shift, or failure of attachment to wall, floor, or ceiling
 - 5. Weld or structural failure (visible weld marks)
 - 6. Warping or unloaded deflection of components
 - 7. Failure of hardware

1.9 FIELD VERIFICATION

Drawings show arrangement and location of items of equipment. If it is necessary to vary from arrangement shown, because of structural, mechanical, electrical or other considerations, make such variations only after approval of Owner's representative and at no additional cost to Owner.

- A. Verify all dimensions at building.
 - 1. Confirm that all equipment will be able to be moved through building in order to reach it designated location. Provide dimensional information of equipment showing length, width and depth of equipment (or largest component) as it is intended to move through building. Dimensions should include all packaging, palleting and transportation equipment dimensions so as to allow leave-out of overhead, walls, etc., to allow equipment to safely be transported to installation point. Failure to do so will result in removals and reinstallation's to be charged to manufacturer or contractor.

1.10 COORDINATION

- A. Coordinate layout and installation of framing and reinforcements for support of miscellaneous fixed equipment.
- B. Coordinate installation of laboratory casework with installation of fume hoods and other laboratory equipment.

1.11 EXCEPTIONS TO DRAWINGS AND SPECIFICATION

- A. All exceptions shall be subject to written approval prior to receipt of bid. If no written communication is received prior to receipt of bid and approval indicated in an addendum, it is assumed that bidder will be in total compliance with specifications and will be held responsible for default or delay, regardless of any statement to the contrary in their written proposal.
- B. Requests for a substitution must be made directly to the Owner's Representative's office for consideration no later than fifteen (15) working days prior to bid receipt date.
- C. Requests for a substitution following the bid opening will be rejected.

- D. Substitutions approved prior to bid date will be handled as an addendum and be sent to all bidders.

PART 2 - PRODUCTS

2.1 ST1: LAB STEAM STERILIZER

- A. Basis of Design: Manufacturer: Tuttnauer USA. Hauppauge, NY
Model: 5596-SP-V
- B. Unit to be 20" x 20" x 38" pre-vacuum steam sterilizer. Standard model to include:
1. Fully Automatic Vertical sliding Single Door
 2. Mod Wall enclosed, see Vivarium equipment specification for Mod Wall
 3. Chamber and door to be 316L grade stainless steel. Chamber jacket to be 316L or 304L stainless steel.
 4. Door gaskets to be operated by compressed air. All valves to be pneumatically operated.
 5. Vacuum to be generated by liquid ring vacuum pump.
 6. Include removable rack with intermediate shelf
- C. Utility Requirements:
1. Elect.: 1/60/115V/ 6 amps
3/60/208V/ 7.6 amps (Vac pump)
 2. Sterilizer Feed Water: 3/4" NPT,
 3. Steam: 3/4". 50-80PSIG, 100 lbs/hr peak, 55 lbs/hr avg.
 4. Chilled water: 1" NPT supply and return, 40-60 PDIG, 12 GPM, inlet temp 50 F max, delta T of 7F.
 5. Compressed Air: 3/8" NPT, 75-95 PSI, 3.5 SCFM
 6. Drain: Floor Drain
- D. Warranty: Unit shall carry a three (3) year warranty. Vessel and door will carry a fifteen (15) year warranty.
- E. Acceptable Manufacturers: Getinge; Belimed

2.2 ICE-UC: UNDERCOUNTER ICE FLAKER

- A. Basis of Design: Manufacturer: Scotsman Ice
Model: AFE 424
- B. Unit to be compact, 24 1/4"W x 33"H x 24"D, free-standing ice flaker with minimum of 80 pound capacity self-contained insulated storage bin. Unit to produce a minimum of 300 pounds of ice per day (24 hours) at an ambient room air temperature of 70oF and a water inlet temperature of 50oF.
- C. The ice making mechanism to have a heavy duty, hermetically sealed compressor: automatic expansion valve refrigerant control: safety control thermostat to turn off ice maker should inlet water pressure become insufficient for ice production or if storage bin reaches maximum capacity. Evaporator to be close tolerance brass cylinder with brass shell, stainless steel auger, completely insulated with polyurethane foam. Auger to be powered by belt-driven single reduction worm gear. Condensing unit to be air cooled.

- D. Include the following installed options:
1. An in-line sediment filter, equal to Scotsman model ADS-AP1, sized for a minimum 60 day filter life under 75% specified machine load.
 2. An in-line carbon filter for the removal of chlorine, sized for a minimum 60 day filter life under 75% specified machine load.
 3. Install filters on wall above machine. This vendor responsible for piping from filters to machine. Include coordinated installation drawing in submittal.
- E. Utility Requirements:
1. Elect.; 1/60/115V/ 9.0 amps, with cord for standard outlet
 2. CW: 3/8" od copper
 3. Drain: Floor Drain
- F. Acceptable Manufacturers: Scotsman; Hoshizaki; Ice-O-Matic

2.3 CP: CABLE PASS-THRU

- A. Basis of Design: Manufacturer: Acoustic Sciences Corporation, Eugene, OR
Model: Acoustic Cable Pass-thru
- B. Unit to be pair of steel clad acoustic doors on each side of a framed 'port'. The port shall be approximately 8" x 5". When cables are passed through the port, a gasketed door on each side of the port seals the opening, including the cables in an uncrimped state, to reduce sound transmission.
- C. Model to include:
1. Stainless clad construction; all exposed surfaces shall be stainless steel, in a no. 4 finish. Exposed fasteners are acceptable, although shall be in stainless steel.
 2. Thumbscrews, in plastic or stainless allow for operation without tools
 3. Ports installed as located on drawings. Mount bottom of port at 8'-0" AFF, unless otherwise noted.
- D. Utility Requirements: None
- E. Acceptable Manufacturers: Acoustic Sciences Corporation, other manufacturers will be considered upon submittal of a product sample, and compliance with all specifications.

2.4 CMT: CAMERA MOUNT TRACK

- A. Basis of Design: A custom direct ceiling mounted track to assist in the semi-permanent mounting of scientific observation equipment.
- B. Unit to be P-1000 Unistrut track mounted directly to the testing room ceiling as shown on plans.
- C. System to include:
1. Main track, P-1000, mounted through the finished ceiling to Unistrut or similar support hung from the building structure, capable of supporting a 50 lb load at any single point along the length of the track. The track shall be located as shown on plans. The length of the track shall be such that each end is 4" from the ceiling / wall intersection. .

2. A 48" 'swivel arm', also of P-1000 shall be attached to the main track with a spring nut, thumb screw and washer (if needed), for ease of adjustment without tools.
3. Three additional spring nuts and thumbscrews shall be provided with each system
4. All exposed parts of the system shall be stainless steel.
5. This contractor to provide all Unistrut / miscellaneous support required to meet the design load criteria.

D. Utility Requirements: None

E. Acceptable Manufacturers: UniStrut Corporation, other manufacturers will be considered upon submittal of a product sample, and compliance with all specifications.

2.5 BSC4/A2: CLASS II/TYPE A2 BIOLOGICAL SAFETY CABINET – 4'

A. Basis of Design: Manufacturer: The Baker Company
 Model: SterilGARD SG-403AHE

B. Unit to be a ventilated cabinet, designed to be classified as a Class 11, A2 cabinet when exhausted to the room.

C. Product Description:

1. Provide a certified copy of the Personnel, Product and Cross-contamination (Biological) tests, equivalent to or more severe than as specified in NSF Standard #49, Performed on one unit from each production run from which cabinets have been manufactured. All units must meet NSF #49 performance requirements and have NSF #49 label attached.
2. Cabinet will have zoned or uniform down flow velocity profile relative to down flow velocity over the work surface. All biologically contaminated ducts and plenums maintained under negative pressure or enclosed within a negative pressure zone.
3. Sliding view screen of ¼" tempered glass capable of moving to a fully closed or open (20") position during shut down periods. Audible alarm to indicate when view screen is in unsafe position. Calculated intake velocity through front 10" access opening maintained between 100-110 fpm.
4. Both exhaust and supply filters to be front loading and meet the zero-probed HEPA 99.99% efficient on all particles 0.3 micron by DOP test. Minihelic pressure gauge (up to 2" W.G.) to monitor filter loading.
5. Cabinet constructed of #18 gauge cold-rolled steel, with #16 gauge stainless steel work surface and radius (rounded) corners on the work surface. Side walls and rear wall one-piece or welded construction. Stainless steel air diffuser and filter protector provided in work area. Stainless steel fixed or adjustable leg assembly will provide a work surface height of 30". Units must pass through an 84" high door opening.
6. Work area provided with two (2) externally mounted GFI duplex 120V outlets with drip-proof covers and circuit breakers. Provide one(1) vacuum (V) with all external piped service connections from beneath unit (external side mounted connections are not acceptable). Provide fluorescent light (100 foot-candles of illumination at work surface) and a germicidal ultra-violet (UV) light.

7. Unit capable of automatically handling a 150% minimum increase in filter loading without a decrease in total air delivery of more than 10%. Provide a voltage compensating motor speed controller that automatically compensates for voltage changes to maintain constant voltage to motor. Speed controller will permit manual adjustment to handle a 250% increase in filter loading and maintain total air delivery at or above 90%.
8. No canopy or exhaust thimble is required: Unit will be exhausted to the room.
9. Provide low flow sensing device. This device shall include the following factory wired and assembled components:
 - a. One monitor which includes tricolor jumbo LED indicator lights, (green: normal airflow; yellow: caution; red: low flow), electronic analog meter (with green, yellow and red zones) and audible alarm. In addition there shall be a switch to silence the audible alarm and a separate indication that the audible alarm has been silenced.
 - b. One (1) airflow sensor probe
 - c. One (1) Transformer: 120VAC input
 - d. Appropriate mounting brackets and hardware to install the monitor and probe to the bio safety cabinet.
 - e. The probe shall be factory calibrated to the monitor thereby eliminating field calibration.
 - f. The monitor shall have a factory reset operating range of 500-2000 feet per minute (FPM)
 - g. There shall be an LCD that displays status indicators and icons indicating operating mode and conditions and, in the user's option, the measured airflow velocity in feet per minute (fpm) or meters per second (m/s)
 - h. The monitor shall have a night setback capability
 - i. Unit shall be capable of operating at 10-30C
 - j. The monitor shall have a relay output.
 - k. Alarm manufacturers: Alnor Corporation #Airgard-335BSC, Air Monitor Corporation or Flow Safe corporation.
10. Unit completely factory pre-wired with 6' power cord.
11. Unit to carry a three (3) year warranty.

D. Utility requirements:

- E 1/60/115V (4.0 Amp operating amperage), Stand-by recommended
V 3/8" MPT, as shown on plans

- E. Unit(s) will be equal to Baker SterilGARD model SG403aHE 4' nominal length Class II, Type A2 Biological Safety Cabinet. Unit(s) manufactured by NuAire shall be considered equal provided that they meet the requirement of this specification.

2.6 PL: PROCEDURE LIGHT

- A. Basis of Design: Manufacturer: Steris Corporation, Mentor, Ohio
Model: Amsco Examiner 10 Exam light

- B. Unit to be a single head wall mounted examination light for use in providing illumination for small animal procedures.

- C. Standard model to include:

1. Single light head, 150 watt quartz-halogen lamp, (rated at 500 hours min).
2. Dichroic, coated parabolic reflector with Pyrex diffuser.
3. 'No tool' lamp replacement.
4. Wall mounted, with 2) 14" extension arms
5. Supply one spare bulb.

D. Utility Requirements:

1. Elect. 1/60/115V/ 2 amp operating load

D. Equipment item(s) shall be CFCI.

E. Acceptable Manufacturers: Steris. Unit(s) manufactured by Getinge or Burton Medical (Chatsworth, CA) will be considered equal provided that they meet requirements of this specification.

2.7 WP: WATER POLISHER

- A. Basis of Design: Manufacturer: Millipore Corporation
Model: Milli-Q Integral 3

B. Unit to be an Ultrapure Water Production Unit suitable for converting tap water to Type I and Type II water.

C. Standard model to include:

2. Type I water production at 70 liter / day max, 3 liter / minute.
3. Type II water production at .1 liter per / minute.
4. Primary production unit to be 35 cm w x 52 cm hi x 48 cm d.
5. Unit to be wall mounted - Include wall mounting bracket.
6. Unit to include bench standing finish dispenser on a flexible umbilical cord / tube.

E. Utility Requirements:

1. Elect: 1/60/115V/ 2 amp operating load
2. CW: 1/2" copper
3. Drain To sink below

F. Acceptable Manufacturers: Millipore Corporation.

2.8 CDR: CYLINDER RESTRAINT

- A. See requirements for Cylinder restrains in Specification Section 12345, Wood Laboratory Casework.

PART 3 - EXECUTION

3.1 INSPECTION

Check for shipping damage. Reject units with scratches, dents or other defects that cannot be readily corrected.

- A. Check job site to insure that rough-ins and substrates are correct and that equipment will fit as indicated on Equipment Drawings. Do not proceed with installation until defects or oversights are corrected.

3.2 INSTALLATION

- A. Uncrate all equipment and place in locations shown on Equipment Drawings. Remove all crating materials and packing debris.
- B. Install all items in accordance with Manufacturer's standards. Provide all accessories necessary for a complete installation.
- C. Verify plumbing, ventilation and electrical connection requirements for all equipment and coordinate connections with work of Division 22, 23, & 26.

3.3 ADJUST AND CLEAN

Check operation and installation of equipments as necessary to meet Manufacturer's or these specifications (whichever is more stringent).

- A. Repair or replace defective or damaged components at no cost to the Owner.
- B. Clean and polish equipment in accordance with Manufacturer's recommendation before and after demonstration for Owner. Leave ready for use with copy of instruction manual attached to equipment in a manner to be specified by Owner's Representative.
- C. Each manufacturer shall submit with his Contract Price proposal an itemized list of available accessories for Owner's selection as part of this work. Provide unit prices for these accessory items; unit price cost shall be valid through entire construction period of project and for an additional 90 days after substantial completion.

3.4 SERVICE CONTRACT

Each manufacturer shall submit a service contract for his piece of equipment and cost of same. Owner shall determine if contracts are to be accepted.

END OF SECTION 11710

SECTION 12 21 13 - HORIZONTAL LOUVER BLINDS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Horizontal slat louver blinds.
- B. Operating hardware.

1.2 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Concealed wood blocking for attachment of headrail brackets.

1.3 REFERENCE STANDARDS

- A. WCMA A100.1 - Safety of Corded Window Covering Products; Window Covering Manufacturers Association. (ANSI/WCMA A101.1)

1.4 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Provide data indicating physical and dimensional characteristics and operating features.
- C. Shop Drawings: Indicate opening sizes, tolerances required, method of attachment, clearances, and operation.
- D. Samples: Submit two samples, 6 inches long illustrating slat materials and finish, color, wand type and color.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 - 2. Extra Blind Assemblies: One of each size.
 - 3. Extra Slats: 20 of each type and size.
 - 4. Extra Lift Cords, Control Cords, and Wands: One of each type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Horizontal Louver Blinds:
 - 1. Hunter Douglas: www.hunterdouglas.com.
 - 2. Levolor Contract; Product Riviera Classic: www.levolorcontract.com. (Basis of Design)
 - 3. Bali division of Springs Window Fashions: www.springswindowfashions.com.
- B. Substitutions: See Section 01 60 00 - Product Requirements.

2.2 BLINDS AND BLIND COMPONENTS

- A. Blinds: Horizontal slat louvers hung from full-width headrail with full-width bottom rail; manual control of raising and lowering by cord with full range locking; blade angle adjustable by control wand; complying with WCMA A100.1.

- B. Metal Slats: Spring tempered pre-finished unperforated aluminum; radiused slat corners, with manufacturing burrs removed.
 - 1. Width: 1 inch.
 - 2. Thickness (1 inch blinds): 0.008 inch.
 - 3. Valences: Integrated with blind unit.
 - 4. Color: As selected by Architect from manufacturer's full range.
- C. Slat Support: Woven polypropylene cord, ladder configuration.
- D. Head Rail: Pre-finished, formed aluminum box, with end caps; internally fitted with hardware, pulleys, and bearings for operation; same depth as width of slats
- E. Bottom Rail: Pre-finished, formed aluminum with top side shaped to match slat curvature; with end caps. Color: Same as headrail.
- F. Lift Cord: Braided nylon; continuous loop.
- G. Control Wand: Extruded hollow plastic; round shape.
 - 1. Removable type.
 - 2. Length of window opening height less 3 inches.
 - 3. Color: clear .
- H. Headrail Attachment: Wall brackets.
- I. Accessory Hardware: Type recommended by blind manufacturer.

2.3 FABRICATION

- A. Fabricate blinds to cover window frames completely.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install blinds in accordance with manufacturer's instructions.
- B. Secure in place with flush countersunk fasteners.

3.2 INSTALLATION TOLERANCES

- A. Maximum Variation of Gap at Window Opening Perimeter: 1/4 inch.
- B. Maximum Offset From Level: 1/8 inch.

3.3 ADJUSTING

- A. Adjust blinds for smooth operation.

3.4 CLEANING

- A. Clean blind surfaces just prior to occupancy.

END OF SECTION

SECTION 122413 - WINDOW SHADE SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Manually-operated window shades and accessories for sun/glare/heat control and room darkening.

1.2 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Manufacturer's catalog data, product descriptions, installation instructions, detail sheets, and specifications for each type system specified.
- C. Samples for Selection: Manufacturer's color chart or sample set.
- D. Shop Drawings: Prepared specifically for this project; show dimensions and interface with other products.
 - 1. Room schedule including field-verified dimensions of each opening to receive window shade systems.
 - 2. Indicate System Series, operator, fabric selection, and mounting type.
 - 3. Indicate control type.

1.3 QUALITY ASSURANCE

- A. Installer: Approved by manufacturer.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to project site in manufacturer's original cartons.
- B. Individually package and mark shades with room number and opening number.
- C. Inspect the materials upon delivery to assure that specified products have been received.
- D. Store and handle shades to prevent damage to fabrics, finishes, and operators prior to installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Base Manufacturer: MechoShade Systems, Inc., 42-03 35th Street, Long Island City, NY 11101. Tel: (718) 729-2020, Fax: (718) 729-2941.
- B. Other Acceptable Manufacturers:
 - 1. Draper Inc.: www.draperinc.com
 - 2. Hunter Douglas: www.hunterdouglas.com
- C. Substitutions: See Section 01 60 00 - Product Requirements.
- D. Provide all window shade systems from a single manufacturer.

2.2 MANUFACTURED UNITS

- A. Manually-Operated Shades: Mecho 5/Double Shade Bracket #15 with Lift Assist Mechanism.

2.3 EQUIPMENT

- A. Mounting: Surface mounted with fascia.
- B. Configuration: Double solar and blackout shadecloth.

2.4 FABRICS

2.5 SHADE CLOTH

- A. Room Darkening Shadecloth: MechoShade Systems, Inc., ThermoVeil 3000 series, single thickness non-raveling 0.030-inch thick vinyl fabric, woven from 0.018-inch diameter extruded vinyl yarn comprising of 21 percent polyester and 79 percent reinforced vinyl.

2.6 COMPONENTS

- A. Mounting Brackets: Stamped steel, custom fabricated as required for inside jamb mounting.
- B. Roller Idler Assembly for Manual Shades: Clutch operated rollers incorporating high-strength fiberglass-reinforced polyester gudgeon, which snaps-locks into mounting bracket.
- C. Draw Bar: Custom extruded of 6063-T5 aluminum, 1-1/2 inches wide by length, electrostatically coated; include provision for weight, if needed.
- D. Top Roller Box and End Caps: Four-sided, interlocking box and cover custom-extruded of 6063-T5 aluminum, 0.062 inch minimum wall; electrostatic finish.
 - 1. Size: 4-5/8 inches wide.
 - 2. End Caps: 16 gage steel, electrostatic finish, incorporating mounting brackets.
- E. Jamb and Sill Frames/Tracks: Custom extruded of 6063-T5 aluminum, 0.062 inch minimum wall. Provide sizes as required.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install window shade systems in accordance with manufacturer's instructions and these specifications.
- B. Assume responsibility for all field dimensions and mounting surfaces.
- C. Adjust window shade systems for proper operation.

END OF SECTION

SECTION 123450 - WOOD LABORATORY CASEWORK

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 the work of this section.

1.2 WORK INCLUDED

- A. Furnishing of materials, products, accessories, tools, equipment, services, scaffolding, ladders, transportation, supervision, labor, product protection, and other items that may not be specifically mentioned, but are necessary for the fabrication and installation of laboratory casework.
- B. Furnish and install laboratory casework including, but not limited to, counter tops, reagent shelves, tables, standards, slotted studs, filler panels, scribes, knee space panels, accessories, casework in environmental rooms, utility space framing, utility space closure panels between base cabinets and at exposed ends of utility spaces, laboratory sinks, cup sinks, cup drains, strainers, overflows and sink outlets with integral or separate tail pieces and miscellaneous items of equipment as listed in these specifications and as shown on drawings, including delivery to the building, unpacking, installing, leveling and scribing to walls and floors as required.
- C. Furnish and deliver packed in boxes for receipt, handling and installation by others; electrical service fixtures, task lights including fluorescent bulbs, electrical receptacles and switches listed in these specifications and as shown on drawings as part of the laboratory casework. The above-defined items are to be supplied, not attached, and loose in boxes, properly marked for tailgate delivery.
- D. Furnish and set in place for installation by other trades; service fittings where part of the laboratory casework, listed in the specifications or shown on drawings. Tailpieces shall be furnished less couplings required to connect to the trap or drain piping system. Install service fittings "finger tight".
- E. Casework System: Laboratory casework components and assemblies shall meet local seismic restraint requirements.

1.3 RELATED WORK BY OTHER SPECIFICATION SECTIONS

- A. Furnishing, installation and connection of "Service Lines" within and/or attached to equipment, slotted studs, partitions, service tunnels or service turrets, through, under or along backs of working surfaces as required for "Service Fixtures."
- B. Final installation, tightening and connecting "Service Fixtures" furnished by laboratory casework manufacturer including the pulling of wire and connecting of electrical fixtures in service lines.

- C. Connecting separate laboratory sinks, cup sinks or drains, overflows, sink outlets and tail-pieces furnished by the laboratory casework manufacturer.
- D. Furnishing, installing and connecting vents and drain lines.
- E. Furnishing, installing, setting and connecting special electrical and plumbing fixtures and piping to meet local codes, even though not specifically called for in specifications and shown on drawings.
- F. Furnishing, installing and connecting of ducts from fume hoods to blowers and from blowers to atmosphere.
- G. Furnishing, handling and installing fans with motors (blowers).
- H. Furnishing, and installation of framing or reinforcements for wall, floors and ceilings to adequately support laboratory equipment and brick, plaster, metal or wood grounds required for proper anchoring of the equipment.
- I. Furnishing and installation of pipe hangers.
- J. Furnishing and installation of resilient base on walls and fixed laboratory casework after laboratory casework installation is completed.
- K. Furnishing in-wall exhaust duct and connection to vented cabinets.
- L. Related Sections include the following:
 - 1. Division 1, Section “LEED Requirements” for additional LEED requirements.
 - 2. Division 6, Section “Rough Carpentry” for wood blocking for anchoring casework.
 - 3. Division 6, Section “Interior Architectural Woodwork”.
 - 4. Division 9, Section “Gypsum Plaster” for reinforcements in metal- framed plaster partitions for anchoring casework.
 - 5. Division 9, Section “Gypsum Wallboard Assemblies” for reinforcements in gypsum board partitions for anchoring casework.
 - 6. Division 9, Section “Resilient Wall Base and Accessories” for resilient base applied to casework.
 - 7. Division 11, Section “Laboratory Fume Hoods”
 - 8. Divisions 22, 23 and 26 Sections for installing service fittings specified in this section.
 - 9. Divisions 22, 23 and 26 for connecting service utilities at indicated points. Piping and wiring for service fittings within casework up to point of connection are specified in this Section.

1.4 DEFINITIONS

- A. “Laboratory Casework Contractor” is defined as the manufacturer and/or manufacturer’s representative furnishing and installing the laboratory casework, equipment, and accessories listed under these specifications, laboratory equipment schedule and/or shown on drawings.

- B. “Service Fixtures” are defined as gas, air, and vacuum cocks, hot, cold, reagent grade water faucets, remote control valves, electrical receptacles with necessary flush mounting boxes, conduits or pedestals and plates, fluorescent and/or incandescent light fixtures, light switches and/or motor switches for hoods and other items which serve as a functional part of the equipment.
- C. “Service Lines” are defined as gas, air, vacuum, hot, cold, reagent grade and reference grade water piping, drain lines, fittings and shut off valves necessary to carry respective services from building roughing-in floors or walls through equipment to “service fixture”.
- D. “Service Lines” also include conduit, junction boxes, conduit fitting, wire disconnect switches and fuse or circuit breakers necessary to carry electrical services from building roughing-in outlets in floors or walls through equipment to “service fixtures.”
- E. “Standards” are wall mounted, single and twin-tracked shelf supports.
- F. “Slotted Studs” are double-faced, twin-tracked studs comprising the frame spanning between the utility chase and the building wall or workstation at peninsula bench assemblies.
- G. Exposed Portions of Cabinets: Surfaces visible when doors and drawers are closed, including bottoms of cabinets more than 48 inches above floor, and surfaces visible in open cabinets.
- H. Semi-exposed Portions of Cabinets: Surfaces behind opaque doors, such as interiors of cabinets, shelves, dividers, interiors and sides of drawers, and interior faces of doors. Tops of cases 78 inches or more above floor are defined as semi-exposed.
- I. Concealed Portions of Cabinets: Surfaces not usually visible after installation, including sleepers, web frames, dust panels, and ends and backs that are placed directly against walls or other cabinets.

1.5 STANDARDS

- A. Reference Scientific Equipment & Furniture Association (SEFA)
 - 1. SEFA 1: Laboratory Fume Hoods (for reference)
 - 2. SEFA 2.3: Scientific Laboratory Furniture and Equipment
 - 3. SEFA 3: Work surfaces
 - 4. SEFA 7: Laboratory and Hospital Fixtures
 - 5. SEFA 8: Laboratory Furniture-Casework-Shelving and Tables – Recommended Practices
- B. American Society for Testing and Materials (ASTM)
 - 1. A240-Heat Resistant Chromium and Chromium – Nickel Stainless Steel Plate, Sheet, and Strip for pressure Vessels
 - 2. A312-Seamless and Welded Austenitic Stainless Steel Pipe
 - 3. D260-Boiled Linseed Oil
 - 4. D570-Water Adsorption of Plastics
 - 5. D695-Compressive Properties of Rigid Plastics

6. D790-Fluctural Properties of Un-reinforced and Reinforced Plastics and Electrical Insulating Materials
 7. E84-Test Method for Surface Burning Characteristics of Building Materials
 8. A554-03 Standard Specification for Welded Stainless Steel Mechanical Tubing
 9. A513 Standard Specification for Electric Resistance Welded Carbon and alloy Steel Mechanical Tubing
- C. Builders Hardware Manufacturers Association (BHMA)
 - D. National Electrical Manufacturers Association (NEMA)
 - E. American National Standards Institute (ANSI) A208.1-Wood Products
 - F. American National Standards Institute (ANSI) A135.4-Basic Hardboard
 - G. American National Standards Institute (ANSI) HPVA HP-1-2000 American National Standard for Hardwood and Decorative Plywood.
 - H. American Plywood Association (APA) Engineered Wood Association
 - I. National Particleboard Association (NPA) 8-Voluntary Standard for Formaldehyde Emission from Particleboard
 - J. United States Department of Commerce, Product Standard (PS) 1-Construction and Industrial Plywood
 - K. United States Department of Commerce, Product Standard (PS) 51-Hardwood and Decorative Plywood
 - L. National Fire Protection Association (NFPA) 30 Flammable Liquid Storage
 - M. National Fire Protection Association (NFPA) 70 Electrical Components, Devices and Accessories.
 - N. Architectural Woodwork Institute (AWI) Quality Standards, Guide Specifications, and Quality Certification Program, 8th Edition, version 1.0, 2003.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative of the casework manufacturer for installation and maintenance of units required for this Project.
- B. Source limitations: Obtain all casework, including countertops, sinks, service fittings and accessories through one source from a single manufacturer. Obtain through same source from same manufacturer as fume hoods specified herein after or in Division 11 Section "Laboratory Fume Hoods".
- C. Flammable Liquid Storage: Where cabinets are indicated for solvent or flammable liquid storage, provide units that are listed and labeled as complying with requirements of NFPA 30 by UL or another testing and inspecting agency acceptable to authorities having

jurisdiction.

- D. Electrical components, Devices and Accessories: Listed and labeled as define in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction and marked for intended use.
- E. Pre-installation Conference: Conduct a conference at the Project Site to comply with requirements in Division 1 Section “Project Management and Coordination.
- F. Product Standard: Comply with SEFA 8, “Laboratory Furniture-Casework, Shelving and Tables-Recommended Practices”.

1.7 SUBMITTALS

- A. Refer to submittal section of the General and Supplementary Specification in Division 1 for requirements and procedures. Fabrication or purchase of any items prior to approval will be at the manufacturer’s risk.
- B. Samples: Laboratory casework manufacturer shall submit the following samples for approval by the Owner’s Representative, prior to fabrication of the specified mock-up:
 - 1. One (1) 24” wide full height base cabinet consisting of one (1) drawer, one (1) door, one (1) cupboard with adjustable half/full depth shelf and related hardware (pulls, hinges, etc.), complete with finish.
 - 2. One 36” wide x 36” high wall cabinet with two internal adjustable shelves and one adjustable shelf below the cabinet, as well as related hardware and doors, complete with finish.
 - 3. One (1) 24” long standard, and one (1) end bracket, with specified finish.
 - 4. Service Fixtures: one of each fixture type required for project.
 - 5. Adhesives and sealants.
 - 6. Countertop material (one of each specified): 12”x12”x1” thick, showing top, front edge and backsplash construction.
- C. Reviewed samples will be retained by the Owner’s Representative.
- D. Stain and Finish Samples for Wood Components
 - 1. Stain for casework and miscellaneous items, shall be selected by the Architect from not less than ten (10) standard manufacturer’s samples. The laboratory casework manufacturer shall furnish stain and finish samples on same material from which the casework and miscellaneous items will be constructed for approval before fabrication of casework starts. Samples shall be clearly identified.
 - 2. Stain and finish samples will be retained by the Owner’s Representative.
- E. Shop Drawings. Fabrication or purchase of any equipment prior to approval will be at the manufacturer’s own risk. The laboratory casework manufacturer shall furnish shop drawings showing enclosures, cabinets, hardware, and service banks complete with numbers and names of items and details including construction kinds and gages of

materials for hood, cabinets, benches and other items necessary to complete the work. In addition, it is the responsibility of the casework manufacturer to flag any deviations in dimension, material, detail, etc. that is not exactly the same as shown on the contract documents. Those deviations not flagged will be considered “not reviewed”, even if missed during the approval process and will have to be changed. Provide number of copies of drawings and data sheets in accordance with Division 1 requirements.

- F. Shop drawings shall be stamped and signed by a registered engineer for conformance to structural and lateral requirements. Stamped and signed calculations supporting the design and detailing of shelving structural support shall also be provided.
- G. LEED Submittals:
 - 1. Credit EQ 4.4:
 - a. Composite wood manufacturer's product data for each composite wood product used indicating that the bonding agent contains no urea formaldehyde.
 - b. Adhesive manufacturer's product data for each adhesive used indicating that the adhesive contains no urea formaldehyde.
 - 2. Credit MR 7: Certificates of chain-of-custody signed by manufacturers certifying that wood used to produce cabinets [and countertops] was obtained from forests certified by an FSC-accredited certification body to comply with FSC 1.2, "Principles and Criteria." Include evidence that factory is certified for chain-of-custody by an FSC-accredited certification body.
 - a. Include statement indicating costs for products containing certified wood.
- H. Qualification Data: For testing agency.
- I. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating compliance of laboratory casework finishes and countertops with requirements specified for chemical and physical resistance.

1.8 EXCEPTIONS TO DRAWINGS AND SPECIFICATION

- A. All exceptions to the contract documents shall be processed in accordance with provisions of division 1.
- B. Substitutions approved prior to bid date will be handled as an addendum and be sent to all bidders.

1.9 WARRANTY

- A. Furnish a written warranty that Work performed under this Section shall remain free from defects as to materials and workmanship for a period of one (1) year from date of acceptance. Defects in materials and workmanship that may develop within this time are to be replaced without cost or expense to the Owner. Defects include, but are not limited to:
 - 1. Ruptured, cracked, or stained coating

2. Discoloration or lack of finish integrity
3. Cracking or peeling of finish
4. De-lamination of components or edge banding
5. Slippage, shift, or failure of attachment to wall, floor, or ceiling
6. Weld or structural failure (visible weld marks)
7. Warping or unloaded deflection of components
8. Failure of hardware

1.10 TESTING

- A. The laboratory casework manufacturer shall be required to include in their initial submittals, certified test reports indicating compliance of their laboratory casework finish and work top materials with requirements specified for chemical and physical resistance; and confirmation of load performance for movable tables. The material test reports shall be performed by an independent testing agency qualified for testing indicated, as documented according to ASTM E548.

1.11 FIELD MEASUREMENTS

- A. It is the laboratory casework manufacturer's responsibility to verify field measurements and that equipment will fit through entryways, corridors and door openings enabling a smooth flow of equipment to its proper location in the building. Wall-to-wall counter tops are to be installed with a maximum ¼" gap.

1.12 DELIVERY, STORAGE AND HANDLING

- A. Deliver casework only after painting, utility rough-ins and similar operations that could damage, soil or deteriorate casework have been completed in installation areas. If casework must be stored in other than installation areas, store only in areas where environmental conditions meet requirements specified in "Project Conditions" Article of this specification section.
- B. Keep finished surfaces covered with polyethylene film or other protective covering during handling and installation.

1.13 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install casework 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. Field Measurements: Where casework is indicated to fit to other construction, verify dimensions 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 the casework without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.14 COORDINATION

- A. Coordinate layout of metal framing and reinforcements in wall assemblies for support of the casework.
- B. Coordinate installation of casework with installation of fume hoods and other laboratory equipment including rough-in locations and requirements.

1.15 CERTIFIED WOOD PRODUCTS

- A. Wood products used in the fabrication of all wood components shall comply with the Forest Stewardship Council (FSC) “Percentage Based Claims Policy Green Rating System” and shall bear the Forest Conservation Program Label. Wood/fiber products shall come from FSC “certified” sustained managed forestry sources, complying with FSC 1.2, Principals and Criteria. Manufacturer shall submit documentation that the source of at least 70% of the wood/fiber material used in its products are certified for sustainability contents, do not contain urea formaldehyde and a “chain-of- custody” certificate, with their shop drawing submittal. Certificate shall provide a system for tracking certified wood from the forest, through each stage of production and distribution, to the point of sale. Certificates shall be by U.S. Based certifiers, Scientific Certification Systems, Emeryville, California or SmartWood Program, Richmond, Virginia.
- B. Wood products shall utilize an environmentally friendly, laboratory grade finish. Finish process, stains and finishes, shall be executed with the use of compression spray equipment capable of providing high-transfer efficiency and low waste generation.
- C. Adhesive manufacturer’s product data sheets are to be provided indicating that the adhesive does not contain urea formaldehyde.

PART 2 - PRODUCT

2.1 MANUFACTURERS

- A. Wood Casework: Subject to compliance with specification requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Bedcolab (Quebec, Canada)
 - 2. O.C. River (Suring, WI)
 - 3. Kewaunee Scientific Corp., (Statesville, SC)
- B. Epoxy Resin Countertops, Troughs and Sinks: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - 1. Durcon Corporation (Plymouth, MI)
 - 2. Epoxyn Products (Mountain Home, AR.)
 - 3. Laboratory Tops Inc. (Taylor, TX.)
- C. Chemical-Resistant Plastic Laminates:
 - 1. Arborite; Division of Premark Canada Inc.
 - 2. Formica Corporation

3. International Paper; Decorative Products Division
 4. Panolam Industries International Incorporated; Pionite Decorative Surfaces
 5. Wilsonart International
- D. The naming of a manufacturer and designation of a product is for the purpose of identifying a basis of design. Other manufacturers capable of producing the same appearance and having the same quality, durability, and performance may be proposed for use on this project subject to approval of the Owner's Representative, prior to the receipt of bid.

2.2 CASEWORK RELATED MATERIALS

- A. Stainless Steel:
1. Counter tops, sinks, stainless steel accessories, shelves and shelf supports noted on drawings as "Stainless Steel" shall be type 302/304, austenitic chromium nickel stainless steel in accordance with A.I.S.I. specification containing 8% nickel and 18% chromium. Where noted as such, stainless steel components and shelf supports shall be constructed exactly as those fabricated of cold rolled sheet steel and the same gages. Exposed surfaces shall have #4 finish.
 2. Counter tops and sinks noted on drawings as "Type 316 Stainless Steel" shall be similar to type 302/304 except molybdenum is added to improve the general corrosion and pitting resistance.
- B. Glass: Glass for glazed doors, fume hood windows, vented workstations and sliding sashes shall be 1/4" thick clear laminated safety glass, complying with ASTM C1172, Kind LT, Condition A, Type 1, Class 1 with 2 lites not less than 3.0mm thick with clear, polyvinyl butyl interlayer.
- C. Solid Hardwood: AWI Grade I, Solid hardwoods shall be properly air-dried, then kiln dried to 5% to 6% moisture content, and then tempered in inside storage to moisture content of 6% to 8%. Wood used in interior construction to match exterior in species, finish and grade.
- D. Core:
1. Maximum Moisture Content for Lumber: 7 percent for hardwood and 12 percent for softwood.
 2. Hardwood Plywood: HPVA HP-1-2000, veneer core, hardwood cross plies and 1/42"-1/50" face veneers and shall be constructed from aspen or basswood, made without urea formaldehyde. (Not permitted in Premium Grade doors and drawer fronts).
 3. Particle Board Core: ANSI A208.1-1999, Grade M-3-Exterior Glue, 45 lb. Doors shall be cross-banded with veneer then apply 1/42"-1/50" face veneer, made with binder containing no urea formaldehyde.
 4. MDF Core: ANSI A208.2-2002, Grade 130-MR50, banded on vertical edge of the hinge side with 1-1/2 inch solid hardwood. Door shall be cross-banded with 1/42"-1/50" face veneer.
- E. Edge-banding for Wood-Veneered Construction: Minimum 3/32" thick, square solid wood of same species as face veneer.

- F. Plywood: Plywood shall be veneer core construction glued with water resistant resin adhesives. Hardwood plywood for exposed surfaces shall have face veneers of selected hardwood species and shall conform to ANSI/HPVA HP1 product standards, latest edition. Plywood for interior and unexposed surfaces shall be hardwood plywood conforming to U.S. Department of Commerce Voluntary Product Standard PS-1.
- G. Particleboard: Particleboard to be used with plastic laminate countertops and shelves shall be of 45lb. density, and balanced construction with moisture content not to exceed 8%. Particleboards shall meet or exceed the requirements for its type and classification under Commercial Standard CS-236-66, Federal Specifications LLL-B-800A and ASTM D 1037-78. Particleboard shall meet the following performance requirements. Submit compliance data from the manufacturer prior to fabrication:
1. Screw-holding, Face 247 lbs.
 2. Screw-holding Edge 225 lbs.
 3. Modulus of Rupture 2,393 psi.
 4. Modulus of Elasticity 398,900 psi
 5. Internal Bond 80psi.
 6. Surface Hardness 500 lbs.
- H. Hardboard. Hardboard shall meet or exceed ANSI/AHA A135.4-1995 Un-tempered hardboard ¼”, S1S, nominal thickness, smooth exposed side.
- I. Exposed Materials:
1. General: Provide materials that are selected and arranged for uniformity of grain and color. Do not use materials adjacent to one another that are noticeably dissimilar in color, grain, figure, or natural character markings. 100% sapwood, no heartwood, no water stains, no sharp contrasts at veneer joints.
 2. Wood Species and Veneer Cut: Maple, plain sliced.
 - a. Stain Colors and Finishes: Match Architect's samples.
 - b. Solid Wood: Clear hardwood lumber.
 - c. Plywood: Hardwood plywood; Grade A exposed faces at least 1/50 inch thick, solid cross-bands. Backs of same species as faces.
- J. Semi-exposed Materials:
1. Solid Wood: AWI Grade I, Sound hardwood lumber, selected to eliminate appearance defects of same species as exposed solid wood.
 2. Plywood: Hardwood plywood of same species as exposed plywood. Grade A faces, Grade J cross-bands.
- K. Concealed Materials:
1. Solid Wood: Any hardwood or softwood species, with no defects affecting strength or utility.
 2. Plywood: Hardwood plywood. Grade 1, Concealed backs of plywood with exposed or semi-exposed faces shall be same species as faces.
- L. Veneer, grain and color shall be as follows:
1. Exposed surfaces: Grade AA with vertical grain including doors and drawers.

2. Semi-Exposed surfaces: Grade A, horizontal grain.
3. Concealed surfaces: Grade 1.
4. Door and drawer heads, within the same cabinet shall be cut and vertically matched from the same sheet of veneer and be book matched, centered and balanced across the cabinet width. Sink cabinets or other cabinets with a single piece apron across the front shall also have veneers that are vertically aligned and matched to adjacent faces, centered and balanced across the cabinet width. Cabinet fronts shall be cut from the same sheet of veneer. For fixed casework, veneers shall be sequence matched across the entire elevation.
5. Grain direction on bottoms and tops of base, wall and tall cabinets and on shelves shall run lengthwise..

2.3 COUNTER TOPS AND CURBS

- A. General: Counter tops shall be 1” thick. Curbs shall be ¾” thick of the same material as the counter top and shall be provided at the rear of counter tops and on end returns. Laboratory counter tops, shall be epoxy resin unless otherwise noted on the drawings. Epoxy and stainless steel counter tops to be installed without field cutting or drilling. The gap between the curb and wall is to be sealed with silicone sealant, color matched to the counter top. Sink counter tops shall be fabricated in one piece and have a marine edge around the four sides to create a dished top. Counter tops shall be cut to maximum lengths possible. Provide front and end overhang of 1 inch, with continuous drip groove on underside ½ inch from edge.
- B. Epoxy Resin. Epoxy resin counter tops and curbs shall be molded from a modified epoxy resin especially compounded and cured to give optimum physical and chemical resistant properties. Material shall be a uniform mixture throughout the full thickness. Materials shall have a non-specular finish in black color. Exposed edges shall have a 1/8” radius on front top edge and at vertical corners. Curbs shall typically be 4” high, unless otherwise noted on Drawings, and shall be ¾” thick bonded to the surface of the top to form a square joint. Epoxy resin tops shall be 1” thick except in fume hoods where they will be 1-1/4” thick. Joints between tops shall be smooth, even, square, 1/16” wide maximum and shall be watertight by use of a silicone adhesive with corrosion-resistant quality. Epoxy resin countertops shall be made with a separate service strip to accept service fixtures.
 1. Physical Properties:
 - a. Flexural Strength: Not less than 10,000 psi (70 MPa)
 - b. Modulus of Elasticity: Not less than 2,000,000 psi (1400 MPa)
 - c. Hardness (Rockwell M): Not less than 100
 - d. Water Absorption (24 Hours): Not more than 0.02 percent
 - e. Heat Distortion Point: Not less than 260 deg F (127 deg C)
 2. Chemical Resistance: Epoxy-resin material has the following ratings when tested with indicated reagents according to NEMA LD 3, Test Procedure 3.4.5:
 - a. No Effect: Acetic acid (98 percent), acetone, ammonium hydroxide (28 percent), benzene, carbon tetrachloride, dimethylformamide, ethyl acetate, ethyl alcohol, ethyl ether, methyl alcohol, nitric acid (70 percent), phenol, sulfuric acid (60 percent), and toluene.
 - b. Slight Effect: Chromic acid (60 percent) and sodium hydroxide (50

- percent).
3. Countertop Fabrication: Fabricate with factory cutouts for sinks and with butt joints assembled with epoxy adhesive and pre-fitted, concealed metal splines.
 - a. Countertop Configuration: Flat, 1 inch thick, with rounded top, front edge and all corners, with drip groove and integral coved backsplash. Ends shall be square.
 4. Sink Fabrication: Molded in 1 piece with radiused corners, and bottom sloped to outlet with integral side mounted overflows; 1/2-inch minimum thickness producing a smooth finish, the same color as the surrounding counter top.
 - a. Provide with polypropylene strainers and tailpieces.
 - b. Provide sinks for under-mount installation.
- C. Stainless Steel: Counter tops and curbs noted on drawings as “Stainless Steel”, (Type 302/304) and/or Type 316 Stainless steel shall be constructed of 16 gauge nominal thickness, stainless steel sheet, ASTM A666. Exposed surfaces shall have #4 satin finish.
1. Extend top down 1 inch at edges with a 1/2-inch return flange under frame. Apply heavy coating of heat-resistant, sound-deadening mastic to undersurface.
 2. Form curb coved to and integral with top surface of one piece, without seams or joints. The top of the curb shall be chamfered 45 degrees.
 3. Provide raised (marine) edge around perimeter of countertops containing sinks; pitch two ways to sink to provide drainage without channeling or grooving.
 4. Reinforce underside of countertop with channels where necessary to insure rigidity without deflection and coat with a sound deadening material where not exposed to view.
 5. Tops shall be as long as practical to permit access to the building and room. Where field-made joints are required, provide continuous channels welded to the underside of the counter for reinforcing and aligning the butt-joints.
 6. Electrically weld shop and field made joints, and grind and polish surfaces to produce uniform, directionally textured finish, free of cross scratches. When polishing is completed, rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
 7. Where stainless steel sinks or cup sinks occur in stainless-steel countertops, factory weld into one integral unit, grind welds smooth, polish and rinse. Tops shall be adequately reinforced to accept sinks.
 8. Stainless-Steel Shelves: Made not less than 0.050-inch nominal thickness. Fold down front edge 3/4 inch; fold up back edge 3 inches. Provide integral stiffening brackets, formed by folding up ends 3/4 inch and welding to upturned [back edge] [front and back edges]. Weld shop made joints, grind smooth and polish.
 9. Sinks: Made not less than 0.050 inch thick. Fabricate with corners rounded and coved to at least 5/8-inch radius. Slope sink bottom to outlet. Provide double wall construction for sink partitions with top edge rounded to at least 1/2-inch diameter. Provide continuous butt-welded joints, grind smooth and polish surfaces to produce non-directional #4 satin finish, free of scratches. When polishing is completed, rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean. Provide factory punchings for fittings, stainless steel strainers and tailpieces. Provide integral rims when not used with stainless steel counter tops.

10. Cup Sinks: 3 x 9-inch nominal size of equal quality and material as the sinks. Provide stainless steel strainers and integral tailpieces.

2.4 ADJUSTABLE SHELVES

- A. General: Adjustable shelves shall be constructed from materials as indicated in the drawings.
- B. Adjustable shelves shall be of dimensions noted on the Drawings.
- C. Adjustable shelves shall be mounted to surface type steel standards (wall condition) or slotted studs (above peninsula benches). Adjustable shelves shall be supported by steel shelf brackets not to exceed 48 inches on center. Brackets shall be minimum 12 gauge cold rolled steel, with epoxy powder coated finish, complying with BHMA A156.9, Types B04102 and B04112. Shelves shall be fastened to brackets with two stainless steel screws per bracket.
- D. Adjustable shelves mounted on slotted studs shall be supplied edge-banding on all four sides with a continuous 2" high band to create a 1" high curb at the rear of the shelf. The curb along the back shall be of similar material as the shelf.

2.5 CABINET DESIGN

- A. Casework shall be fabricated as sectional units, ready for placement in the laboratory as a complete integral rigid unit permitting relocation at any subsequent time. Equivalent to AWI Section 01600-Division A-Wood Cabinets, Premium grade. Component parts of the unit shall be manufactured ensuring uniformity, interchangeability and accurate alignment. No staples will be permitted as fasteners on any cabinet components. All base cabinets to have integral enclosed bases.
- B. Base cabinets must be capable of supporting an equipment load of at least 500lb. per running foot above and beyond the weight of the assembly including the counter top when tested in accordance with the test procedures as outlined in SEFA 8 Section 4.
- C. Where noted as such, provide wall-mounted casework that matches all other laboratory casework in design and material. The assembly must be capable of supporting an equipment load of at least 150 lb. per running foot above and beyond the weight of the assembly when tested in accordance with test procedures as outlined in SEFA 8, section 9.

2.6 CABINET CONSTRUCTION

- A. Cabinet construction shall meet AWI, Flush Overlay requirements and specifically meet the following tolerances:
- B. The gap between doors, drawers and pull out boards shall be consistently straight and not exceed 1/8".
- C. The vertical gap between door, drawer head and pull out boards and the gap between adjacent cabinets shall not exceed 1/8". This criteria will require the doors, drawer heads

and pull out boards be no further than 1/16” from the exterior vertical edge of the cabinet.

- D. To achieve these tolerances, the hinge must be mortised into the door side. Wall cabinets with hinged doors shall meet the same gap tolerances as base cabinets.
- E. Fixed sectional units to be located on the laboratory floor shall be equipped with adjustable leveling devices.
- F. Where noted on the drawings, cabinets with casters shall be constructed without toe spaces. The cabinet shall be constructed with a reinforced base capable of supporting a 4” high caster assembly in each corner. Casters shall be swivel, locking type on front and swivel, non-locking type on rear, rated for minimum 250 pounds load each. The entire assembly shall be reinforced to permit mobility without twisting and achieve an industry standard height of 31” or 37” including the flush 1” counter top. Allow sufficient clearance between top of cabinet and underside of countertop, apron or frame to facilitate movement. Cabinets with casters shall be completely finished on four sides and top since surfaces are considered exposed. Casters shall be through bolted through bottom of cabinet at all four bolts and interior bolt heads shall be countersunk.
- G. Adjustable Shelves located in cabinets shall be edge banded on front and back edges of each shelf component.
- H. Fixed shelves located in cabinets shall be edge banded on front edge of each shelf component.
- I. Units, except cabinets with casters or carpet glides, shall have backs with removable panels for access to the pipe spaces at the rear of the units. Removable panels shall be provided in sides of units where units occur in the corners of the rooms and access is required to the pipe spaces. These removable panels shall be designed to permit removal, utilizing only a screwdriver, through the fronts of the units and no intermediate rails between drawers are required.
 - 1. Ends of Cabinets: 3/4inch, 7-ply veneer plywood with front exposed edges faced with a 1/8inch, squared, solid hardwood. End panels shall be glued to horizontal frame units and to solid bottom panels. Joint construction shall be blind, not extended to face of cases. Joinery shall be blind mortise and tenon, multiple doweled, or stopped tongue and groove.
 - 2. Tops of Wall Cabinets and Tall Cabinets: 3/4-inch-thick 7 ply veneer faced plywood with exposed edge faced with 1/8inch solid hardwood.
 - 3. Fixed Backs of Movable Cabinets: 3/4-inch-thick 7 ply veneer faced plywood where exposed, doweled and rabbeted into end panels.
 - 4. Backs on Stationary Cabinets: 1/4-inch-thick veneer core plywood dadoed into sides, bottoms, and tops where not exposed. Removable backs shall be removable from inside the cabinet with a minimal use of tools. Provide 1inch x 1inch cleats, top, bottom and sides, at the rear corners of the cabinet to fasten the removable panel.
 - 5. Wall Mounted Cabinet Bottoms: 3/4-inch-thick 7 ply veneer core plywood with exposed edge faced with 1/8inch solid hardwood.
 - 6. Shelves: 3/4-inch-thick 7 ply veneer core plywood with exposed edge faced with 1/8inch solid hardwood. The shelves shall be full depth adjustable type.

7. Drawer Fronts: 3/4-inch-thick particleboard or medium dense fiberboard with solid hardwood stiles and rails with hardwood faced veneers, edge banded with 1/8-inch solid hardwood. Drawer fronts shall be fastened to the drawer bodies with two pan head machine screws.
8. Drawer Box Fronts, Sides and Backs: 1/2-inch-thick solid wood or 1/2inch thick 7ply veneer core plywood, with glued dovetail or multiple-dowel joints.
9. Drawer Bottoms: 1/4-inch-thick veneer core plywood glued and dadoed into front, back, and sides of drawers. Use 1/2-inch-thick material for drawers more than 24 inches wide.
10. All corners of cabinet box, doors, drawers and shelves shall be eased or chamfered not greater than 1/16". Radiused corners shall not be permitted.
11. Doors 48 Inches or Less in Height: 3/4 inch thick, with particleboard or medium-density fiberboard cores, solid hardwood stiles and rails, and hardwood face veneers and cross-bands.
12. Doors More Than 48 Inches in Height: 1-1/8 inches-thick, with particleboard cores and hardwood face veneers and cross-bands.
13. Stiles and Rails of Glazed Doors: 3/4-inch-thick solid hardwood.

2.7 ACID STORAGE CABINET

- A. Provide 1/4" thick white polypropylene or polyethylene lining on interior surfaces.
- B. Provide 1-1/2 inch diameter polyethylene vent hose connecting at the rear of base cabinet to the top plenum of the hood chamber above the baffle plate and sealed. No holes are to be made through the work surface. When cabinet is used without a fume hood, vent hose is to extend to the appropriate laboratory exhaust system.
- C. Removable back panel.
- D. No self-closing or bi-fold doors.
- E. Provide one adjustable lined shelf, of similar material and thickness as interior liner, supported with nylon "locking" clips to avoid inadvertent removal. Shelf shall be capable of supporting 150lbs.without deflection.
- F. Provide a 1 inch-deep liquid tight drip pan to cover the entire floor area of the lined cabinet compartment. Pan to be fabricated of 1/4" thick white polypropylene or polyethylene with seams heat welded.
- G. Fasteners to be stainless steel or plastic and shelf supports to be plastic or epoxy coated metal.
- H. Apply silkscreen signage, color: red, to cabinet doors indicating "CORROSIVE CHEMICALS". Font, size and location as directed in the drawings.

2.8 FLAMMABLE LIQUIDS STORAGE CABINET

- A. Conform to OSHA Regulations and the requirements of NFPA 30-2003 Chapter 6-3, National Fire Protection Association, Flammable and Combustible Liquids Code. Cabinets shall be Factory Mutual (FM) approved and Underwriters Laboratories (UL)

listed. Cabinets shall limit the internal temperature at the center, one inch from the top to not more than 325 degrees Fahrenheit when subjected to a ten-minute fire test that simulates the fire exposure of the standard time-temperature curve specified in NFPA 251.

- B. Provide 1-1/2” diameter, minimal, insulated, NPT stainless steel vent pipe routed from bottom of cabinet directly to the adjacent fume hood duct collar. in accordance with NFPA91.
- C. Casing: Bottom, top, back, door and sides of cabinet shall be constructed of exterior grade plywood, one inch thick. Material shall not break down or delaminate under fire conditions. All joints shall be rabbeted and shall be fastened in two directions with wood screws. Provide with adjustable zinc plated leveling legs.
- D. No bi-fold doors
- E. Ground (to structure) and bond cabinet.
- F. Provide flame arrestor on cabinet vent outlet.
- G. Adjustable, full width, metal shelf supported with “locking” clips to avoid inadvertent removal.
- H. Apply silkscreen signage, color red, in a conspicuous size to cabinet doors indicating “FLAMMABLE – KEEP FIRE AWAY”. Font, size and location shall be as directed in the drawings.
- I. Door: Provide with continuous piano hinge, three point latch mechanism integrated into lever handle with door sill raised at least 2 inches above the bottom of the cabinet to retain spilled liquid within the cabinet. When more than one door is used, there shall be a rabbeted overlap or not less than one inch. Doors shall be equipped with a means of latching and hinges shall be constructed and mounted in such a manner as to not lose their holding capacity when subjected to fire exposure.
- J. Finish: Finish as specified for wood laboratory casework except interior and shelf shall be triple coated.

2.9 WOOD FINISH:

- A. Preparation: Exposed surfaces to receive finish shall be free of machine marks, carefully and smoothly sanded, prior to assembly, in preparation for finishing. Sand edges of doors, drawer fronts and molded shapes with profile-edge sander. Sand casework after assembling for uniform smoothness at least equivalent to that produced by 600 grit sanding.
- B. Staining: Remove fibers and dust before applying stain to exposed and semi-exposed surfaces as necessary to match approved samples. Apply stain in a manner that will produce a consistent appearance.
 - 1. Exposed surfaces shall be first coated with a stain or toner to secure the desired color. The color coat shall be thoroughly dried. Wood finish shall consist of two

- coats of sealer and three coats of a chemical resistant finish applied and thoroughly dried and cured providing a semi-gloss finish. When a natural finish is required, the color coat is omitted. Stain shall be as selected by Architect.
2. Semi-Exposed Surfaces shall receive a stain coat, a double coat of resinous sealer and three coats of a chemical resistant finish.
 3. Concealed Surfaces shall receive a double pass coat of resinous sealer.
- C. Chemical Resistant Finish: Apply three coats of chemical resistant, transparent finish consisting of sealer and catalyzed topcoat(s) complying with AWI TR-5. Finish shall be individually applied, sanded and allowed to individually dry. Top frames of drawer openings and toe spaces shall be sealed with clear sealer.
- D. Chemical Resistance Testing Criteria: Finish shall comply with acceptance levels of cabinet surface finish tests in SEFA 8. Acceptance levels for chemical spot test shall be no more than four Level 3 conditions and as follows: Level 0: no detectable change; Level 1: slight change in color; Level 2: Slight surface etching or severe staining; Level 3: Pitting, cratering, swelling or erosion of coating. Obvious and significant deterioration when tested in the following method
1. Method A: Test volatile chemicals by placing a cotton ball saturated with reagent in the mouth of a 1-oz. Bottle and inverting the bottle on the surface of the panel.
 2. Method B: Test non-volatile chemicals by placing five drops of the reagent on the surface of the panel and covering with a 24mm watch glass, convex side down.
 - a. Acetate Acids: Amyl and Ethyl A
 - b. Acetic Acid: 98% B
 - c. Acetone A
 - d. Acid Dichromate, 5% B
 - e. Alcohols: Butyl, Ethyl or Methyl A
 - f. Ammonium Hydroxide, 28% B
 - g. Benzene A
 - h. Carbon Tetrachloride A
 - i. Chloroform A
 - j. Chromic Acid: 60% B
 - k. Cresol A
 - l. Dichlor Acetic Acid A
 - m. Dimethylformamide A
 - n. Dioxane A
 - o. Ethyl Ether A
 - p. Formaldehyde, 37% A
 - q. Formic Acid: 90% B
 - r. Furfural A
 - s. Gasoline A
 - t. Hydrochloric Acid: 37% B
 - u. Hydrofluoric Acid: 48% B
 - v. Hydrogen Peroxide: 3% B
 - w. Iodine, Tincture of B
 - x. Methyl Ethyl Ketone A
 - y. Methylene Chloride A
 - z. Mono Chlorobenzene A

aa.	Naphthalene	A
bb.	Nitric Acid: 20%	B
cc.	Nitric Acid: 30%	B
dd.	Nitric Acid: 70%	B
ee.	Phenol, 90%	A
ff.	Phosphoric Acid 85%	B
gg.	Silver Nitrate, Saturated	B
hh.	Sodium Hydroxide: 10%, 20% or 40%	B
ii.	Sodium Hydroxide, Flake	B
jj.	Sodium Sulfide, Saturated	B
kk.	Sulfuric Acid: 33%	B
ll.	Sulfuric Acid: 77%	B
mm.	Sulfuric Acid: 96%	B
nn.	Sulfuric Acid: 77% and Nitric Acid 70%	B
oo.	Toluene	A
pp.	Trichloroethylene	A
qq.	Xylene	A
rr.	Zinc Chloride, Saturated	B

- E. Hot Water Test: SEFA 8; Hot water (190 degree F. to 205 degree F. shall be allowed to trickle (with a steady stream and at a rate of not less than 6 ounces per minute) on the finished surface, which shall be set at an angle of 45 degrees, for a period of five minutes. After cooling, and wiping dry, the finish shall show no visible effect from the hot water.
- F. Impact Resistance Test: There shall be no visual evidence to the naked eye of cracks or checks in the finish due to impact when a 2” diameter, one pound ball is dropped onto the finished surface from a height of 12” onto a flat horizontal surface, in accordance with testing as described in SEFA 8.

2.10 MOVABLE TABLES:

- A. Movable tables shall be constructed as indicated on the Drawings.
- B. Movable tables shall have 2” solid apron front and 7” solid apron sides and back. It shall have 1” x 1” tubular stainless steel, ASTM A554-03, telescoping legs drilled at 1inch increments inside a 2-1/2inch square wood leg lined with a plastic tube for the adjustable leg to slide in. Where adjustable legs are shown, provide a stainless steel 3/8-16 thread stainless steel machined nut and 2-1/4inch long stainless steel slot flat head screw in each leg. Each leg shall be fitted with a 1-1/2” diameter adjustable non-marring floor glides with 1” micro-adjustment capability complete with grater clip and 3/8-16 thread hex lock nut.
- C. Moveable tables shall have the ability to be adjusted in height from 31” to 38” in 1” increments inclusive of 1” thick counter top. Center bench tables, where legs are shown on drawings as fixed, shall include a leveler so the table may be leveled to the height of the adjacent casework.
- D. Movable tables shall be installed at height indicated on Drawings. Fixed wood section of leg shall be set at height appropriate for a 31” high table top. Coordinate the under-counter clearance with casework and refrigerators.

- E. Movable tables shall be reinforced with a deep welded steel channel frame and corner brackets appropriate for the load bearing requirements and concealed by wood elements. Load capacity of tables shall be 50lb. uniform design load and support a 250 lb. concentrated load at mid-space with deflection not to exceed 1/8”.
- F. Provide a removable 12inch wide reinforced metal shelf between the legs 8 inches above finished floor, where indicated on the drawings.
- G. Movable table shall be equipped with an epoxy counter top unless otherwise noted.

2.11 MOVABLE BASE CABINETS

- A. Movable Base Cabinets: Cabinets with casters shall be constructed as follows:
- B. Base cabinets shall be constructed as described for fixed base cabinets, except that edge banding shall be continuous under all exposed edges.
- C. Base cabinet dimensions shall be as shown on drawings. Top of the base cabinet shall be plastic laminate (color selected by Architect) with 3/4” wide x 1/8” thick edge banding on four sides.
- D. Drawer units must be equipped with a drawer interlock mechanism so that only one drawer in a vertical stack can be opened at one time. Base cabinets shall have a finished 12 gauge (minimum) metal plate across the full bottom face of the cabinet through which casters shall be attached. Interior bolt heads for casters shall be countersunk.

2.12 HARDWARE AND ACCESSORIES

- A. General: Provide laboratory casework manufacturer’s standard satin-finish, commercial grade quality, heavy-duty hardware complying with requirements indicated for each type.
- B. Drawer, Door and Pull Out Board Pulls: Door and drawer pulls shall be 4” wire type, satin chrome plated finish, fastened from the back with two pan head machine screws. Drawer and pullout board pulls shall be installed horizontally, door pulls shall be installed vertically. Wall cabinet and floor storage cabinet pulls should be located for reaching convenience and ADA accessibility guidelines. Two pulls shall be required on all drawers over 24inches wide.
- C. Rollers and Sheaves: Rollers and sheaves shall be cadmium plated hardened steel or nylon, specifically designed for their application. Sliding door sheaves shall have a special contour for engagement with the one-piece double “V” stainless steel tracks. The positive ball bearing sliding door retainers shall be adjustable for removal of the doors when required.
- D. Hinges on base and wall cabinets shall be exposed axle, zinc die cast and satin chrome plated finish complying with BHMA A156.9, Grade 1 with antifriction bearings and rounded tips similar to units as manufactured by Hafele Aximate #344.52.101, Grass #950 or Hettich #4000-180T22-11M. Hinge shall be capable of supporting a 150 lb. dynamic load, 100 lbs on each side of the door located 12” from the hinge. Provide (2) hinges for 36” high doors, (3) for 48” high doors and (4) for 84” high doors.

- E. Door Catches: Hafele hinges have integral door catch mechanism. Catches shall be provided on hinged doors and shall be spring-loaded nylon roller types with a steel strike plate. Double doors without locks shall have a catch on each door. Tall cases shall have latching devices located on the structurally fixed center shelf. The left hand door shall have a positive catch and the right hand door shall have a roller type catch. Where locks are used, catches and strike plates shall be used on left hand doors of double door cases and shall be steel, cadmium plated.
- F. Toe space filler: At gap created between the cabinet or ledge static panel and the floor due to leveling conditions, mechanically fasten (flat head screw) a 4" wide 18 gage galvanized steel plate to the cabinet behind the base molding to support its application. Provide continuous clear silicone sealant at intersection of floor/wall and steel plate.
- G. Drawer slides:
1. Drawer slides shall be self-closing, nylon tired, ball bearing, full extension zinc plated assembly that will allow the drawer body to be completely exposed and physically accessible, complying with BHMA A156.9, Type B05091. Drawer slides shall have an integral stop mechanism to avoid inadvertent removal. Assembly shall be typically rated for 100 lb. at full extension, dynamic load. Slides shall be as manufactured by Precision Slide, Accuride or Waterloo.
 2. Drawer slides for file or bin drawers shall be nylon tired, ball bearing, full extension zinc plated assembly that will allow the drawer body to be completely exposed and physically accessible, complying with BHMA A156.9, Type B05091. Drawer slides shall have an integral stop mechanism to avoid inadvertent removal. Assembly shall be typically rated for 150 lb. at full extension, dynamic load. Slides shall be as manufactured by Precision Slide, Accuride or Waterloo.
- H. Shelf Adjustment: Adjustable shelf support clips inside wall, floor and base cabinets shall be designed for adjusting shelves on 2" centers and shall be nylon complying with BHMA A156.9, Type B04013. Clip shall be configured to clamp top and bottom of shelf to avoid movement. Clip may have one or two pins. In addition to shelf clips required for initial assembly, six (6) dozen additional clips to be provided to the owner. Clips shall be Hafele #282.47.402 clear.
- I. Locks: Locks to be furnished where noted on the Drawings. Drawer and door locks shall be brass, five-pin tumbler type, complying with BHMA A156.11, Type EO7281 having paracentric keys. The exposed face shall be chromium plated with satin finish. Locks shall be mounted in special housing so designed as to prevent removal when in locked position. The locks and lock housings shall be fully concealed within the drawer heads and doors. The lock tongues shall engage the rails or stiles when in locked position. Sliding door locks shall be push-type operating in sleeves and engaging both doors when in locked position and provided with positive door holding device. Install theft panels above each drawer or cupboard segment in order to isolate locked section. Locks shall be separately keyed (including cabinets with multiple locks and cabinets in the same room) and two (2) keys shall be furnished with each lock. Supply two (2) master keys for all locks.
- J. Standards: Surface mounted adjustable shelves, shall be mounted to twin-tracked

standards. Standards shall be coated with an epoxy powder coating complying with BHMA A156.9 Types B04102 with a nominal cross section of 1-1/2" x 1/2". Acceptable manufacturers shall be Reeve, Fixture Hardware Manufacturing Corporation, and Knape and Vogt. Standards and slotted studs shall have a fully compatible slot pattern. Fasten standards to concrete masonry walls or properly blocked steel studded walls with appropriate flat head screws. Adjustable shelves, wall cabinets and pegboards will be furnished with integral mounting brackets or clips.

- K. Slotted Studs: Adjustable shelves, wall cabinets and peg boards mounted above peninsula or island benches shall be mounted to a welded double-sided, twin tracked stud assembly. Assembly shall be fabricated of 14 gage, fully welded, steel tube with slots laser cut into uprights and be coated with an epoxy powder coat. Acceptable manufacturers shall be Reeve, Fixture Hardware Manufacturing Corporation, and Knape and Vogt. Slotted studs and standards shall have a fully compatible slot pattern. Adjustable shelves, wall cabinets and pegboards shall be furnished with integral mounting brackets or clips to meet design load.
- L. File Drawers: File drawers shall be furnished with Pendaflex metal inserts to hold files in a front-to-back configuration. File drawer shall be notched appropriately to accept metal inserts. NOTE: THIS REQUIRES A MINIMUM DIMENSION OF 16".
- M. Grommets: Black ABS plastic wire access grommets shall be designed to accommodate computer and computer peripherals plugs up to 2-1/4" wide. Unit shall be 3" OD, require a 2-1/2" hole and shall be configured with a separate and removable cap that completely covers the grommet liner. Unit shall be equal to Doug Mockett & Company #EDP Grommet.
- N. Glazing in doors shall be installed on a foam cushion with the glazing tape installed on sides trimmed below the level of the frame and glazing stops. Glazing stops shall be of the same material and finish as the cabinet door.
- O. Levelers are 3/8" – 16 NC x 3.5" long, model # 23015T56 as manufactured by McMaster-Carr Supply Company, New Brunswick, NJ.
- P. Casters shall be equal to Algood, model S5033-SRG, soft rubber wheeled casters.

2.13 UMBILICALS

- A. Vertical service columns shall extend from the floor or counter top to a minimum of 6" above the hung finished ceiling and secured at bottom and top to insure structural stability.
- B. Umbilical shall be fabricated and finished the same shelves and supports. Color to be selected by Architect.
- C. Umbilical shall have a removable access panel, screwed in place, on the side adjacent to the shelves. The exposed side shall be free of seams and fasteners.
- D. Provide 4" high curb around counter-mounted umbilical of the same material as counter top with corners mitered. Provide cut-out in counter top centered under the service

column to accommodate services from above as indicated on the Drawings. Coordinate and provide cut-outs on face of umbilical for feeds to electrical raceway and panel mounted fixtures.

2.14 MECHANICAL SERVICE FITTINGS

- A. Mechanical service fixtures shall comply with SEFA 7, “Laboratory and Hospital Fixtures-Recommended Practices. Fixtures for liquids and gaseous mixtures shall have lettered and colored indexes for each service. Handles shall be standard 4-arm handles, with color tabs identifying utility. Serrated hose ends shall have seven (7) serrations. Fixtures for gas, air and vacuum shall be needle valve, large type. Water fixtures shall be compression type. Drain fittings shall be polypropylene unless otherwise noted. Fixtures that serve special gases (N₂, O₂, NO₂, etc.) and instrument air shall be lubricated, cleaned, capped protected, and delivered certified for “Oxygen” service.
1. Provide fittings complete with washers, locknuts, nipples and other installation accessories. Include the deck flanges, escutcheons, handle extension rods and similar items.
 2. Provide units that comply with recommendations in SEFA 7, Section 11, “Vandal-Resistant Faucets and Fixtures.
- B. Materials: Plumbing fixtures, except for drain fixtures and fittings, shall be a forged red-brass composition containing at least 85% copper with washers and seats, of maximum wear resistant materials for the specific use. Reagent grade water fixture to be brass gooseneck type with an internal polypropylene lining that permits recirculation to the manual outlet.
- C. Needle Valves (Large): Provide large needle valves with a renewable valve seat and floating cone made of stainless steel or Monel metal with removable serrated outlet.
- D. Compression Water Valves: Provide units complying with ASME A112.18.1. Compression water valves shall have a renewable unit containing all working parts, including a stainless steel replaceable seat and valve disc. Unit shall be broached on the outside for permanent position in the valve body. The unit shall contain an integral control device for volume of water discharged by the faucet. The valve shall have a removable serrated hose unless otherwise noted. Valve shall be rated for 125 psi operating pressure with a max of 190 psi for intermittent use.
- E. Faucet Accessories: Hot and cold water combination sink faucets shall have aerator tips. Cup sink and reagent grade water faucets to have serrated hose ends. Faucets are to be swivel type except reagent grade water.
- F. Vacuum Breakers: ASSE 1035 Integral vacuum breakers shall be supplied on all domestic water fixtures. The fume hood fixture shall have the vacuum breaker exposed 7 ft A.F.F. on face of hood (exposed vacuum breaker and piping to have same finish as other fixtures). The vacuum breaker for the eye wash fixture shall be located under the sink cabinet, visible when the cabinet doors are open.
- G. Service Identification: Index buttons mounted in fixture handles shall identify the following services. Buttons shall be color-coded and lettered.

1.	Hot Water	HW	Red
2.	Cold Water	CW	Green
3.	Gas	Gas	Blue
4.	Air	Air	Orange
5.	Vacuum	Vac	Yellow
6.	Reagent Grade Water	RG	White
7.	Nitrogen	N2	Brown
8.	Carbon Dioxide	CO2	Pink

- H. Service Fixture Finish: Laboratory brass service fixtures shall be ground smooth, coated satin chromium plated finish with a clear epoxy coating except where corrosion resistant finish is indicated. Fixtures shall receive multiple applications of coating and are baked for polymerization. Units must be assembled before coating and pressure tested before shipment. Provide corrosion resistant finish in laboratory' casework manufacturer's standard metallic brown, aluminum or other color as approved by the Architect.
- I. Fixture Shipment: Fixtures shall be assembled in factory and supplied loose except for fume hood factory mounted fixtures.
- J. Manufacturers: Service fittings shall be manufactured by:
1. Water Saver Corporation
 2. Far Laboratories
 3. Broen Corporation
- K. Hand Held Eye Wash: Where indicated with designation "EW" on floor plans, provide a unit that consists of a dual head eye wash assembly, 6ft length of rubber hose, counter top mounting stand, slip ring mechanism to allow for hands free operation and in-line vacuum breaker. Unit's finish shall match other service fittings.

2.15 SINKS

- A. General: Provide sinks and accessories as shown on the Drawings and as specified herein.
- B. Sink Supports: Epoxy sinks and stainless steel sinks mounted in epoxy resin tops, shall be supported on steel channels or solid wood rails attached to the ends of sink cabinets, under the sink and adjustable by screw type rods to insure tight fit to the underside of the table with a waterproof compound. Sinks installed in dissimilar material counter tops shall have self-rimming design.
- C. Sink Outlets, Tailpieces and Overflows: Sinks shall be equipped with an integral overflow that is connected directly to the tailpiece. Overflow shall consist of an outlet located 2" below counter top and ½" diameter tygon tubing to connect overflow to tailpiece which shall be modified to accept tubing.
- D. Traps: Furnished under Division 22 Mechanical.
- E. Cup Sinks: Cup sinks in counter tops shall be 3 inch x 9 inch epoxy resin or polypropylene. Mount cup sink on the surface of the counter top in order to avoid discharge of chemicals in waste stream.

2.16 PEGBOARDS.

- A. Pegboards shall be fabricated of 1” thick, phenolic resin equal to “Tech Resin” (NuLab Furniture Corporation, Englishtown, NJ) “Trespa” (Hoechst Celanese Corp. Somerville, NJ), or “Lab Resin” (J.H.C. Inc., Brooklyn, NY). All surfaces to be polished, edges radiused 1/8”, and the color shall be black throughout. In sizes as indicated on the Drawings.
- B. Stainless steel drip trough, ¼” diameter drip trough outlet and flexible black, white or gray rubber tubing between drip trough outlet and sink (cut as required).
- C. Pegboards at umbilical shall be furnished with integral clips to attach to standards. Pegboard size and configuration shall be as indicated on the Drawings.
- D. Provide continuous silicone sealant at intersection between pegboard and trough.

2.17 ELECTRICAL FIXTURES

- A. General: All electrical devices, electrical raceways and task lights, where required, shall be furnished and installed under Section 26. Laboratory furniture contractor shall provide adequate space for all conduit and provide cut outs, where required, in laboratory casework.

2.18 CYLINDER RACKS

- A. General: Furnish and install wall mounted cylinder racks, in locations indicated on the Drawings.
- B. Manufacturers: Cylinder racks shall be fabricated of steel channels similar to products by:
 - 1. Unistrut Corporation (Wayne, MI)
 - 2. Kindorf (Baltimore, MD)
 - 3. Power Strut. (Shrewsbury, MA)
 - 4. Products similar to the Unistrut P1000 series, 12 gauge, in lengths indicated on the Drawings along with associated accessories, including but limited to bolts and spring nuts. Channels and parts shall be furnished to laboratory casework manufacturer in their standard acid resistant epoxy powder coat finish. Color to be selected by Architect.
 - 5. Accessories: Cylinder strap holders angle fittings, two per cylinder, with one inch nylon strapping, safety belt buckle and quick disconnect similar to Model # 29695T56 / 29695T66 as manufactured by McMaster-Carr Supply Company (New Brunswick, NJ.)

2.19 WALL MOUNTED CASEWORK

- A. Where noted on drawings, provide wall-mounted casework that matches all other laboratory casework in design and material. The assembly’s construction however, must be modified to withstand the rigors of being mounted directly to the wall and suspended above the floor, without sagging or effecting the door or drawer operation. The assembly must be capable of supporting an equipment load of at least 150 lb. (68.04kg) per running

foot above and beyond the weight of the assembly.

PART 3 - EXECUTION

3.1 JOB SITE CONDITIONS

- A. Carefully examine the installed work of others and verify that such work is complete to the point where this installation may properly commence. Coordinate with the General Contractor/Construction Manager to verify that required backing and reinforcements are in place, secure, and accurately located and that project is ready for the installation of the laboratory casework.
- B. Proceed with work when conditions permit Work to be installed in complete accordance with the original design, accepted submittals, and the manufacturer's written instructions.
- C. In the event of discrepancy, immediately notify the Architect in writing. Do not proceed with the installation in areas of discrepancy until issues have been resolved.

3.2 INSTALLATION

- A. Base Cabinet Casework shall be located in their designated positions, leveled, and plumbed true and straight by means of the micro-adjustment device located in each bottom corner of the cabinet. Adjust top rails and sub-tops within 1/16 inch of a single plane. Fasten cabinets to utility space framing, partition framing, blocking or reinforcements in partitions with fasteners spaced not more than 24 inches o.c. Align similar adjoining doors to a tolerance of 1/16 inch.
- B. Counter top lengths shall be fabricated as specified and indicated on the drawings with ends abutting tightly, and sealed with corrosion resistant sealants. The horizontal surface shall be smooth and level with no raised edges at the joints. Tops shall be anchored to base cabinets.
- C. Install miscellaneous filler panels and scribe as required for a continuous tight and accurate fitting installation with fasteners concealed where practical, without gaps or spaces between cabinetwork or counters and adjoining surfaces. All back splashes to be sealed at wall surfaces with corrosion resistant sealants.
- D. Assemblies are to be fastened together with devices of adequate strength to support cabinet or shelf fully loaded. Fully loaded will be defined as twenty-five (25) pounds per linear foot per shelf for enclosed wall cabinets or open adjustable shelves not inclusive of cabinet, shelf and bracket weight. Securely fasten wall-mounted items to solid supporting material only. Installation to meet local seismic requirements.
- E. Wall Cabinets: Adjust fronts and bottoms within 1/16 inch of a single plane. Fasten to hanging strips, masonry, partition framing, blocking or reinforcements in partitions. Fasten each cabinet through back, near top, at not less than 24 inches o.c. Align similar adjoining doors to a tolerance of 1/16 inch.
- F. Utility Space Framing: Secure to floor with two fasteners at each frame. Fasten to partition framing, wood blocking, or metal reinforcements in partitions and to base

cabinets.

- G. Install hardware uniformly and precisely. Set hinges snug and flat in mortises.
- H. Adjust laboratory casework and hardware so doors and drawers align and operate smoothly without warp or bind and contact points meet accurately. Lubricate joints only where shown on Shop Drawings.

3.3 COUNTER TOP INSTALLATION

- A. Counter top lengths shall be fabricated as specified and indicated on the drawings with ends abutting tightly in a hairline joints, single true plane, smooth and level with no raised edges at the joints with supports place to prevent deflection. All joints are to be sealed with corrosion resistant sealants.
- B. Make field jointing in same manner as factory jointing using dowels, splines, adhesives, and fasteners recommended by manufacturer. Locate field joints as shown on accepted submittal drawings. Joints shall be factory prepared requiring no job site processing of top and edge surfaces.
- C. Tops shall be anchored to base cabinets. Secure tops to cabinets/supports with concealed “Z” type angles or equal fastening devices spaced no more that 24 inches on center, with one located within 6 inches of front and back edge. Tighten according to manufacturer’s written instructions to exert a uniform heavy pressure at joints. Countersink exposed heads approximately 1/8 inch and plug flush with material equal in chemical resistant, color, harshness and texture to adjoining surface. Where work surface in intended to be moveable use a clamping device that is removable. Counter tops to be installed with a maximum 1/8” gap. Secure epoxy countertops to cabinets with epoxy cement, applied at each corner and along perimeter edges at not more than 48 inches o.c.
- D. Provide holes and cutouts as required for equipment and service fittings and fixtures. Verify size of opening with actual size of item to be used, prior to making openings. Form inside corners to a radius of not less than 1/8” . After cutting, rout and file cutouts to ensure smooth, crack-free edges. Seal exposed edges after cutting with a chemical resistant sealer recommended by the manufacturer.
- E. Provide scribe moldings for closures at junctures of countertop, curb and splash with walls as recommended by manufacturer for materials involved. Match materials and finish to adjacent laboratory casework. Use chemical-resistant, permanently elastic sealing compound where recommended by manufacturer.
- F. Carefully dress joints smooth, remove surface scratches and clean entire surface.

3.4 INSTALLATION OF ACCESSORIES

- A. Install in accordance with manufacturer’s directions. Turn screws to a flat seat; do not drive. Adjust moving parts to operate freely without excessive bind.
- B. Securely fasten adjustable shelving supports, shelves and pegboards to partition framing, blocking or reinforcements in partitions.

- C. Install shelf standards plumb and at heights to align shelf brackets for level shelves. Install shelving level and straight, closely fitted to other work where indicated.

3.5 CLEANING

- A. Repair or remove and replace defective, damaged or soiled work to match original factory finish.
- B. Clean finished surfaces, including wiping of drawers and cabinet shelves, touch up as required.
- C. Clean counter tops leaving tops free of grease and streaks. Use no wax or oils.

3.6 PROTECTION

- A. Protect against soiling and deterioration during remainder of construction period.
- B. Protect counter tops and ledges for the remainder of the construction period with ¼” corrugated cardboard or equal completely covering the top and securely taped to edges. Mark cardboard in large lettering “No Standing”.

END OF SECTION

SECTION 12 36 00 - COUNTERTOPS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Countertops.
- B. Sinks installed into countertops.

1.2 RELATED REQUIREMENTS

- A. Section 06 41 00 - Architectural Wood Casework.

1.3 REFERENCE STANDARDS

- A. ANSI Z124.3 - American National Standard for Plastic Lavatories.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- C. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards.
- D. ISSFA-2 - Classification and Standards for Solid Surfacing Material; International Solid Surface Fabricators Association.
- E. NEMA LD 3 - High-Pressure Decorative Laminates.
- F. PS 1 - Structural Plywood.

1.4 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Specimen warranty.
- C. Shop Drawings: Complete details of materials and installation.
- D. Verification Samples: For each finish product specified, minimum size 6 inches square, representing actual product, color, and patterns.
- E. Test Reports: Chemical resistance testing, showing compliance with specified requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 COUNTERTOP ASSEMBLIES

- A. Quality Standard: Premium Grade, in accordance with AWI/AWMAC/WI Architectural Woodwork Standards.

- B. Plastic Laminate Countertops: High pressure decorative laminate sheet bonded to substrate.
1. Laminate Sheet, Unless Otherwise Indicated: NEMA LD 3 Grade HGS, 0.048 inch nominal thickness.
 - a. Surface Burning Characteristics: Flame spread 25, maximum; smoke developed 450, maximum; when tested in accordance with ASTM E84.
 - b. Finish: See Finish Schedule.
 - c. Surface Color and Pattern: As scheduled.
 - d. Manufacturers:
 - 1) Formica Corporation: www.formica.com.
 - 2) Lamin-Art, Inc: www.laminart.com.
 - 3) Panolam Industries International, Inc\Nevamar: www.nevamar.com.
 - 4) Panolam Industries International, Inc\Pionite: www.pionitelaminates.com.
 - 5) Wilsonart International, Inc: www.wilsonart.com.
 - 6) Substitutions: See Section 01 60 00 - Product Requirements.
 2. Exposed Edge Treatment: As detailed.
 3. Back and End Splashes: Same material, same construction.
 4. Fabricate in accordance with AWI/AWMAC Quality Standards Illustrated Premium Grade.
- C. Solid Surfacing Countertops: Solid surfacing sheet or plastic resin casting over continuous substrate.
1. Flat Sheet Thickness: 3/4 inch, minimum.
 2. Solid Surfacing Sheet and Plastic Resin Castings: Complying with ISSFA-2 and NEMA LD 3; acrylic or polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.
 - a. Surface Burning Characteristics: Flame spread 25, maximum; smoke developed 450, maximum; when tested in accordance with ASTM E84.
 - b. Sinks and Bowls: Separate units for undercounter mounting; minimum 3/4 inch wall thickness; comply with ANSI Z124.3.
 - c. Finish on Exposed Surfaces: As scheduled.
 - d. Color and Pattern: As scheduled.
 - e. Manufacturers:
 - 1) Dupont: www.corian.com.
 - 2) Formica Corporation: www.formica.com.
 - 3) Avonite Surfaces: www.avonitesurfaces.com.
 - 4) Wilsonart International, Inc: www.wilsonart.com.
 - 5) Substitutions: See Section 01 60 00 - Product Requirements.
 3. Other Components Thickness: 1/2 inch, minimum.
 4. Exposed Edge Treatment: Built up to minimum 1-1/4 inch thick; edge profile as indicated on drawings; use marine edge at sinks.
 5. Back and End Splashes: Same sheet material, square top; minimum 4 inches high.

2.2 ACCESSORY MATERIALS

- A. Plywood for Supporting Substrate: PS 1 Exterior Grade, A-C veneer grade, minimum 5-ply; minimum total thickness 1 inch thick; join lengths using metal splines. Where substrate sheets require lamination to achieve total thickness, lamination adhesive shall be moisture-cure, waterproof polyurethane.

B. Adhesives: Chemical resistant waterproof adhesive as recommended by manufacturer of materials being joined.

C. Joint Sealant: Mildew-resistant silicone sealant, clear.

2.3 FABRICATION

A. Fabricate tops in the largest sections practicable, with top surface of joints flush.

1. Join lengths of tops using best method recommended by manufacturer.

B. Provide back/end splash wherever counter edge abuts vertical surface unless otherwise indicated.

1. Secure to countertop with concealed fasteners and with contact surfaces set in waterproof glue.

2. Height: 4 inches, unless otherwise indicated.

C. Solid Surfacing: Fabricate tops up to 144 inches long in one piece; join pieces with adhesive sealant in accordance with manufacturer's recommendations and instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

C. Verify that wall surfaces have been finished and mechanical and electrical services and outlets are installed in proper locations.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

A. Securely attach countertops using concealed fasteners. Make flat surfaces level; shim where required.

B. Attach plastic laminate countertops using screws with minimum penetration into substrate board of 5/8 inch.

C. Seal joint between back/end splashes and vertical surfaces.

3.4 CLEANING

A. Clean countertops surfaces thoroughly.

3.5 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 210500 – FIRE PROTECTION

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 requirement shall govern.

1.2 GENERAL DESCRIPTION

- A. Provide all materials, equipment, and labor, including all required drilling for the design and installation and modification of new and existing supervised automatic sprinkler system(s) for the University of South Carolina Discovery Building.
- B. The sprinkler system(s) shall be supplied from the existing automatic fire pump and served from existing sprinkler zone assemblies. Any new waterflow switches and valve tampers shall be furnished and installed under this contract.
- C. The piping for each system shall be sized in accordance with hydraulic calculations to comply with the hydraulic requirements found in NFPA Standard 13-2010 and the Owner's Insurance Underwriter Standards.
- D. All core drilling of floors and walls shall be included under this contract. All electrical work related to this contract shall be provided under Division 26, Electrical.
- E. Secure all required approvals and inspections from City of Columbia, Richland County and the State of South Carolina.
- F. Submit all required drawings and calculations.
- G. All work must be performed in accordance with these specifications and other related documents.
- H. Contractors shall be solely responsible for design and installation of the system(s) in accordance with the specifications.

1.3 INTENT OF SPECIFICATIONS

- A. The work performed shall be complete in every respect. Each system that has been installed or modified shall be complete in accordance with the applicable codes, standards, University's Insurance Underwriter requirements, manufacturer's

recommendations and Underwriters Laboratories, Inc. (UL) listings.

- B. Upon completion of this work, the Owner shall be provided with the following:
1. Complete information and record drawings describing and depicting all systems as installed, including all information necessary for maintaining, troubleshooting, and expanding the systems.
 2. Complete documentation of system testing.
 3. Certify that each system installed or modified has been inspected and tested, has been installed or modified entirely in accordance with the applicable code, standards, Manufacturer's recommendations and UL listings, and is in proper working order. Contractor shall use "Contractor's Material and Test Certificates for Aboveground Piping and Underground Piping".

1.4 SCOPE

- A. The requirements of Division 23, Sections "Mechanical and Electrical General Provisions" and "Basic Materials and Methods" shall apply to work specified under this section.
- B. The area of work shall be fully sprinklered throughout in accordance with NFPA Standard 13-2010. Provide new automatic sprinkler protection in accordance with NFPA Standard 13-2010, except as made more stringent herein.
- C. Provide sprinkler system supervisory switches and waterflow indicators as required. All electrical work related shall be provided under Division 26, ELECTRICAL.
- D. Provide all required drains and inspector test connections, connected and ready to use.
- E. Prepare and submit shop drawings, record drawings, and other submittals required herein.
- F. Flush and test the sprinkler and standpipe systems.
- G. Warrant all new equipment, systems, and modifications during installation for a one (1) year period after final acceptance of the work by the Architect.
- H. Provide all required drilling for sprinkler, standpipe and water supply piping.
- I. 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.
- J. Sprinkler heads shall be provided as required by NFPA Standards. Sprinkler head locations shall be coordinated with the Architectural reflected ceiling plans. Sprinkler shop drawings shall indicate the ceiling grid, lighting fixtures, air devices, etc. Sprinkler heads shall be centered in tiles, plus or minus two (2) inches from tile centerlines.

- K. 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.
- L. All requirements of the State of South Carolina, the State Fire Marshal's Office, and the City of Columbia Fire Prevention Bureau shall apply to this specification. Provide systems according to NFPA 13-2010.
- M. The sprinkler contractor shall provide all required construction coordination as specified in Division 23, Section "Mechanical and Electrical General Provisions". 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. Provide and install all piping as required by NFPA Standards and approved plans in accordance with all applicable standards. Piping installation and hangers shall be in accordance with Division 23, Section "Basic Materials and Methods", unless specified otherwise in this Section.
- B. Electrical power supply to the system control panel(s), interlock wiring and conduit for shutdown of HVAC, dampers and/or electric power supplies, relays or shunt trip breakers, and connection to local/remote fire alarm systems, listed central alarm station(s) or sprinkler preaction/deluge valve actuation shall be provided under other sections of this specification.

1.6 WORKING CONDITIONS

- A. The Contractor shall be responsible for attending a pre-construction meeting and construction coordination meetings with the Owner and Architect.

1.7 CODES, STANDARDS, ORDINANCES, AND PERMITS

- A. All work shall conform to the requirements of the applicable portions of the latest editions of the National Fire Protection Association (NFPA) Standards and Recommended Practices listed herein:
 - 1. NFPA 13: Standard for the Installation of Sprinkler Systems, 2010 Edition
 - 2. NFPA 25: Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems, 2008 Edition
 - 3. NFPA 70: National Electrical Code®, 2008 Edition
 - 4. NFPA 72: National Fire Alarm and Signaling Code, 2010 Edition
 - 5. NFPA 101: Life Safety Code®, 2009 Edition.
 - 6. The Fire Protection Sprinkler Systems Act. SC 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 including the current editions of the International Building and Fire Prevention Codes, and the International Building Code, as modified or interpreted by the State of South Carolina to permit use of current NFPA Standards.
- C. All designs, work, and materials shall conform to the Owner's Insurance Underwriter guidelines and standards.
- D. If there is a conflict between the referenced NFPA Standards, Federal, State or local codes, Insurance Underwriter requirements, and this specification, it shall be the Contractor's responsibility to bring the conflict to the attention of the Architect for resolution.
- E. All devices, systems, equipment, and materials furnished and installed shall be of types or models approved by City of Columbia, Richland County, the State of South Carolina and Underwriters Laboratories for use in systems and occupancies of this type.

1.8 QUALIFICATIONS OF CONTRACTOR

- A. The Contractor shall hold all licenses and obtain all permits necessary to perform work of this type.
- B. The Contractor shall be regularly engaged in the design, installation, testing, and servicing of automatic sprinkler systems.
- C. 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. The Owner and Architect or their representative(s) will review all submittals for conformance to these specifications.
 - 2. If the Contractor's submittals, upon review by the Owner or Architect do not conform to the requirements of these specifications, the Contractor shall be required to resubmit with modifications, within seven (7) working days of receipt of the Architect's notification to the Contractor.
 - 3. If the Contractor's submittals conform to the requirements of these specifications, the Engineer of Record will issue a Certificate of Compliance. Subsequently, the Fire Sprinkler System Specification Sheet and Certificate of Compliance will accompany the shop drawing submittal to the State Fire Marshal for review and approval.
- B. Hydraulic Calculations
 - 1. The contractor shall submit hydraulic calculations based on the information

provided on the Fire Sprinkler Specification Sheet (FSSS).

C. Shop Drawings:

1. The Contractor shall submit sufficient quantity of AutoCAD prepared shop drawings, catalog cuts, and hydraulic calculations to the Architect for approval. 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. Plans showing sprinkler work shall be not less than 1/8 inch per foot.
 - a. The AutoCAD prepared shop drawings shall be consistent and compatible with AutoCAD format being used by the Architect.
 - b. Shop drawings shall show all of the information required by NFPA Standard 13-2010 for working plans and shall include drawings showing the location of all equipment, controls, piping, valves, and drains.
 - c. Shop drawings shall show locations of pipe supports, seismic braces and end-of-line pipe restraints in plan view. Shop drawings shall also detail pipe supports, seismic braces and end-of-line restraints.
 - d. The shop drawings shall indicate all areas to be sprinklered and type of hazard, locations and sizes of water supply pipe, major drains and tests, alarm check valve and water motor 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.
 - e. Shop drawings shall be provided in sufficient detail to show compliance with the Standards referenced on the Fire Sprinkler System Specification Sheet (FSSSS) to the degree required by the regulations of the State Fire Marshal.
 - f. Provide all electrical wiring diagrams of flow switches, alarms, and supervising equipment for coordination under Division 26, ELECTRICAL. All wiring shall be provided under Division 26, ELECTRICAL.

D. Samples:

1. Submit to Architect one sample of each type of sprinkler head to be provided. Samples shall be retained by the Engineer.

E. Operation and Maintenance Manual

1. Refer to Division 23, Section "Mechanical and Electrical General Provisions" for additional requirements of operation and maintenance manuals. The Contractor shall provide the Architect with a loose-leaf manual containing the following data:
 - a. A detailed description of the new sprinkler system(s).
 - 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.

2. Within thirty (30) days of the completion of the work, six (6) copies of the approved manual with as-built drawings and a copy of NFPA-25 shall be delivered to the Owner.

F. 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, one set of black line record drawings shall be submitted to the Architect for review and approval.
4. Upon approval of the black line record drawings, four (4) additional sets of black line record drawings and one set of unprotected AutoCAD 2006 disks shall be delivered to the Owner.

G. Drawing Approval by Code Authority:

1. The Contractor's shop drawings are subject to approval by the Authority Having Jurisdiction (AHJ).

1.10 WARRANTY PERIOD

- A. The Contractor shall provide a one (1) year warranty for all materials and workmanship beginning with the date of substantial completion. The Contractor shall be responsible during the design, installation, testing, and warranty 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 four (4) hours to familiarize the building personnel with the features, operation, and maintenance of the sprinkler systems. Training sessions shall be scheduled by the Architect at a time mutually agreeable to the Contractor and the Owner.
- 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 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 Authority Having Jurisdiction (AHJ).
 - 2. Required submittals, system operation and maintenance manuals, record drawings, spare parts, special tools, and training have been provided to, reviewed, and accepted by the Owner and Architect.

PART 2 - PRODUCTS

2.1 DESIGN CRITERIA

- A. Hydraulically calculated wet-pipe sprinkler systems shall be installed, designed to produce uniform discharge over the design area, and shall conform to the hydraulic requirements of NFPA Standard 13-2010, the FSSSS and to the requirements as specified herein.
 - 1. The design calculations shall include an allowance for hose streams and a ten (10) pound per square inch safety factor for future water supply deterioration.
- B. Contractor shall follow the hydraulic design criteria contained in the NFPA Standard 13-2010 as interpreted by the State of South Carolina and the Owner's Insurance Underwriter and as shown on the FSSSS.
- C. Contractor shall furnish and install hydraulic calculation signs for each sprinkler zone.
 - 1. Signs shall include all information indicated in Appendix A, NFPA Standard 13-2010.
 - 2. Signs shall be rigid, flat steel or aluminum plaques with embossed enamel background and lettering.
 - 3. Signs shall be secured by chain or durable wire to each sprinkler zone control valve.

2.2 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.

- C. Unless specified otherwise, the standard manufactured products of Grinnell, Viking, Reliable or equal shall be provided. Equipment and installation shall comply with NFPA Standards 13-2010.

2.3 PIPING

- A. Fire protection system piping shall meet the requirements of NFPA Standard 13-2010 and the following:
1. Schedule 40 black steel pipe meeting ASTM A-795 requirements with the following:
 - a. Black cast-iron screwed fittings 125 pound steam, 175 pound water ANSI B16.4 and threaded joints conforming to ANSI B1.20.1.
 - b. Mechanical grooved pipe couplings and fittings for roll or cut pipe sizes 2-1/2 inches and larger.
 - c. Plain-end pipe coupling and fittings for pipe sizes one (1) inch through two (2) inches.
 2. Pressure ratings of all fittings shall meet or exceed maximum working pressures available within the system.
 3. If piping systems utilizing mechanical couplings are used, all coupling and pipe fittings such as elbows, tees, reducers, etc. (not including valves and specialties) shall be provided by one manufacturer and shall be part of a UL/FM approved assembly.
- B. Flexible Sprinkler Hose Fittings
1. Manufacturer: FlexHead Industries, Inc. or equal
 2. Description: Flexible Sprinkler Hose Fittings for use in commercial suspended ceilings and sheetrock ceilings.
 3. Regulatory Requirements: In accordance with NFPA 13-2010.
 4. Product Performance Criteria:
 - a. FM Approved for its intended use pursuant to FM 1637 Approval Standard for Flexible Sprinkler Hose with Threaded End Fittings.
 - b. UL Listed for its intended use pursuant to UL 2443 Standard for Flexible Sprinkler Hose with Fittings for Fire Protection Service.
 - c. Seismically qualified for use pursuant to ICC-ES AC-156 Acceptance Criteria for Seismic Qualification by Shake-Table Testing of Nonstructural Components and Systems.
 5. FlexHead Flexible Hose Assemblies and End Fittings:
 - a. 100% Type 304 Stainless Steel.
 - b. Straight Hose Assembly Lengths: 2ft length, Model #2024, 175 psi maximum rated pressure. Fully welded non-mechanical fittings, braided, leak-tested with minimum 1-inch true-bore internal corrugated hose diameter.
 - c. Elbow Hose Assembly Lengths (For use in confined spaces): 2ft length, Model #2024E, 175 psi maximum rated pressure. Fully welded non-mechanical fittings, braided, leak-tested with minimum 1-inch true-bore internal corrugated hose diameter.
 6. FlexHead Ceiling Bracket:

- a. Type G90 Galvanized Steel.
- b. Direct attachment type, having integrated snap-on clip ends positively attached to the ceiling using tamper-resistant screws.
- c. Flexible Hose Attachment: Removable hub type with set screw.

C. UL Listed Flexible Expansion Loop

1. All fire protection pipe passing through or crossing building seismic or expansion joints shall contain a UL listed flexible expansion loop, designed for seismic movement. Flexible loops shall impart no thrust loads to building structure.
2. Loops shall be located at, or near, the building seismic or expansion joint. Seismic bracing shall not pass through building seismic joint and shall not connect or tie together different sides or parts of building structure. Flexible loops shall be capable of movement in the $\pm X$, $\pm Y$, $\pm Z$ planes. Movement requirements and location, relative to seismic separation, shall be determined by system design engineer. Flexible loops may be installed to accommodate thermal expansion, seismic movement, and building settlement. Unless specified otherwise by system design engineer or governing codes, all flexible loop connections to sprinkler piping shall be installed, inspected, and tested in accordance with NFPA 13-2010 standards.
3. Flexible loops shall consist of two flexible sections of hose and braid, two 90 degree elbows, and 180 degree return. Loops shall include a factory supplied, center support nut located at the bottom of the 180 degree return, and a drain/air release plug. Materials of construction and end fitting type shall be consistent with pipe material and equipment/pipe connection fittings.
4. Flexible expansion/seismic loops shall be equal to Metraloop Fireloop as manufactured by Metraflex Company or equal.

2.4 CONTROL AND DRAIN VALVES

A. Fire Protection system control valves shall be the following types:

1. Gate Valves 2-1/2 inch and over shall be UL listed 175 pounds per square inch (psi) water working pressure (WWP), OS&Y with cast iron body and flanged end equal to Stockham Fig. No. G-634.
2. 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.
3. Check Valves 2-1/2 inch and over shall be UL listed, 175 pounds per square inch (psi) water working pressure (WWP), swing check with cast iron body and flanged end equal to Stockham Fig. G-939. For vertical installations, provide UL listed wafer check valve, 175 psi WWP equal to Grinnell.
4. Butterfly valves with integral valve supervisory switches, whose entire assembly is approved for use in sprinkler systems for pipe sizes 1-1/2 inch and smaller.
5. Ball drips shall be Elkhart Fig. No. 702.

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. Valve marking shall correspond to campus wide valve marking procedure.
- E. Pressure ratings of all valves shall meet or exceed maximum working pressures available within the system.
- F. Provide inspector's test and drain assemblies.
- G. Provide check valve in accordance with NFPA Standard 13-2010.

2.5 AUTOMATIC SPRINKLERS

- A. Sprinklers shall be listed by Underwriters 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. Sprinklers shall be provided and installed in accordance with NFPA Standard 13-2010 and properly coordinated with other work including duct and electric fixture installation. The correct type of sprinkler head shall be used in every location.
- B. The correct temperature rating of every sprinkler head shall be used according to the maximum ceiling temperature rating and requirements in NFPA Standard 13-2010. All sprinklers with the exception of specified decorative types and bulb type sprinklers shall have their frame arms colored at the factory in accordance with the standard table in NFPA Standard 13-2010. High temperature heads shall be used where required by NFPA Standard 13-2010 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 equal). Sprinklers under open gratings shall be provided with approved shields.
- D. Automatic sprinklers shall be of the following types:
 - 1. Quick Response sidewall, semi-recessed pendent or concealed sprinklers shall be installed in all areas, including offices, conference rooms, classrooms, corridors, storage rooms, and other technically appropriate areas. Sprinkler heads in gypsum, plaster and wood ceilings shall be concealed type. Sprinkler heads in acoustical ceiling tile shall be semi-recessed pendent type. Quick Response sprinklers shall be ordinary temperature rated. All sprinklers in these areas shall be Quick Response which will permit removal and replacement of ceiling without cutting tiles.
 - 2. Standard upright or pendent sprinklers shall be installed in areas not provided with Quick Response Sprinklers.
 - 3. Architect will select finish for all automatic sprinklers from samples of available finishes supplied by Contractor from the manufacturer.
 - 4. All sprinklers within a space shall be from the same manufacturer and have the

same heat response element, including temperature rating and response characteristics.

5. It shall be the Contractor's responsibility to install all sprinklers securely and in a manner acceptable to the Owner and Architect.

2.6 SUPERVISORY AND ALARM EQUIPMENT

- A. Vane-type waterflow indicators with adjustable pneumatic retard (0-90 seconds) shall be used to indicate waterflow in each sprinkler system zone.
- B. Valve supervisory switches (riser control valves) shall be provided for all new valves controlling the water supply to the sprinkler system(s) and standpipes.
- 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 26, ELECTRICAL. 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 IBC 2009 Section 903.4 and 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.

2.7 HANGERS

- A. Provide hangers from the building structure in strict accordance with NFPA Standard 13-2010. Provide seismic bracing and supports for all fire protection piping to comply with NFPA Standard 13-2010. Submittal shall detail seismic bracing and pipe supports and show locations of each. All pipe supports and seismic bracing shall be of UL listed components. Engineered pipe supports will only be allowed if shop drawings containing calculations according to NFPA Standard 13-2010 (9.1.1.4) are approved by the AHJ prior to the start of installation.

2.8 FLOW SWITCHES

- A. Approved water flow switches (Potter Model VSR, VS-SP, or equal) shall be installed where indicated. Conductors shall be provided under Division 26, ELECTRICAL to provide fire alarm and 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 INSPECTION

- A. The contractor shall examine daily all areas in which the work will be performed. The Contractor shall immediately report unsatisfactory working conditions to the Architect for resolution. The Contractor shall not proceed with work until all unsatisfactory working conditions have been resolved.

3.2 INSTALLATION

A. General:

1. The Contractor shall thoroughly review with the Architect pipe routing, sprinkler location, and method of installation. Any facet of sprinkler installation that does not meet with the Owner's approval shall be revised by the Contractor to the Owner's satisfaction at no expense to the Owner.
2. Due to the need to maximize area availability, each zone may be constructed in phases requiring multiple hydrostatic tests, set-up, clean-up, etc.
3. All holes made by the Contractor in any new 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 sections and 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 23, Section "Mechanical and Electrical General Provisions". 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. Install all pipe, fittings, valves, controls, and hangers as indicated and required in accordance with NFPA Standard 13-2010.
2. Piping installed under this Section shall be coordinated with that of all other Sections and trades so that all work may be installed in the most direct and workmanlike manner and so that interference between piping, ducts, equipment, electrical, architectural and structural features will be avoided.
3. 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.
4. Drains and test piping shall be furnished and installed so that all parts of the system may be drained and tested properly. Low point drains shall be clearly marked and piped to the exterior of the building. A sign be provided in the existing

fire pump room of the number and location of the low point drains.

5. All risers including the alarm check valve shall be equipped with drains with sizes as specified in NFPA Standard 13-2010. The alarm check valve drain ("main drain") shall be piped to the outside of the building at a point free from causing water damage.
6. An alarm test connection not less than 1 in. in diameter, terminating in a smooth bore corrosion resistant orifice, giving a flow equal to or less than one sprinkler of a type having the smallest orifice installed on the particular system, shall be provided to test each waterflow alarm device for each system. The discharge should be at a point where it can be readily observed. Obtain Architect's approval for each discharge location.
7. 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.
8. All sprinkler piping installed in areas with suspended ceiling shall be concealed in the walls and ceilings.
9. All exposed pipe which passes through a wall, ceiling, or floor shall be provided with escutcheon plates.
10. 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.
11. Pipe which passes through fire-resistive barriers (including shaft walls and stairways) shall be sleeved and grouted to maintain the structural integrity and rating of the fire-resistive barriers.

C. System Drains:

1. Discharge from inspector's test pipe and system drains shall be extended and terminated outside with a Zurn Z199-DC-VP or approved equal downspout cover, or with an indirect connection over an open drain. Discharge locations shall be approved by the Architect.
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.
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 pipe hangers and supports for fire protection piping as hereinbefore

specified in Division 23, Section “Mechanical and Electrical General Provisions” and in no case less than the requirements of NFPA Standard 13-2010.

2. All sprinkler piping shall be substantially supported from the building structure which must support the total load of the water filled pipe plus a minimum of 250 pounds applied at the point of hanging in accordance with NFPA Standard 13-2010. All hanging apparatus and equipment shall be of an approved type installed in accordance with NFPA Standard 13-2010.
3. All flexible couplings shall be designed and installed as required by NFPA Standard 13-2010 (including all appendices). Flexibility, internal pressure, and differential movement between the piping and building, earth, or other supporting structure(s) shall be allowed for, so that no allowable stress is exceeded in any member.
4. All sway bracing shall be designed and installed as required by NFPA Standard 13-2010. Sprinkler contractor shall provide two-way, four-way, lateral, longitudinal, etc. bracing for seismic protection.

3.3 IDENTIFICATION

- A. Identification signs similar to or the same as those recommended in NFPA Standard 13-2010 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 of all sign locations in finished spaces.
- C. A fire sprinkler valve drawing shall be provided to identify the locations, details of arrangements and function of all system valves, including control, drain, test, inspection valves. One (1) copy of the drawing shall be mounted and framed under plastic protection in the fire pump room (location per Architect).

3.4 INSTALLATION, ACCEPTANCES, AND TEST

- A. Installation, tests, and acceptance shall be in accordance with all applicable codes and authorities having jurisdiction.
- B. Installation shall be in accordance with all applicable codes, including the Occupational Safety and Health 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 Architect for final inspection and witnessing of the final acceptance test. The Architect 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 Architect may require retesting at no cost to the Owner.
- E. All tests and inspections required by the referenced Codes and Standards, the Owner, AHJ, and the Architect shall be performed by the Contractor.
 - 1. When local code authorities or third parties are required to witness tests, the contractor shall be responsible for making all necessary arrangements with the code authorities and coordinating the work with the Architect.
 - 2. The Contractor shall be responsible for obtaining all test documents with necessary approval stamps and signatures for the code authorities. The Contractor shall submit one copy of the “Contractors Material and Test Certificates for Aboveground Piping” with all information filled out and original signatures.
- 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 reinspection 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 low point of the system. The hydrostatic test shall be for the entire system as installed and specified.
 - 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. The following materials shall be furnished by the Contractor at the conclusion of the final acceptance test:
 - 1. Operating and maintenance instructions.
 - 2. The spare sprinklers hereinbefore specified.
 - 3. Any and all special tools noted by the manufacturer required for the fire protection items furnished.
- I. 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. Storage:

1. The General Contractor will provide the Contractor with a storage space for the Contractor's use during this project. The Contractor will be responsible for the security of this space.
2. The material storage area may be used for pipe cutting and threading, and component assembly.
3. Overnight storage of material shall be limited to the assigned storage area. Materials brought to the work area shall be installed the same day, or returned to the assigned storage area unless otherwise previously approved by the General Contractor.

B. Receiving and Handling:

1. The Contractor shall be responsible for all receiving, handling, and storage of his materials at the job site.
2. Use of loading docks, service driveways shall be coordinated with the Owner.

C. Rubbish Removal:

1. Contractor shall remove rubbish and debris resulting from his work on a daily basis. Rubbish not removed by the Contractor will be removed by the General Contractor and back-charge to the Contractor.
2. Removal of debris from the premises shall be coordinated with the General Contractor.

3.6 WELDING AND FLAME CUTTING

- #### A.
- Welding or flame cutting by the Contractor shall be permitted on the premises in accordance with NFPA 13-2010, 6.5.2.

3.7 EXISTING FIRE PUMP FLOW TEST DATA

- #### A.
- Refer to Fire Sprinkler System Specification Sheet.

END OF SECTION


Project Data

Project name: USC Discovery One Biomedical Research Building Upfit		
Location in South Carolina:	Address (street # & street name): 915 Greene Street, 29201	State project: <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
	City: Columbia	County: Richland
		State project #: H27-6080-LC-A

Water Supply Information
(flow test data must be less than 1 year old per §40-10-250(A)(1))

Date test conducted: 09/14/2012	Static pressure (psi):	Residual pressure (psi):	Flow (gpm):
Distances of test gauges relative to the base of the riser:		Horizontal (ft):	Vertical (elevation difference in ft):
Source of water supply:	<input type="checkbox"/> Municipal dead-end <input type="checkbox"/> Municipal circulation <input type="checkbox"/> Other:		Pipe Size (in.):
Test data by/from:	Name: Robert A. Davis		Title:
	Organization: Palmetto Automatic Sprinkler Co., Inc.		Telephone #: 803 794 1602
Fire pump:	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	Pump Capacity (gpm): 750	Churn Pressure (psi): Net 87 as tested
	<input type="checkbox"/> New <input checked="" type="checkbox"/> Existing	Rated Pressure (psi): 75	Pressure @ 150% flow (psi): Net 60 as tested
On-site storage tank:	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> New <input type="checkbox"/> Existing	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 Hazard	Offices, Corridors, Vestibule, Break Room, Conference, Reception, Restrooms, Stairs, Bull Pen, Work Rooms, Computer Lab, ASPH
2	Ordinary Group 1	Electrical, Mechanical, Data, Elevator, Elevator Equip, Custodial, Janitor, IT, Server, Storage, Soiled Work Area, Clean Work Area, Sterilization, Lab Space, Testing, Procedure, IC

Design Parameters
(attach continuation page when necessary)

Area #	System Type	Density (gpm/ft ²) / Area (ft ²) or Other (reference code section)	Inside Hose (gpm)	Outside Hose (gpm)
1	Automatic Wet	0.10 / 1500	100	0
2	Automatic Wet	0.15 / 1500	100	150

Seismic Design Data: S_s=0.552g

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**
 NFPA-13(2010), ICC IBC(2009), ICC IFC(2009)

Scope of work (such as sprinkler system A.G. from 1'-0" A.F.F., U.G. from tap to 5'-0" outside, etc.) and notes (attach continuation page when necessary):
 Renovations to existing automatic wet fire sprinkler system; Partial First Floor, Upfit shell space entire Third, Fourth and Fifth Floors.

Specifier's Information

Name: Todd E. Smith, P.E.		
Engineering services provided through a firm: <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No		
Firm name: RMF Engineering, Inc.		
Address: 194 Seven Farms Drive, Suite G		
City: Charleston		
State: South Carolina Zip: 29492		
Phone #: 843 971 9639 Fax #: 843 971 9641		
E-mail: todd.smith@rmf.com		

SECTION 220500 - PLUMBING

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 the storm, soil, waste, drain, vent and domestic water systems from their source of supply or point of disposal to and including their connection to equipment and fixtures.
- B. The requirements of Division 23, Sections “Mechanical and Electrical General Provisions” shall apply to all work specified under this section. Sterilization shall comply with Section 610 of the 2009 International Plumbing Code.
- C. Vents through roof shall be installed by plumbing contractor. Roofing contractor(s) shall be responsible for flashing all roof penetrations thru roof systems to maintain warranties.

1.3 CODES

- A. All plumbing work shall comply with the 2009 International Plumbing Code and the regulations of the South Carolina Department of Health and Environmental Control (DHEC), and the State of South Carolina. Obtain all approvals before starting plumbing work. Request all inspections during the course of work.
- B. Installation shall meet the regulations contained in the Safe Drinking Water Act (SDWA) concerning lead and copper concentrations.
- C. All residential type faucets, electric water coolers and drinking fountains shall meet the requirements of NSF Standard 61, Section 9.

1.4 EQUIPMENT CONNECTIONS

- A. Provide all plumbing connections required by equipment which is provided on this project. Certain items of equipment 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 equipment is in place.

PART 2 - PRODUCTS

2.1 PIPE, VALVES AND FITTINGS

- A. Provide materials as hereinbefore specified in Division 23, Section "Basic Materials and Methods". All floor, wall and ceiling penetrations for piping shall be sealed with appropriate sealant.
- B. Unions or flanges shall be provided at all connections to each piece of plumbing equipment and on both sides of valves and other in-line devices that require removal for maintenance. Bronze adaptors shall be used at all copper to flanged or IPS connections.

2.2 CLEANOUTS

- A. Cleanouts shall be placed in piping throughout the building, where noted and where required by code and at not greater than seventy five (75) foot intervals. Cleanouts on piping below floors, at ends of runs and changes of direction of piping shall consist of Y branches, the full size of pipes to which they are connected with cleanout plugs and covers as listed below or as detailed. Extend cleanouts on concealed piping to finished walls, floors and grade. Cleanouts shall be Josam, Zurn or J.R. Smith equal to Josam numbers indicated below.
- B. In concrete floors on grade (generally) - Series 55000-1-SQ cleanout with scoriated square satin nikaloy top, bronze cleanout plug with gasket seal, and adjustable frame.
- C. At base of vertical piping and in walls - Series 58910-Z cleanout tee with countersunk bronze threaded plug. Where risers are concealed, provide Series 58760 cleanout tee with plug and nickel satin access cover and frame.
- D. Cleanouts on exposed and above ceiling horizontal piping shall be Series 58900 with bronze threaded plug.
- E. Cleanouts in waterproofed equipment rooms - Series 58460A with bronze plug.
- F. Provide cleanouts in each exposed P-trap not integral with the fixture.
- G. Clean-outs shall be the same nominal size of the pipe for sizes 4" and smaller and 4" nominal size for larger pipe.

2.3 DRAINS

- A. Drains installed where water-proofing membranes exist shall have a flashing clamp device.

1. Provide drains where indicated. Drains shall be Josam, Jay R. Smith or Zurn equal to below:

Floor Drain (FD-1 – Finished Floor)	Josam 30000-A-ARE with Josam 88450-ARE-50 no-hub spigot adapter for trap primer connection.
Floor Drain (FD-2 – Ice maker)	Josam 3000-E1-ARE with Josam 88450-ARE-50 no-hub spigot adapter for trap primer connection.
Floor Drain (FD-3 – Mechanical Room)	Josam 32100 with trap guard equal to ProSet TG34-IP
Floor Sinks (FS-1 – Stainless Steel)	Zurn Z1751-IP-2 with Zurn Z1023 trap primer connection adaptor, threaded x no-hub.
Floor Sinks (FS-2 – Stainless Steel)	Zurn Z1751-P-2

2.4 PLUMBING FIXTURES

- A. Provide all plumbing fixtures indicated on the drawings and as specified herein. All exposed metal parts of all fixtures, including all trim and fittings, shall be brass, chromium plated. Each hot and cold water connection to each fixture shall be provided with a stop valve and all nipples shall be chrome plated red brass. Provide backflow devices on all faucets and fittings requiring same. Devices may be inline type when not provided integral with the faucet. All faucet handles, where possible, shall have color coded "indexes" identifying the service used. All "serrated" or slip hose connection spout outlets shall have Allen wrench operated volume controls to control "splashing" of water as it hits sink bottoms. Waste line for handicapped lavatories and sinks shall be offset.
- B. The Contractor shall provide metal supports necessary to adequately and substantially hang and set all fixtures subject to the approval of the Architect. No wood grounds, wood plugs, or expansion bolts shall be permitted for fixture support. Provide carriers where specified below and as required to hang fixtures.
- C. Insulate all exposed piping under lavatories and sinks with a white, fitted/molded antimicrobial undersink pipe cover equal to Truebro Lav Guard 2. Cover shall have internal, E-Z Tear-To-Fit trim feature for square, clean trimming (internal ribs) and built-in, concealed E-Z Grip fasteners (no cable-tie fasteners allowed).
- D. Acceptable Manufacturers
 1. Fixture shall be American Standard, Crane or Kohler, equal to American Standard or other manufacturer of the types listed below.

2. Flush valves shall be Zurn, Sloan, Delany or Cambridge Brass, equal to Sloan of the types listed below.
3. Faucets shall be Sloan, Kohler, Chicago Faucet, T & S Brass, Crane, Eljer or American Standard equal to Sloan of the types listed below.
4. Drinking fountains shall be Elkay, Oasis or Halsey Taylor equal to Elkay of the types listed below.
5. Toilet seats shall be Bemis (Church), Beneke, Sperzel equal to Church of the types listed below.

E. Fixtures:

1. P-1 Lab Sink:

Fixture: Refer to Laboratory Equipment drawings.
Faucet: Refer to Laboratory Equipment drawings.
Strainer: Refer to Laboratory Equipment drawings.
Trap: Enfield No. W1021 p-trap
Supplies and Stops: Chicago Faucet No. 1006
Remarks: Acid resistant drain pipe and fittings. Contractor shall verify and coordinate rough-in locations.

2. P-2 Lab Sink:

Fixture: Refer to Laboratory Equipment drawings.
Faucet: Refer to Laboratory Equipment drawings.
Strainer: Refer to Laboratory Equipment drawings.
Trap: Enfield No. W1021 p-trap
Supplies and Stops: Chicago Faucet No. 1006
Remarks: Acid resistant drain pipe and fittings. Contractor shall verify and coordinate rough-in locations.

3. P-3 Break Room Sink:

Fixture: Elkay DLR 221910, 18 gauge Type 304 (18-8) nickel bearing stainless steel, drain punch #35 centered, (4) faucet holes on 4" centers (coordinate with faucet).

- Faucet: Elkay LK231BH5, concealed mount mixing faucet with retractable spray and hose, 9-1/2" cast swing spout, self cleaning aerator.
- Strainer: McGuire 151 heavy duty forged brass basket strainer with a polished and chrome plated brass strainer body, 1 1/2" x 4" seamless brass tailpiece, cast brass lock and coupling nuts.
- Trap: McGuire 8912 1 1/2" x 1 1/2" cast brass chrome plated P-trap with cleanout with 17 gauge tubular wall bend, cast brass slip nuts. Trap shall be in compliance with CSA and bear both manufacturer and testing mark.
- Supplies and Stops: Chicago Faucet No. 1006
- Remarks: Countertop mounted. Contractor shall verify and coordinate rough-in locations.

4. P-4 Hand Wash Sink:

- Fixture: Elkay CHS1716C Type 304 (18-8) stainless steel hand wash-up sink. 1-3/4" radius coved basin corners, full length 7" high backsplash, brushed finish on exposed surfaces.
- Faucet: Elkay LK940GN05T4H two hole dual handle wall mounted faucet, solid brass construction, quarter turn ceramic disc cartridge, 2.2 GPM VR aerator with 1.5 and .5 GPM inserts
- Strainer: Elkay LK8 chrome plated stamped brass perforated strainer grid with 1 1/2" x 4" tailpiece.
- Trap: McGuire 8912 1 1/2" x 1 1/2" cast brass chrome plated P-trap with cleanout with 17 gauge tubular wall bend, cast brass slip nuts. Trap shall be in compliance with CSA and bear both manufacturer and testing mark.
- Supplies and Stops: Chicago Faucet No. 1006
- Remarks: Wall mounted. Furnish with wall brackets and integral stainless steel support brackets. Contractor shall verify and coordinate rough-in locations.

5. P-5 Combination Hose Station:

- Fixture: Strahman M-750TG wall mounted stainless steel mixing units hose station, equipped with globe valves, a blending chamber

and quick acting dial-type dual Fahrenheit and Centigrade temperature gauge.

Remarks: Wall mounted. Provide with 50' of "S" hose assembly, 5/8" high pressure neoprene premium wrapped homoflex hot water hose with 3/4" male NPT fitting on one end and swivel connector on the nozzle end. Provide S-70 series black nozzle and HR-100 wall mounted stainless steel hose rack. Contractor shall verify and coordinate rough-in locations.

6. P-6 Combination Hose Bibb:

Fixture: Chicago Faucet No. 305-XKRCF, 3/4" male hose thread outlet with metal lever handles, rough chrome finish.

Remarks: Wall mounted. Contractor shall verify and coordinate rough-in locations.

7. P-7 Refrigerator Ice Maker Connection:

Fixture: IPS Guy Gray Model MIB1HA ice maker outlet box

Remarks: 20 gauge box and 20 gauge faceplate, white powder coat on cold rolled steel finish, 1/4 turn ball valve with 1/2" sweat connection and hammer arrester. Provide plumbing connections in accordance with manufacturer's written instructions.

8. P-8 Emergency Shower Unit:

Fixture: Water Saver Faucet Co. ESBF672-FC20 recessed emergency shower with wall mounted 10" stainless steel shower head with horizontal supply pipe and wall escutcheon, 1" IPS brass stay-open ball valve with stainless steel "panic bar", stainless steel access panel and 1" IPS unions for valve. Regulates shower flow rate to 20 GPM. Provide AP280-230 electric light and alarm horn unit recessed in finished wall. Light shall be illuminated and horn sounds when shower is activated.

Remarks: Exposed pipe and escutcheon shall be brushed stainless steel (ESBF672). Emergency fixture shall be in compliance with ANSI Z358.1-2009. Installation shall meet the American with Disabilities Act guidelines and ANSI A117.1 Accessible and Usable Buildings and Facilities.

9. P-9 Emergency Eyewash:

Fixture: Refer to Laboratory Equipment drawings.

Remarks: Emergency fixture shall be in compliance with ANSI Z358.1-2009. Installation shall meet the American with Disabilities Act guidelines and ANSI A117.1 Accessible and Usable Buildings and Facilities.

2.5 SPECIALTIES

A. Trap Primer:

1. Trap primer system shall be provided where indicated on the plans and shall consist of Precision Plumbing Products Model No. PTS. System shall consist of ¾" inch NPT female inlet, ½" inch compression fitting outlets, circuit Breaker, manual over ride switch/test button, timer, UL listed solenoid valve, anti-siphon atmospheric vacuum breaker. Electric timer shall be arranged for one (1) five second operation every twenty-four (24) hours. The entire system shall be packaged and mounted in a common, locking control panel with ¾" Type "L" copper tubing manifold with the total number of discharge lines and balancing cocks as indicated on the drawings. Extend 3/8 inch water line to floor drains in all locations except for toilet rooms. System shall utilize 120 volt power source provided under Division 26.

B. Thermostatic mixing valves for emergency fixtures shall be Bradley, Leonard or Lawler equal to Bradley models below. Valve shall have positive shut off on hot and cold supply and built-in cold water by-pass to ensure non-scalding upon failure of valve. Valves shall be preset for 85 degrees F. Flow, temperature settings, and installation shall be in accordance with ANSI Z358.1-2009.

1. Mixing valve for emergency eyewash units shall be equal to Bradley Navigator EFX25 Model S19-2100-RE-W, minimum flushing fluid of 0.4 gpm @ 30 psi.
2. Mixing valve for emergency eye/face wash units & drench hoses shall be equal to Bradley Navigator EFX25 Model S19-2100-RE-W, minimum flushing fluid of 3 gpm @ 30 psi.
3. Mixing valve for emergency showers shall be equal to Bradley Navigator EFX25 Model S19-2100-RE-W, minimum flushing fluid of 20 gpm @ 30 psi.
4. Based on manufacturer's requirements, emergency shower and combination units shall be provided with a flow restrictor as required to utilize a thermostatic mixing valve.

2.6 LABORATORY VACUUM SYSTEM

- ### A. Laboratory vacuum system shall be LifeLine System manufactured by Beacon Medaes or approved equal. Vacuum system shall be "oil-less" claw vacuum, stack-mount duplex system with a common base and single point connections for the electrical panel, vacuum intake, and discharge.

- B. Each pump and the receiver shall be connected to a common intake manifold. Each pump shall be connected to a common discharge manifold. The common base shall be sized to fit through standard 34.5" doorway. Designed and manufactured with ISO 13485 processes, each system shall be completely tested before shipment and include:
1. Two "oil-less" claw rotary vacuum pumps with two motors
 2. Integral pre-wired control panel
 3. Horizontal air receiver with full-size three-valve bypass, sized for appropriate demand
- C. Each pump shall be a direct driven, non-contacting claw type, capable of operating continuous duty at 28.4" Hg at sea level. The pumping chamber shall be oil free. The pump shall be completely air-cooled with no water requirements. Each pump shall contain:
1. 5 micron inlet air filter
 2. Vacuum relief valve
 3. Check valve to prevent backflow through off-cycle units
 4. Flexible connector and isolation valve
 5. High discharge temperature sensor
 6. Oil drain valve and oil sight glass
- D. The motor shall be a continuous duty, NEMA rated, C-face, TEFC, 1800 RPM, with 1.15 service factor suitable for 208V or 230/460V, 60 hertz, 3 phase electrical service. Refer to drawings for electrical requirements.
- E. Each vacuum pump shall have a factory piped intake with integral flex connector, isolation valve, and check valve. Interconnecting piping shall consist of powder-coated steel tubing and flanges.
- F. The vacuum receiver shall be ASME Code stamped, and rated for a minimum 150 PSIG design pressure. The receiver shall have a full-size three-valve bypass system to allow for draining of the receiver without interrupting the vacuum service. A manual drain shall be provided on the receiver.
- G. Each vacuum pump shall be factory piped to an exhaust manifold with integral flex connector and drip leg with ball valve and condensate drain. Interconnecting piping shall consist of powder coated steel tubing and flanges. An exhaust muffler shall be shipped loose.
- H. The duplex control system shall be NEMA 12 and U.L. labeled. The control system shall provide automatic lead/lag sequencing with circuit breaker disconnects for each vacuum pump with external operators, full voltage motor starters with overload protection, redundant 120V control circuit transformers, visual and audible reserve unit alarm with isolated contacts for remote alarm, visual alarms for high discharge temperature shutdown with isolated contacts for remote alarm, hand-off-auto lighted selector switches

and runtime hourmeters. A programmable logic controller (PLC) shall control the automatic alternation of both vacuum pumps with provisions for simultaneous operation if required, and automatic activation of reserve unit if required. The control system shall include a minimum run timer. A vacuum gauge shall be provided in the control panel.

2.7 LABORATORY COMPRESSED AIR UNIT

- A. Laboratory compressed air system shall be LifeLine System manufactured by Beacon Medaes or approved equal. Compressed air system shall be oil-less scroll, based mount duplex system with single point connections.
- B. The oil-less scroll compressed air package shall feature a common base with single point connections for electrical, intake air, discharge air, and condensate drains. Designed and manufactured with ISO 13485 processes, each system shall be completely tested before shipment and include:
 - 1. Two compressor towers, each with two “oil-less” scroll compressors and one motor
 - 2. Duplex desiccant drying system with purge control
 - 3. Integral pre-wired control panel
 - 4. Corrosion resistant vertical air receiver
- C. The compressors shall be continuous duty rated scroll type, single stage and air-cooled. The compressors shall have one fixed and one orbiting scroll sealed with PTFE tip seals and include the following:
 - 1. Field replaceable tip seals
 - 2. Dust and contamination protection from two part face seal
 - 3. Orbiting bearing and pin crank bearings are grease filled with maintenance intervals of 10,000 hours for 2 Hp through 5 Hp and 8,000 hours for 7 ½ Hp
 - 4. Heat dissipation maximized by an integral cooling fan
 - 5. V-belt driven compressor protected by totally enclosed beltguard
 - 6. Fully adjustable motor mounting base to achieve belt tensioning
- D. The compressor motor shall be NEMA rated, open dripproof and operates at 3600 RPM with 1.15 service factor suitable for 230/460V or 208V electrical service. Refer to drawings for electrical requirements.
- E. The piped intake manifold shall include one inline inlet air filter and isolation valve per compressor and a high inlet vacuum switch to protect the compressors. The compressor discharge assembly shall include:
 - 1. Integral air-cooled aftercooler with a maximum approach temperature of 15°F above ambient and integrated drain trap with automatic solenoid drain valve
 - 2. Discharge lines include heat-shielded flex connector, safety relief valve, isolation valve and check valve

3. Integral valve per compressor provides load-less starting and rapid air evacuation at shutdown
- F. Four-point, heavy duty seismic/vibration isolation system for a minimum 95% isolation efficiency shall fully isolate the compressor / motor tower from the system.
- G. Corrosion resistant, ASME Coded, National Board Certified vertical air receiver rated for minimum 150 PSIG design pressure. The air receiver assembly shall include:
1. Zero Loss electronic drain valve, liquid level gauge glass, safety relief valve, and manual drain valve
 2. Piped 3-valve bypass assembly with flange-fitted valves
 3. Pressure gauge
- H. Each desiccant dryer shall be sized for peak calculated demand and produce a 10°F pressure dew point. Each dryer shall operate from a demand based purge saving control system featuring repressurization cycles. The dryer assembly shall include the following mounted and piped:
1. Transfer valve utilizing two sliding ceramic plates with a 5-year warranty
 2. High efficiency coalescing prefilter rated for 0.01 micron with automatic drain and element change indicator
 3. Fully duplexed final line particle filters rated for 1 micron with element change indicators
 4. Duplexed final line regulators and safety relief valves
 5. Ceramic type dew point sensor with $\pm 2^\circ$ F system accuracy
- I. The duplex control system shall be NEMA 12 and U.L. labeled. The control system shall provide automatic lead/lag sequencing and automatic alternation of both compressors based on first-on/first-off principle with provision for simultaneous operation if required, circuit breaker disconnects for each motor with external operators, full voltage motor starters with overload protection, redundant 120V control circuit transformers. Screen displays and functions shall include visual/audible alarm indications with isolated contacts for all standard remote alarms, service alerts, runtime hourmeters, system status, system pressure level and dew point level.

2.8 GAS VALVE CABINET

- A. Valve cabinet shall be recessed type and consist of the following components: A steel valve box housing single shut-off ball valves with tube extensions, an aluminum frame, and a pull-out removable window. Boxes shall be provided to accommodate size and type of gas valves as indicated on Contract Drawings. No cabinet shall serve more than one laboratory.
- B. The valve box shall be constructed of 18 gauge steel complete with a white epoxy finish and provided with (2) two galvanized steel brackets for the purpose of mounting to

structural support. The assembly trim shall accommodate various finished wall thickness of up to one inch and be field adjustable.

- C. The doorframe assembly shall be constructed of anodized aluminum mounted to the back box assembly by screws as provided and shall have a sliding removable front consisting of an opaque door with a pre-mounted pullout ring and smoke colored window. Access to the zone shut-off valves shall be by merely pulling the ring assembly to remove the window from the doorframe. The window shall be capable of re-installation without the use of tools and only after the valve handles have been returned to the open position. The window shall be labeled "Caution – Laboratory Gas Shut-Off Valve - Close Only in Emergency".
- D. Mount engraved rigid plastic identification plate on wall above cabinet. Color code identification plate to match gas identification color. Identification plate must be clearly visible at all times. Provide inscriptions on plate to read in substance: "GAS VALVE CONTROL SUPPLY TO ROOM [identify room number]."
- E. Valves shall be same as specified herein for line shut-off valves except locking devices are not required.
- F. Each valve shall be supplied with an identification bracket bolted directly onto the valve body for the purpose of applying an approved identification label. A package of labels shall be supplied with each valve box assembly for application by the installer.
- G. All valves shall be securely attached to the box and provided with pipe stub extensions of sufficient length to protrude beyond the sides of the box for connection to system piping. Suitable plugs or caps shall be installed by the manufacturer to prevent contamination of the assembly prior to installation.
- H. For installation in 2-hr fire rated walls, provide fire putty around the box and provide a U.L. Listed intumescent pad to the back of the valve box.

2.9 CARBON DIOXIDE CYLINDER GAS MANIFOLD

- A. The Digital Medical Gas Manifold shall be an Amico Alert-2 Heavy Duty series or approved equal. This manifold shall also include a five-year warranty which warrants a defect-free product.
- B. The manifold shall be a digital, fully automatic type and shall switch from "Bank in Use" to "Reserve" bank without fluctuation in delivery supply line pressure and without the need for external power. After the switch-over, the "Reserve" bank shall then become the "Bank in Use" and the "Bank in Use" shall become the "Reserve" bank. The manifold shall have a microprocessor based digital display panel.
- C. The unit shall be compact, measuring 16-3/4" high x 17" wide x 9" deep.

- D. The control panel shall incorporate three large, red, illuminated LED displays for the Left Bank, the Right Bank and for the Supply Pressure.
- E. The control panel shall have six LED's, two Green for "Bank in Use", two Amber for "Bank Ready" and two Red for "Bank Empty".
- F. The manifold shall be equipped with a 3/4" outlet shutoff valve. The valve shall come complete with a 3/4" type "K" 6-3/4" long pipe extension and 1/8" port for an optional pressure switch.
- G. The header bars shall be equipped with emergency high pressure shutoff valves outside the cabinet to allow for emergency isolation of the header bars. The header bar shall incorporate integral check valves for each station. The manifold shall be equipped with limit switches and pressure transducers for indication and for operation of the fail-safe relay which transmits a remote Normally Closed signal to the master medical gas alarm.
- H. The header bar shall come with universal mounting brackets to be mounted direct or with a 12" wall spacing when the optional wall mounting bracket is used. The header bar mounting brackets are only supplied with more than 10 cylinders, for a staggered header bar, and more than 4 cylinders for a straight header bar.
- I. All manifold regulators, piping and control switching equipment shall be installed inside the cabinet to minimize tampering with the regulators or switch settings.
- J. Provide heater kit for CO₂ manifold.
- K. The manifold shall include two pressure relief valves, one high pressure 225 psi and one low pressure 75 psi.
- L. The manifold shall be UL Listed to U.S. and Canadian safety standards.

PART 3 - EXECUTION

3.1 FLOOR DRAINS

- A. Floor drains and floor sinks shall be covered during periods of construction. If drains are not covered and it is suspected that dirt, debris or trash has entered the drainage system, the interior drainage system shall be professionally cleaned to the Architect's satisfaction and at no expense to the Owner.

3.2 INSTALLATION OF PIPING

- A. Interior Drainage Systems:
 - 1. Soil, waste, vent, and drain piping for sanitary and storm drainage, shall be of the

sizes noted, and shall be run as indicated. Pipes must be run in straight lines and have a uniform grade between elevations noted. No branch drain shall have a grade less than that indicated for the main drain to which it is connected. Where elevations are not given, horizontal pipes shall have a uniform grade of 1/4 inch per foot where possible but in no case less than 1/8 inch per foot and shall be installed to the inverts shown. All piping shall be adequately supported as specified in Division 23, Section “Mechanical and Electrical General Provisions”. All main vertical soil and waste stacks shall be extended as vents full size to approximately 18 inches above the roof of the building. Two (2) or more vent lines shall be connected together where practicable and extended as one (1) pipe through the roof. Vent pipes in roof spaces shall be run as close as possible to the underside of the roof without forming traps in pipes. Vent pipes may be connected to other vent pipes or to main vent stacks provided the connections are at least four (4) feet above the floor on which the fixtures are located so that no vent pipe can be used as a waste. Openings in roof for vent pipes shall be flashed and made watertight. Use vent stack flashing sleeves where applicable. Handicapped plumbing fixtures shall be rough-in to suit the specific mounting of the fixture. Waste lines shall be offset for lavatories and sinks to accommodate wheelchair type strainers and traps shall be insulated.

2. Changes in direction shall be made by appropriate use of forty-five (45) degree wyes, 1/2 wyes, or long sweep 1/4, 1/6, 1/8, or 1/16 bends. Sanitary tees or short quarter bends may be used on vertical stacks of drainage lines where change in direction of flow is from horizontal to vertical; except use long turn tee wyes when two (2) fixtures have common drain. Straight tees, elbows, and crosses may be used on vent lines. Make no change in direction of flow greater than ninety (90) degrees. Where different sizes of drainage pipes or pipes and fittings are to be connected, use standard increasers and reducers of proper size. Reduction of size in horizontal drainage piping in direction of flow is prohibited.
3. Drilling and tapping of drains, soil, waste, or vent piping, and use of saddle hubs and bands are prohibited.
4. Connect piping to fixtures or equipment by couplings or unions so that devices may be replaced with no disturbance to piping.

B. Water Piping Systems:

1. Water piping shall be complete from service connection to all fixtures, equipment, outlets, etc. Sizes of pipes shall be shown or as specified.
2. Chromium plated piping shall be threaded and made up carefully, and not more than one (1) full turn of thread shall be exposed beyond any fitting.
3. Ends of pipes or tubing and recesses of fittings to be bronzed or soldered shall be thoroughly cleaned. Joints shall be assembled without binding. Brazing material or solder shall penetrate fully and shall fill the joint completely.
4. All brass and copper pipe and tubing shall be free from cuts, dents or other surface damage at the time of final inspection. Damaged pipe or tubing shall be removed and replaced with new pipe or tubing.
5. Horizontal runs of brass and copper pipe and tubing over fifty (50) feet in length shall be anchored to wall or floor construction. Anchors shall be located near the

midpoints of the runs so as to force the expansion equally to the ends or in a direction where expansion can take place without excessive strain. Swing joints, offsets, expansion joints, etc., shall be provided where necessary to accommodate expansion of piping, which will be approximately two (2) inches in 100 feet of brass or copper hot water piping.

6. Where non-ferrous metal piping and zinc-coated metal piping are jointed, dielectric (insulating) couplings, fittings or unions shall be provided.
 7. Where pipe sizes shown or specified differ from the connection sizes of meters, pumps, fixtures, outlets, etc., reducing fittings shall be installed.
 8. Water supplies for wall hung lavatories shall be roughed in as high as possible and still permit connections to the faucet. Water supplies shall be insulated for handicapped fixtures and rough-in shall be on accessible side of fixture for flush valves and flush handles.
- C. All rough-in plumbing shall be sealed off with test plugs, caps, etc., until fixtures are ready to be installed.

3.3 CLEANOUTS

- A. Where soil, waste, or roof drainage risers connect to a sewer or drain extending from the building above the lowest floor, the fitting at the base of each stack or downspout shall be a sanitary tee or a combination Y and 1/8 bend with cleanout plug in the end of the run of the main.
- B. Each vertical soil, waste, and vent pipe and each downspout and roof drainage pipe which connects to horizontal drain piping below ground shall be fitted with a test tee above the lowest floor or ground. Where accessible, test tee may be installed in the horizontal pipe at the base of the riser.

3.4 TRAPS

- A. Each fixture and piece of equipment connected to the sanitary system shall be equipped with a trap. Provide traps for storm water lines where required by code. Each trap shall be placed as close to the fixture as possible and no fixture shall be double trapped. All traps on bell and spigot pipe shall be extra heavy cast iron and all traps on threaded pipe shall be galvanized cast iron recessed drainage type.

END OF SECTION

SECTION 230500 – MECHANICAL AND ELECTRICAL GENERAL PROVISIONS

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 describes the general provisions for the fire protection, plumbing, mechanical and electrical work included in Divisions 21, 22, 23 and 26 respectively. This section applies to all sections of Divisions 21, 22, 23 and 26. Refer to Division 26 for additional General Provisions related to electrical work.

1.3 COMMISSIONING

- A. The Owner is pursuing U.S. Green Building Council (USGBC) LEED 2009 Building Certification. The scope of the mechanical and electrical commissioning effort is that which is required to facilitate fulfilling Energy and Atmosphere (EA) Prerequisite No. 1 – Fundamental Commissioning of the Building Energy Systems and Credit 3 – Enhanced Commissioning.
- B. All building energy-related systems shall be commissioned in order to verify and ensure that fundamental building elements and systems are installed, constructed, calibrated to operate, and perform according to the Owner's Project Requirements, Basis of Design, and Construction Documents.
- C. Refer to the Divisions 1, 22, 23 and 26 commissioning specifications for additional information.

1.4 RESPONSIBILITY

- A. The General Contractor shall be responsible for all work included in the Mechanical, Electrical, Plumbing and Fire Protection 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. 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.
- C. The contractor shall obtain and pay for all installation permits, certificates, and inspection fees relative to the work. The preparation of any specific plans or shop drawings necessary to obtain these permits shall also be the responsibility of the contractor.

1.5 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
Indicated	- indicated in Contract Documents
Concealed	- hidden from normal sight; includes items within furred spaces, pipe and duct shafts, above suspended ceilings and within return air plenums.
Exposed	- non concealed - Work within Equipment Rooms shall be considered exposed.
Exterior	- items being or situated outside. Items located within a crawl space shall be considered exterior.
Conditioned	- a heated or cooled space, or both, within a building and, where required, provided with humidification or dehumidification means, so as to be capable of maintaining a space condition falling within the comfort envelope set forth in ASHRAE 55.
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.

1.6 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.

1.7 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 Mechanical Code
2009 International Plumbing Code
2009 International Fire Code
2006 International Energy Code
National Electric Code, 2008 Edition
National Fire Protection Association Standards (Latest Editions)
State Fire Marshal Regulations
Fire Prevention Bureaus of the City of Columbia, Richland County and the State of South Carolina
ASHRAE Standards and Handbooks (Latest Editions)
Local Health Department
State Health Department
Local Utility Companies
Underwriters Laboratories
Owner's Insurance Underwriter Standards
Environmental Protection Agency

1.8 MATERIALS LIST AND SHOP DRAWINGS

- A. See Division 1, GENERAL REQUIREMENTS for Additional Requirements related to submittals and shop drawings.
- B. 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.
- C. 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.

- D. 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".
- E. 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.
- F. 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.
- G. 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.
- H. Submit data and shop drawings as listed below, in addition to provisions of paragraphs above. Identify all shop drawings by the name of the item and system and applicable specification paragraph number.

Shop Drawings:

Section 210500 – Fire Protection

- AutoCad Shop Drawings
- Record Drawings
- Site and Final Inspection Forms
- Valve Tag Drawing
- Hydraulic Calculations
- Piping
- Control and Drain Valves
- Tamper Switches
- Automatic Sprinklers
- Supervisory and Alarm Equipment
- Flow Switches
- Pipes and Fittings
- Hangers
- Valves
- Fire Extinguishers
- Sprinkler System Drawings and Calculations
- Sprinkler System Acceptance Test Statement

Section 220500 – Plumbing

- Cleanouts
- Drains
- Plumbing Fixtures
- Trap Primers
- Laboratory Gas Valve Cabinets
- Laboratory Vacuum System
- Laboratory Compressed Air System
- Tempering Valve
- Carbon Dioxide Cylinder Manifold

Section 230500 – Mechanical and Electrical General Provisions

- Record Drawings
- Installation and Coordination Drawings
- Pipe and Conduit Hangers and Supports
- Access Doors
- Sleeves and Penetrations Drawings
- Operation and Maintenance Manuals
- List of Manufacturers' Material and Equipment
- Welder Certificates

Section 230513 – Motors

- Motors

Section 230530 – Basic Materials and Methods

- Hangers and Pipe Shields
- Identification Items
- Pipe, Fittings, and Joints
- Balancing Valves
- Butterfly Valves
- Ball Valves
- Drain Valves
- Gate and Globe Valves
- Check Valves
- Manual and Automatic Air Vents
- Pressure Regulating and Relief Valves
- Backflow Preventers and Vacuum Breakers
- Strainers
- Flowmeter Fittings
- Temperature Wells
- Pressure Gauges
- Thermometers

Test Plugs
Steam Traps
Steam Vacuum Breakers
Dielectric Fittings
Unions
Test Reports
Sterilization Report

Section 230548 – Mechanical Vibration, Sound and Seismic Controls

Vibration Isolation and Seismic Restraint Components

Section 230550 – Variable Frequency Drives (VFDs)

Variable Frequency Drives

Section 230593 – Testing and Balancing

Test Reports

Section 230700 – Mechanical Systems Insulation

All Insulation Types
Adhesives, Sealers, and Coatings
Fabric Jackets
Fitting and Valve Covers
Metallic Components

Section 230900 – Building Automation and Temperature Control System

Sensors
Control Dampers:
 Motor Operated
 Back Draft
Humidistats
Thermostats
Transmitters
Gauges and Thermometers
Control Valves
Operators
Control Panels
Receiver Controllers
Fire and Smoke Control Devices
Electronic Components
Software
Field Hardware
Automatic Temperature Control System

Section 233110 – Air Distribution

Air Terminal Units
Air Devices
Sound Attenuators and Certified Test Data
Air Filters and Holding Frames
Dampers:
 Fire
 Fire/Smoke
 Smoke
 Volume
Ductwork
Medium Pressure Ductwork Samples
Duct Lining
Air Measuring Devices
Fans

Section 237300 – Outdoor Central-Station Air Handling Unit

Air Handling Unit

Section 238120 – Heating and Air-Conditioning Equipment

Fan Coil Units
Heating and Cooling Coils

- I. Contractor, additionally, shall submit for approval any other shop drawings as requested by the Architect. No item listed above 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.

1.9 SUSTAINABLE DESIGN (LEED) DOCUMENTATION SUBMITTALS

- A. LEED submittals are in addition to other submittals. If submitted item is identical to that submitted to comply with other requirements, submit duplicate copies as a separate submittal to verify compliance with indicated LEED requirements.
- B. Water Conserving Fixtures: Submittals must include manufacturer's cut sheets for all water-consuming plumbing fixtures and fittings (toilets, urinals, faucets, showerheads, etc.) highlighting maximum flow rates and/or flush rates. Include cut sheets for any automatic faucet-control devices.
- C. Process Water Use: Provide manufacturer's cut sheets for all water-consuming commercial equipment (clothes washers, dishwashers, ice machines, etc.), highlighting water consumption performance.

- D. Elimination of CFCs AND HCFCs: Provide manufacturer's cut sheets for all cooling equipment with manufacturer's product data, highlighting refrigerants; provide manufacturer's cut sheets for all fire-suppression equipment, highlighting fire-suppression agents; provide manufacturer's cut-sheets for all polystyrene insulation (XPS) and closed-cell spray foam polyurethane insulation, highlighting the blowing agent(s).
- E. Outdoor Air Delivery Monitoring: Provide manufacturer's cut sheets highlighting the installed carbon dioxide monitoring system components and sequence of controls shop drawing documentation, including CO2 differential set-points and alarm capabilities.
- F. Air Filtration: Provide manufacturer's cut sheets and product data highlighting the following:
 - 1. Minimum Efficiency Reporting Value (MERV) for filtration media in all air handling units (AHUs)
 - 2. Minimum Efficiency Reporting Value (MERV) for filtration media installed at return air grilles during construction if permanently installed AHUs are used during construction.
- G. Thermal Comfort Controls: Provide manufacturer's cut sheets and shop drawing documentation highlighting all thermal comfort-control systems components.
- H. Minimum Energy Performance (ASHRAE 90.1 compliance): Provide manufacturer's cut sheets or product data for all heating, air conditioning and domestic water equipment verifying that the minimum system component efficiency requirements listed in ASHRAE 90.1-2007 Tables 6.8.1A-G are met.

1.10 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.

1.11 WARRANTY

- A. The Contractor shall warranty, 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. In default thereof, Owner may have such work done and charge the cost of same to the Contractor.

1.12 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.

1.13 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.

1.14 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 warranty 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.
- F. Contractor shall provide the Owner with all tools required to service and maintain all equipment.

1.15 ELECTRICAL WORK

- A. Under Divisions 22 PLUMBING and 23 MECHANICAL, provide the following items of electrical work which shall conform with the applicable requirements of the Electrical Division:
 - 1. Low voltage 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 Division 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.
- C. Variable frequency drives shall be furnished and set in place under Division 23. Power wiring shall be provided under Division 26

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 Division 1 - 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 a material or equipment is specified by brand name or other identifying information and three (3) 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 or identified basis of design 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 in all buildings. No installation or construction work shall begin until the coordination drawings are completed, submitted, and approved. Drawings shall include, but not be limited to, the following:
 1. Complete Roof and Floor Plans, including all exterior equipment
 2. Mechanical Rooms in the Building
 3. Mechanical Shafts
 4. Pipe sleeves, equipment pads, etc.
- B. Show relationship and integration of different construction elements that require coordination during fabrication or installation to fit in space provided and function as intended.
- C. Prior to fabricating or installing work, prepare composite coordination drawings at appropriate scale; detail major elements, components, and systems of architectural, structural, mechanical, and electrical such as equipment, components, and materials in relationship with each other, installations, and building components. Include dimensions. Composite coordination drawings shall include new and existing elements, components, and systems.
- D. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are important to efficient flow of Work.
- E. Indicate scheduling, sequencing, movement, and positioning of large equipment into building during construction.
- F. Assembly Penetrations: Prepare drawings as required to indicate penetrations in floors, walls, and ceilings and their relationship to assembly construction, other penetrations and installations. Identify where additional bracing and offsets are required to comply with Contract Documents.
- G. Prepare drawings as required to coordinate and integrate ceiling installations, air outlets

and inlets, light fixtures, communications systems components, sprinklers, other ceiling-mounted devices, components located above suspended ceilings, and suspended ceiling support components.

- H. Show interrelationship of components indicated on separate Shop Drawings.
- I. Indicate required installation sequences to minimize cutting and patching.
- J. In addition, prepare coordination drawings required below and in other Specification sections.
- K. Mechanical Systems: Include, but do not necessarily limit to, the following:
 - 1. Proposed locations of piping, ductwork, equipment, and materials.
 - 2. Proposed locations for access panels and doors.
 - 3. Clearances for installing and maintaining insulation.
 - 4. Clearances for servicing and maintaining equipment, including tube removal, filter re-moval, and space for equipment disassembly required for periodic maintenance. Show access locations.
 - 5. Equipment connections and support details, including vibration isolation, seismic and sway bracing.
 - 6. Exterior wall, roof and foundation penetrations.
 - 7. Fire-rated wall and floor penetrations.
 - 8. Sizes and location of required concrete pads and bases.
 - 9. Valve stem movement.
- L. 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.
- M. 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.
- N. Installation and coordination drawings shall be produced on an AutoCad format. Reproduction of any portion of the mechanical and electrical contract drawings for re-submittal 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.
- O. The "Base" architectural and structural background drawings will be provided on Autocad format by the Construction Manager/General Contractor. These "Base" background documents are to be provided to each Contractor in the coordination process

to establish a common platform for each Contractor to use for their design drawings. This same information will be used to communicate their respective coordination with the other Contractors. Coordination will be accomplished by each Contractor superimposing his work on drawings in the following sequence:

1. Construction Manager/General Contractor - Base Drawings indicating structural steel with elevations for bottom of beams & finish floor. The general contractor shall include a layout of ceiling tiles (where applicable).
 2. HVAC Contractor - Ductwork layout drawings & piping with elevations to bottom of ductwork & piping. HVAC contractor shall indicate location of all registers, diffusers and grilles.
 3. Plumbing Contractor - Layout of all piping with elevations.
 4. Sprinkler Contractor - Layout of all piping & heads with elevations.
 5. Electrical Contractor - Conduit layout with junction boxes and location of all electrical fixtures.
- P. If necessary, Contractor coordination meetings shall be held continuously until the coordination drawings are complete and approved by all parties. Any conflicts, etc., discovered in the coordination stages prior to Contractor(s) sign-off which cannot be resolved by the Contractor(s) shall be brought to the Architect's attention for resolution.
- Q. Any conflicts, etc., discovered after the created and submission of the coordination and installation drawings and during the installation of the Work will be the responsibility of the Contractor(s) to resolve with the approval of Architect. Any and all costs for these resolutions shall be solely the responsibility of the Contractor(s).
- R. Work fabricated/installed prior to the completion of the coordination and installation drawings is performed at the Contractors own risk, and compensation of time/costs for corrections will not be awarded. Any work installed that is not in conformance with final approved coordination and installation drawings shall be required to be removed and relocated, and compensation of time/costs for corrections will not be awarded.
- S. Each Contractor is responsible for timely updates to the coordination drawings to indicate as-built conditions for their own work. Updates are required to include all changes regardless of the source or reason for the change, including changes initiated by the Owner, Architects or Engineers.

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 satisfaction and at no expense to the Owner.

- B. Hangers shall be spaced to prevent sag and permit proper drainage. Refer to Division 23, Section "Basic Materials and Methods" for hanger spacing. A hanger shall be placed within one (1) foot of each horizontal elbow. See drawings for any 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. Hangers and support devices shall be by Anvil International , Unistrut, Fee & Mason, Elcene, Kindorf, Mueller or Auto-Grip. Unless otherwise specified, or indicated on the drawings, pipe and conduit hangers and hanger supports shall conform to the following Anvil International 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, Anvil International 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 to the following Anvil International 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. Per IBC code section 1912 and ACI 318 Appendix D, all concrete anchors within the scope of ACI 318 require approved anchors for crack concrete. Attachment devices shall have certified load test data from an independent test laboratory and shall be capable of carrying a minimum of five times the design load. The concrete anchors for the following supported items need to meet the crack concrete requirements:
1. Any suspended pipe, larger than 2", regardless of material.
 2. All components with an Ip 1.5 (example) Sprinkler piping, gas lines, exhaust / fume hoods containing hazards.
 3. Cable tray.
 4. All components required to function after a seismic event (example) generator,

- emergency lightings, fire alarm and all associated conduits / panels, etc.
5. Anywhere required by ASCE 7.
 6. All suspended HVAC and air distribution equipment, including air handling units, supply and exhaust air terminal units, fan coil units and fans.
- H. 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.
- I. Refer to Division 23, Section “Mechanical Vibration, Sound and Seismic Controls”, for vibration hanger requirements.
- J. In no case shall wire or perforated strap be used for pipe or conduit support.
- K. 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.
- L. Gripper hangers shall be used to suspend all exposed rectangular, oval, round and spiral ductwork. Gripper hangers shall consist of a pre-formed wire rope sling with either a pre-formed ferruled loop, permanently fixed threaded stud, or permanently fixed end-stop with or without a toggle. This is secured and tensioned with a Gripper.
1. The contractor shall select the correct specification of Gripper hangers for supporting each particular service.
 2. Gripper hangers shall be installed in accordance with all the manufacturer’s recommendations.

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. 3M products have been specified as the penetration fire stop 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.

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. Sheaves for motors fifteen (15) HP and larger shall be fixed pitch type. Provide any changes to the sheaves, belts, pulleys or drive package to obtain the specified airflow, if required. Any changes shall be installed under Division 23, Section "Air Distribution".
- F. Select the motor of a capacity needed to operate the equipment at the specified mid-position 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.
- G. Do not select fan sheave smaller in diameter than thirty (30) percent of the fan wheel diameter.
- H. 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 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 shall be removed and replaced to the satisfaction of the Architect.

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.

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, non-percussive 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 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 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.

3.7 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.

3.8 WELDING

- A. Welding shall conform to current standards and recommendations of the National Certified Pipe Welding Bureau, with all South Carolina Occupational Safety and Health Acts, State, City and County 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.
- E. Welders on pressure piping shall be certified and carry their identification stamp with them. Welds on lines with operating pressures above 100 psig shall be stamped.

3.9 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.

3.10 COOPERATION WITH OTHER TRADES

- A. 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.

3.11 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.

3.12 ACCESSIBILITY

- A. Locate all equipment which must be serviced, operated, or maintained, in fully accessible positions to eliminate the need for access panels and doors. Equipment shall include, but not be limited to, valves, clean-outs, motors, controllers, dampers, drain points, etc.
- B. Where overhead equipment cannot be located above spaces with either no ceilings or removable acoustical ceiling tiles, contractor shall provide, as part of the contract and no expense to the Owner, fourteen (14) gauge painted steel access doors where required and/or where directed (color shall match ceiling). Locations shall be coordinated with the Architect and indicated on the composite installation and coordination drawings.
- C. Access panels shall be Milcor or approved equal to suit material in which installed. Access 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 eighteen (18) inches by eighteen (18) inches. Doors in Toilet Rooms and Janitor's Closets shall be Type 304 stainless steel.

- D. 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.

3.13 EXCAVATION AND BACKFILL:

A. Excavation:

1. See Division 31 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 Division 31 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 (FT²) 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.

3.14 EQUIPMENT BASES AND SUPPORTS

- A. Refer to Division 23, “Mechanical Vibration, Sound and Seismic Controls” for vibration isolation and seismic restraint requirements.
- B. Concrete bases, curbs, and supports will be furnished and installed under this Division and shall be in accordance with Division 3.
- C. The Subcontractors shall furnish, to the General Contractor, all required foundation sizes, bolts, washers, sleeves, plates and templates for equipment.
- D. The size of the foundation bolts shall be as recommended by the manufacturer.
- E. All equipment shall be set on the foundations, shimmed level with steel shims, and grouted up under base for uniform bearing by the Subcontractor.

- F. 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.
- G. 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.

3.15 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.

3.16 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.

3.17 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.

3.18 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

- B. At the end of each interruption, all services shall be restored so that normal use of the building can continue.

END OF SECTION

SECTION 230513 - MOTORS

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.
- B. Motors for equipment specified in other Sections of the Specification shall comply with the requirements of this Section. In the absence of a requirement in another Section, the requirements in this Specification shall be met.

1.2 SUMMARY

- A. This Section includes basic requirements for factory-installed motors.

1.3 DEFINITIONS

- A. **Factory-Installed Motor:** A motor installed by motorized-equipment manufacturer as a component of equipment.

1.4 SUBMITTALS

- A. **Shop Drawings and Product Data:** Shop drawings and product data for motors shall be provided with the submittal package for the piece of equipment that it serves. In accordance with Division 01, Section “Submittals” provide the following:
 - 1. Product catalog data: nameplate data and ratings; materials of construction; mounting arrangement, size and location of motor terminal box and conduit entry, grounding lugs and coatings.
 - 2. Completed tabulation sheet (template provided at the end of this Section).
 - 3. For motors over 100 hp, submit routine test report for a similar motor. Routine tests shall be as described in NEMA MG 1 using IEEE Method 112 forms.
- B. **Warranties**
 - 1. In addition to the guarantee requirements of the General Conditions, warranties for each motor shall be covered in the warranty for the entire mechanical assembly (fan & motor, pump and motor, etc).

- C. **Manufacturer Seismic Qualification Certification:** Submit certification that motors, accessories, and components will withstand seismic forces defined in Division 23, Section "Mechanical Vibration, Sound and Seismic Controls. 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.**
- D. **Operation and Maintenance Data:** For factory-installed motors to include in emergency, operation, and maintenance manuals.

1.5 DESIGN REQUIREMENTS

- A. Each motor shall be sized to provide adequate operating torque at the operating speed(s) for the equipment served without exceeding the motor's nominal horsepower. The manufacturer of the driven equipment shall provide the motor for that particular piece of equipment. In no case shall the Contractor supply the motor separately for the driven piece of equipment.
- B. Motor speed listed in Section 15 is the synchronous speed for both squirrel cage induction and synchronous motor types. It shall be the responsibility of the driven equipment supplier to match the driven equipment speed requirements with the motor, including motor slip and synchronizing torque requirements.

1.6 QUALITY ASSURANCE

- A. **Source Limitations:** Obtain factory-installed motors through one source from a single manufacturer.
- B. **Product Options for Factory-Installed Motors:** Drawings indicate size, profiles, and dimensional requirements of motors and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."
- C. **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.
- D. Comply with NFPA 70, "National Electrical Code."

- E. NRTL Listing: Motors shall be NRTL-listed.
 - 1. Term "Listed": As defined in "National Electrical Code," Article 100.
 - 2. Listing Agency Qualifications: "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.
- F. Comply with NEMA MG 1, "Motors and Generators."
- G. Comply with UL 1004, "Motors, Electric."
- H. Provide factory test reports in accordance with Part 2 of this Section.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Whenever possible, motor and driven equipment shall be shipped complete as an entire assembly.
- B. Inspect equipment immediately upon arrival and any irregularities or damage shall be reported to the Manufacturer/Supplier and Designer immediately.
- C. Store in accordance with manufacturer's recommendations.

1.8 IDENTIFICATION

- A. Nameplates: All motors shall have a stainless steel nameplate attached with stainless steel fasteners on the motor. The nameplate shall be stamped with nameplate markings listed in NEMA MG 1 20.60, plus the following:
 - 1. Manufacturer
 - 2. Model Number
 - 3. Serial Number
 - 4. Nominal efficiency
 - 5. Minimum efficiency
 - 6. Temperature Rise
 - 7. Bearing manufacturer's name and catalog number

1.9 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices and features that comply with the following:
 - 1. Compatible with the following:
 - a. Magnetic controllers.
 - b. Multispeed controllers.

- c. Reduced-voltage controllers.
 - 2. Designed and labeled for use with variable frequency controllers, and suitable for use throughout speed range without overheating.
 - 3. Matched to torque and horsepower requirements of the load.
 - 4. Matched to ratings and characteristics of supply circuit and required control sequence.
- B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3.

PART 2 - PRODUCTS

2.1 MOTOR REQUIREMENTS

- A. Motor requirements apply to factory-installed motors except as follows:
 - 1. Different ratings, performance, or characteristics for motor are specified in another Section.
 - 2. Motorized-equipment manufacturer requires ratings, performance, or characteristics, other than those specified in this Section, to meet performance specified.
- B. Motors shall be sized to drive the equipment, and perform the specified duty, but in no case less than the size shown or specified. If a motor larger than that specified is required, the Contractor shall bear the expense of changes in foundations, supports, wire and conduit connections, circuit protective devices, or other affected elements of the system. Each motor shall have sufficient capacity to start and operate the machine it drives without exceeding the motor nameplate rating at the speed specified or at the load which may be obtained by the drive actually provided. Motors shall be Class F insulation, Class B temperature rise at 1.0 service factor and 1.15 (minimum) service factor for continuous duty of 115 percent of rated capacity with maximum temperature rise in accordance with NEMA Chapter 12 Tables.
- C. Contractor assumes responsibility for the correct direction of rotation required by the equipment drives. In the event of damage due to reverse rotation, the equipment shall be repaired or replaced at no charge to the Owner.
- D. Motors shall have the following enclosure types in accordance with NEMA MG 1:
 - 1. For clean dry indoor areas: open drip proof (ODP) fully-guarded
 - 2. For outdoor locations: totally-enclosed fan-cooled for small and medium machines, weather protected type II for large machines
 - 3. Explosion-proof machines shall be provided for hazardous areas classified in accordance with NFPA 70 (National Electrical Code). Explosion proof motors shall be NRTL-listed for the hazardous area classification.

- E. Motors, 1/2 HP and larger, shall be three (3) phase, Class B, general purpose, squirrel cage, open type, premium efficiency, induction motors in accordance with NEMA MG1, wound for voltage indicated on the drawings, sixty (60) Hertz, alternating current, unless otherwise indicated on the drawings or specified herein. Motors smaller than 1/2 HP shall be single phase, open capacitor type in accordance with NEMA standards wound for 115 volts, 60 Hertz, alternating current. Motors 1/6 HP and under may be split phase type. Motors 1 HP and larger shall have nameplate rating and efficiency per NEMA MG 1. Ratings shall be based on IEEE Test Procedure 112, Method B.
- F. Each motor, 1 HP or larger, or motor driven equipment, 1 HP or larger shall have a composite power factor (PF) rating of ninety (90) percent to 100 percent when the driven equipment is operating at the design duty defined on the drawings. Power factor correction devices shall be provided to meet the stated criteria.
- G. Devices such as capacitors, or equipment such as solid state power factor controllers, shall be provided as part of the motor or item of motor driven equipment when required for power factor correction. Devices shall be completely mounted and wired to the motor terminal except as follows:
1. For a motor or motor driven equipment requiring other than across-the-line starting, power factor (PF) correcting capacitors, or other equipment, shall be connected to motor terminals via a contactor (controller) with a 120 volt alternating current (VAC) coil. The 120 volt alternating current (VAC) coil shall be energized via an auxiliary contact on the contactor (controller) used to establish the "run" operating mode for the motor driven equipment.
 2. For two (2) speed motors, power factor (PF) shall be corrected at each speed via separate groups of capacitors or other equipment for each speed. Each group of PF correcting components shall be connected to motor terminals via a separate contactor (controller) with a 120 volt alternating current (VAC) coil. Each 120 volt alternating current (VAC) coil shall be energized via an auxiliary contact on the contactor or controller used to establish "run" operations at each speed.
- H. Locked rotor kVA shall not exceed NEMA Code Letter F for motors over 10 horsepower.
- I. Motor Insulation: The insulation system shall consist of Class F or better insulation materials and shall utilize a process of one cycle of vacuum impregnation of 100% polyester resins and two cycles of treatment with a polyester varnish. All materials shall be non-hygroscopic. No asbestos materials shall be used. Motors over 600V shall have windings tested in a water-filled tank in accordance with NEMA MG 1 12.62.
- J. Motor Bearings: Motor bearings shall be specifically designed for the drive application, and shall be approved by the Engineer. Bearings shall have a minimum bearing life of B-10 or L-10 as defined by the AFBMA. Bearings shall be designed to carry the total hydraulic and static thrust developed by the driven load. Bearings shall be grease or oil lubricated. Oil lubricated motors shall be fitted with gravity-feed oil reservoirs. Grease lubricated bearings shall be regreasable (not sealed) and shall be supplied with grease

fittings and drain plugs. Medium voltage and variable frequency controlled motor bearings shall be electrically isolated from the shaft on at least one end to prevent transmission of electric current. Current drain brushes shall be fitted where it is necessary to divert the flow of electrical current from bearings. Bearings, housing and brackets shall be constructed to permit access, removal and replacement of the bearings without disassembly of the motor.

- K. Rotor: The rotor shall be dynamically and statically balanced. Assembled motor shall be tested at the factory in accordance with latest applicable NEMA MG 1 and IEEE 112 methods of testing, and balanced at no more than 0.001 inches total peak-to-peak deflection on the bearing housing and the shaft. Overall vibration readings, including all vibration frequencies, shall be taken and recorded at no load and design speed.
- L. Terminal Box: Motors shall have a watertight cable terminal box. Terminal box shall be oversized, diagonally split, and rotatable in 90° increments to allow conduit and cable entry from top, bottom and sides.
- M. Motor Leads: Motor leads shall be a minimum of 6 inches in length. All motor leads shall be extended from the conduit box. Motors rated over 200 HP or over 600V shall have insulated tin plated copper busbar terminals with bolt holes for compression wire lugs.
- N. Drains and Breathers: Provide drain(s) in the bottom of the motor at the lowest point(s). Enclosed motors shall be fitted with breathers.
- O. Screens: Provide stainless steel screens at motor ventilation openings.
- P. Rotation: Motor rotation shall be coordinated with the requirements of the pump or fan.
- Q. Motor Shaft: The motor shaft shall be ASTM A322 GR140 (AISI 4140) steel and shall be sized to accommodate the required power and torque. Provide shaft end with keyway for connection to coupling with the pump shaft. Coordinate shaft design requirements with driven load.
- R. Stainless Steel Hardware: Provide corrosion resistant hardware for motor components including grease fittings, plugs, nuts, bolts, washers and screws.
- S. Motor Casing and Coating: The motor housing shall be cast iron for small and medium machines and fabricated steel plate for large machines. Housings shall be degreased, primed and painted both inside and outside with a rust inhibitive primer and corrosion resistant polyester paint. Painting shall be performed prior to installing the motor stator windings. The primer and paint materials selected shall be suitable for the environment encountered, both inside and outside of the casing.
- T. Motors connected to Variable Frequency Drives shall be “inverter duty” with additional

magnet wire insulation to achieve a minimum motor impulse voltage rating equal to the VFD manufacturer's recommendations for the motor, cable size, and cable length actually installed.

- U. Shaft Grounding Ring: Each motor shaft shall be provided with a Shaft Grounding Ring (SGR) that will provide a reliable low resistance path from the motor shaft to the motor frame to prevent the build up of destructive high frequency shaft currents that are created by the Pulse Width Modulation of the Variable Frequency Drive units. The SGR shall encircle the shaft and shall be designed to promote efficient discharge of the high frequency shaft currents to the motor frame. The motor frame shall be inherently grounded by design.
- V. Power Factor Correction Capacitors: Provide motor power factor correction capacitors for all motors rated 600V or less (except variable frequency controlled motors) with less than 90% uncorrected power factor. Motor power factor correction capacitors shall be sized as recommended by the motor manufacturer to correct the motor power factor to over 90%. Motor power factor correction capacitor sizes shall not be larger than the maximum size recommended by the motor manufacturer. Enclosure type shall be NEMA 12. Capacitors shall be dry film type with fuses and discharge resistors.
- W. Motor winding temperature protection shall be provided for motors 400 HP and larger. Winding temperature detectors shall consist of six 100 ohm RTD's (resistance temperature detectors) with three leads each, imbedded in pairs in each phase of the stator windings, and brought out to labeled terminal in a separate motor RTD terminal box. Provide compatible motor winding temperature monitoring at the motor controller to shut down the motor when the temperature exceeds 50 deg. F. above the Class B temperature rise, and provide three conductor shielded cable in rigid galvanized steel conduit from the RTD's to the motor controller.

2.2 MOTOR CHARACTERISTICS

- A. Motors 1/2 HP and Larger: Three phase.
- B. Motors Smaller Than 1/2 HP: Single phase.
- C. Frequency Rating: 60 Hz.
- D. Voltage Rating: NEMA standard voltage selected to operate on nominal circuit voltage to which motor is connected.
- E. Service Factor: 1.15 for open dripproof motors; 1.0 for totally enclosed motors.
- F. Duty: Continuous duty at ambient temperature of 105 deg F and at altitude of 3300 feet above sea level.

- G. 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.
- H. Enclosure: Open dripproof.

2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Premium, as defined in NEMA MG 1. Refer to Motor Efficiency Table for average motor efficiencies.

Motor Efficiency			
Motor Size (HP)	6-pole	4-pole	2-pole
1	82.5%	85.5%	77.0%
1.5	86.5%	86.5%	84.0%
2	87.5%	86.5%	85.5%
3	88.5%	89.5%	85.5%
5	89.5%	89.5%	86.5%
7.5	90.2%	91.0%	88.5%
10	91.7%	91.7%	89.5%
15	91.7%	93.0%	90.2%
20	92.4%	93.0%	91.0%
25	93.0%	93.6%	91.7%
30	93.6%	94.1%	91.7%
40	94.1%	94.1%	92.4%
50	94.1%	94.5%	93.0%

- C. Stator: Copper windings, unless otherwise indicated.
 - 1. Multispeed motors shall have separate winding for each speed.
- D. Rotor: Squirrel cage, unless otherwise indicated.
- E. Bearings: Double-shielded, prelubricated ball bearings suitable for radial and thrust loading.
- F. Temperature Rise: Match insulation rating, unless otherwise indicated.
- G. Insulation: Class F, unless otherwise indicated.
- H. 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.
- I. Enclosure: Cast iron for motors 7.5 HP and larger; rolled steel for motors smaller than 7.5 HP.

1. Finish: Gray enamel.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

- A. Motors Used with Reduced-Inrush 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. Designed with critical vibration frequencies outside operating range of controller output.
 2. Temperature Rise: Matched to rating for Class B insulation.
 3. Insulation: Class H.
 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
- C. Rugged-Duty Motors: Totally enclosed, with 1.25 minimum service factor, greased bearings, integral condensate drains, and capped relief vents. Windings insulated with non-hygroscopic material.
 1. Finish: Chemical-resistant paint over corrosion-resistant primer.
- D. Source Quality Control for Field-Installed Motors: Perform the following tests on each motor according to NEMA MG 1:
 1. Measure winding resistance.
 2. Read no-load current and speed at rated voltage and frequency.
 3. Measure locked rotor current at rated frequency.
 4. Perform high-potential test.

2.5 SINGLE-PHASE MOTORS

- A. Type: One of the following, to suit starting torque and requirements of specific motor application:
 1. Permanent-split capacitor.
 2. Split-phase start, capacitor run.
 3. Capacitor start, capacitor run.
- B. Shaded-Pole Motors: For motors 1/20 HP and smaller only.
- C. 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.

- D. Bearings: Ball type for belt-connected motors and other motors with high radial forces on motor shaft; sealed, prelubricated-sleeve type for other single-phase motors.

PART 3 - EXECUTION

3.1 COMMISSIONING

- A. Check operating motors for unusual conditions during normal operation. Coordinate with the commissioning of the equipment for which the motor is a part.
- B. Report unusual conditions.
- C. Correct deficiencies.

END OF SECTION

SECTION 230530 – BASIC MATERIALS AND METHODS

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 requirements for items of equipment, materials and procedures which are common to more than one section of Division 21, 22 and 23 and which are general in nature and use. This section applies to all sections of Divisions 21, 22 and 23.
- B. The requirements of Division 23, Section “Mechanical and Electrical General Provisions” shall apply to all work specified under this section.

1.3 SHOP DRAWINGS

- A. Submit shop drawings for all items of materials specified in this section in accordance with the General Requirements.

1.4 TESTS AND ADJUSTMENTS

- A. The Contractor shall furnish labor, instruments, equipment, and materials required to perform tests prescribed in the sections describing the various systems. All tests shall be performed in the presence of the Owner and/or the Architect. Forty-eight (48) hours prior notice shall be given to the Owner and Architect for all tests. A written test report shall be submitted following all tests and before systems are insulated.
- B. Replace or repair defects found during inspection or tests with new materials. Caulking of welded joints, screwed joints, cracks, or holes is not acceptable. Correct leaks in screwed fittings by remaking joints. Cut out and reweld. Repeat tests after defects have been eliminated.
- C. Where reasonable doubt exists as to a system's ability to comply with contract requirements, perform any reasonable test required by the Architect.
- D. Make static pressure tests and prove to the satisfaction of the Architect the piping is tight before pipes are concealed. Tests shall be provided as hereinafter specified.

- E. Use test instruments tested for accuracy by an approved laboratory or by the instrument manufacturer, and furnish certificates showing degree of accuracy to the Architect when requested. Make calibration histories for each instrument available for examination.
- F. Where gauges, thermometers and other instruments which are to be left permanently installed are used for tests, do not install until just prior to the tests to avoid possible changes in calibration.

1.5 REFERENCES AND DEFINITIONS

- A. Unless otherwise specifically indicated, the term, and requirements of, “domestic” water systems shall universally apply to all potable, HVAC make-up and laboratory water systems.

PART 2 - PRODUCTS

2.1 HANGERS:

- A. See Division 23, Section “Mechanical and Electrical General Provisions” for general requirements.
- B. Hangers and accessories shall be Anvil International, Carpenter-Patterson, Michigan, B-Line, or Basic Engineering of the types specified in Division 23, Section “Mechanical and Electrical General Provisions”.
- C. It shall be the responsibility of the Contractor to provide an adequate pipe suspension system in accordance with recognized engineering practices, using standard, commercially accepted pipe hangers and suspension equipment.
- D. Contractor shall ensure that the pipe support system being provided is adequate for the service. For all pipe hangers, supports, anchors, guides, etc., the Contractor shall submit a pipe hanger assembly drawing in accordance with the recommendations provided by MSS SP-89. Provide proposed equipment manufacturer, manufacturer's model number and size, construction, finish, quantities and/or lengths. Utilize columns shown on Contract Drawings for the location plan. Indicate pipe system, line size, insulation thickness, and Contract Drawing for which the plan view of the pipe hanger location can be found.
- E. All brackets used for supporting piping shall be provided by the Contractor and shall be of welded steel construction with a design safety factor of not less than five.
- F. The design of all hangers and supports shall conform to the latest requirements of ANSI/ASME B31.1 or ANSI/B31.9 and Manufacturers' Standardization Society (MSS) Standard Practice SP-58, SP-69 and SP-89, unless otherwise made more stringent below.

1. Hangers for steel pipe, except as noted otherwise, shall be spaced at least every ten (10) feet.
 2. Hangers for cast iron pipe shall be provided at each joint.
 3. Hangers for copper pipe shall be placed at least every eight (8) feet, except pipes 3/4 inch and smaller shall have hangers at six (6) foot intervals.
 4. Plastic and polypropylene piping systems 1 1/4" and smaller shall be provided with continuous pipe support using light gauge sheetmetal angles strapped to pipes.
 5. Hangers shall be placed within one (1) foot of each horizontal and vertical elbow.
- G. Where concentrated loads of valves, fittings and similar items occur, closer hanger spacing will be necessary.
- H. Generally, hangers shall be clevis type, standard weight for lines 2-1/2 inch and larger.
- I. Vibration hangers shall be provided as hereinafter specified in Division 23, Section "Mechanical Vibration, Sound and Seismic Controls".
- J. Pipe Shields
1. On insulated piping 2" and larger, 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.
 2. On insulated piping smaller than 2", provide insulation protection shield equal to Anvil International Figure 167. Shield shall comply with Manufacturers Standardization Society (MSS) SP-58 (Type 40).
- K. Hangers in direct contact with copper piping systems shall be copper plated.
- L. All hangers shall be prime painted for interior locations and galvanized coated for exterior locations.
- M. Hangers shall be provided with seismic restraints as required by IBC 2009 and ASCE 05-07.

2.2 IDENTIFICATION, VALVE TAGS AND CHARTS

- A. A complete identification system shall be provided for all mechanical and electrical components which conform to the requirements published in ASME A13.1, NFPA 13 and the Fuel Gas Code.
- B. Product Data and Samples: In accordance with Division 1 Section "Submittal Procedures", submit the following:
- C. Manufacturer's technical product data and installation instructions for each type of identification device specified. Include a list of all piping systems indicating a proposed nomenclature where a manufacturer's standard pre-printed nomenclature does not match

up exactly with what is specified.

- D. Samples of each color, lettering style, and other graphic representation required for:
1. Brass valve identification tag.
 2. Pipe contents and identification markers.
 3. Valve Schedules: For each piping system. Reproduce on standard-size bond paper. Tabulate valve number, piping system, system abbreviation as shown on tag, room or space location of valve, and variations for identification. Mark valves intended for emergency shut-off and similar special uses. Besides mounted copies, furnish copies from maintenance manuals specified in Division 1.
 4. Plastic equipment identification plates.
 5. Paint colors for piping systems.
 6. Stencils.
- E. All control devices, i.e.; panels, switches, starters, pushbutton stations, relays, temperature controls, etc., shall be clearly identified as to their function and the equipment controlled. All equipment such as pumps, fans, heaters, etc., shall be marked to clearly identify equipment and space or duty they serve. Mechanical equipment shall be identified using engraved laminated black and white phenolic legend plates. Letters shall be minimum 3/4 inch high white on surrounding black. Plates shall be mounted by means of sheet metal screws. Submit nameplate list for approval.
- F. Piping shall be identified with colored, prerolled, semirigid plastic labels as manufactured by Seton or approved equal. Labels shall be Seton "Set mark" system and shall be set around pipes with a field installed high strength cement compound applied along their longitudinal edge. Labels shall be placed around the piping or insulation every twenty (20) feet and with one (1) label on each pipe in rooms smaller than ten (10) feet. Provide labels on branch lines not more than 5 ft from main header. Provide labels on lines that penetrate walls or floors on each side of penetration not more than 5 ft from penetration. A label shall be placed at every major valve and at least six (6) feet from exit or entrance to an item of equipment. On exterior piping, utilize stencils to paint contrasting letters identifying pipe contents and direction of flow. Letter size and color shall comply with the requirements of adhesive pipe labels.
- G. For supply and exhaust air terminal units located above the ceiling, in addition to a label on the device, labels are to be permanently affixed to the ceiling grid framing as near to the item as possible using epoxy glue. Where hard ceilings are used, the label is to be affixed to the frame of the access panel for the unit. Labels are to be black core white or beige Bakelite. The lettering is to be 3/8" inches high. The minimum label size is 3/4" wide by 1" long. Terminal units shall be identified as indicated on the mechanical drawings and ATC graphics. The thermostat that controls each air terminal unit shall be identified with an identical but appropriately sized label.
- H. For fire, smoke and fire/smoke dampers located above the ceiling, labels are to be permanently affixed to the ceiling grid framing as near to the item as possible using

epoxy glue. Where hard ceilings are used, the label is to be affixed to the frame of the access panel for the damper. Labels are to be black core white or beige Bakelite. The lettering is to be 3/8" inches high. The minimum label size is 3/4" wide by 1" long. Dampers shall be identified as "Fire Damper", "Smoke Damper" or "Fire/Smoke Damper".

- I. Labels shall have minimum 3/4 inch high black letters for pipes one (1) inch and larger, and 1/2 inch letters for smaller pipes. All labels shall have flow arrows. Color coding and stencil designations shall be as follows:

<u>Service</u>	<u>Color</u>	<u>Stencil Designation</u>
Potable Cold Water	Green	Potable Cold Water
Potable Hot Water	Green	Potable Hot Water
Potable Hot Water Recirc	Green	Potable Hot Water Recirc.
Laboratory Cold Water	Yellow	Laboratory Cold Water
Laboratory Hot Water	Yellow	Laboratory Hot Water
Laboratory Hot Water Recirc.	Yellow	Laboratory Hot Water Recirc.
Sanitary	Brown	Sanitary Sewer
Storm Water	Brown	Storm Water
Condensate Drain, Drain	Brown	Drain Water
Chilled Water Supply	Blue	Chilled Water Supply
Chilled Water Return	Blue	Chilled Water Return
Heating Water Supply	Yellow	Heating Water Supply
Heating Water Return	Yellow	Heating Water Return
Steam	Orange	Steam (Designate Pressure)
Steam Condensate	Orange	Steam Condensate
Natural Gas	Yellow	Natural Gas
Laboratory Compressed Air	Yellow	Lab Air
Laboratory Vacuum	White	Lab Vac
Carbon Dioxide	Gray	Carbon Dioxide

- J. All valves, except as specified below, shall be provided with colored plastic valve tags with stamped-in numbers. Tags shall be secured to valve wheels with a metal chain. Stop valves on individual fixtures or equipment where their function is obvious, or where the fixture of equipment is immediately adjacent, need not be so equipped. Care shall be exercised in scheduling and selecting valve numbers to be indicated on a drawing. Drawing shall show locations, details of arrangements, identity, and function of all service and control valves. One (1) copy of each drawing and schedule shall be mounted and framed under plastic protection where directed. Blueprints are not acceptable. A copy of each drawing and schedule shall also be included as a part of the operations and maintenance manuals. Valve tags shall be Seton or approved equal minimum 1-1/2 inch round tags with white characters describing system and valve designation.
- K. Identify fire protection systems (sprinkler and fire alarm) as hereinafter specified as required by NFPA Standards

2.3 PIPE, FITTINGS AND JOINTS

- A. General: Items are referred to by type and shall conform to the latest editions of standards listed below:
- B. Provide pipe and fittings for fire protection as hereinafter specified in Division 21, Sections “Fire Protection.”
- C. All piping shall be new domestic pipe material, manufactured in the United States of America (USA) and be suitable for the specific use indicated on drawings and in the specifications.
- D. Piping Material:

	<u>Service</u>	<u>Piping</u>	<u>Fittings</u>	<u>Joints</u>
1. Sanitary drainage:				
a. Underground:		A	I	a
b. Above ground within building		J	VIII	i
c. Vent piping		J	VIII	i
2. Storm water and drain:				
a. Above ground		J	VIII	i
3. Domestic cold water:		F	III	e
4. Domestic hot water, tempered water and hot water recirculation:		F	III	e
5. Chilled water supply and return:				
a. 2-1/2" and larger		C	VII	b
b. 2" and smaller		C	IV	c
c. 2" and smaller (optional)		F	III	e
6. Heating water supply and return:				
a. 2-1/2" and larger		C	VII	b
b. 2" and smaller		C	IV	c

	c.	2" and smaller (optional)	F	III	e
7.		Steam and steam relief:			
	a.	2-1/2" and larger	C	VII	b
	b.	2" and smaller	C	XII	c
8.		Steam Condensate:			
	a.	2-1/2" and larger	D	VII	b
	b.	2" and smaller	D	XII	c
9.		Natural Gas:			
	a.	2-1/2" and larger	C	VII	b
	b.	2" and smaller	C	IV	c
10.		Condensate Drain/Drain:			
	a.	Optional	J	VIII	i
	b.	Optional	B	II	e
11.		RO/DI	P	XVI	m
12.		Laboratory Gases:			
	a.	Vaccum	F	III	f
	b.	Compressed Air	F	III	f
	c.	Carbon Dioxide	F	III	f
13.		Carbon Dioxide Relief Vent	F	III	f
14.		Acid Waste Drainage and Vent	Q	XVII	n
E.		Piping Assembly:			

Type

Designation

- | | | |
|----|--|---|
| 1. | Cast iron hub and spigot pipe, service weight ASTM A74. All pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute and listed by NSF International. | A |
| 2. | Copper drainage tubing, drain, waste, and vent, DWV, ASTM B306 | B |
| 3. | Black steel pipe, ASTM A53/106 Grade B Seamless ANSI Schedule 40 | C |
| 4. | Black steel pipe, ASTM A53/106 Grade B Seamless ANSI Schedule 80 | D |
| 5. | Seamless copper water tube, ASTM B88, Type L, hard | F |
| 6. | Cast iron soil pipe, service weight No-Hub, ASTM A-888. All pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute and listed by NSF International. | J |
| 7. | Polypropylene (PP) pipe by George Fischer, Asahi, or Orion, equal to George Fischer PPro-Seal, suitable for use in reverse osmosis/deionized (RO/DI) water systems. Natural virgin copolymer polypropylene with no added plasticizers, pigments or re-grind that is manufactured to schedule 80 wall thickness and is compliant with US Food and Drug Administration regulations 21.CFR 177.1520 Sections A1, B & C and conforms to ASTM D4101. Pipe shall be manufactured to the dimensions and tolerances of ASTM D1785. All pipes shall be packaged in polybags at the point of manufacturing to preserve pipe cleanliness. | P |
| 8. | Plenumline FR-PVDF flame retardant polyvinylidene fluoride (PVDF) acid resistant drainage pipe, ASTM F 1673, Schedule 40, meeting the requirements of ASTM E84 and UL723 | Q |

F. Fitting Materials:

	<u>Type</u>	<u>Designation</u>
1.	Cast iron soil pipe fittings, service weight, ASTM A74	I
2.	Wrought copper and bronze drainage fittings, ANSI A16.29	II
3.	Wrought copper solder joint fittings, 150 pound ANSI B16.22	III

- | | | |
|----|---|------|
| 4. | Black malleable iron screwed fittings, 150 pound, ANSI B16.3 for less than seventy-five (75) pounds per square inch and 300 pounds for seventy-five (75) pounds per square inch or more | IV |
| 5. | Steel butt-welding fittings ANSI B16.9 using long-turn ells, ANSI B16.5 weld neck or slip on flanges & Bonney Forge Weldolets and Threadolets. Wall thickness to match pipe. | VII |
| 6. | Cast iron soil pipe fittings, No Hub, ASTM A-888 | VIII |
| 7. | Black Cast iron screwed fittings, ANSI B16.4, 125 pound for less than seventy-five (75) pounds per square inch and 250 pounds for seventy-five (75) pounds per square inch or more | XII |
| 8. | Polypropylene (PP) fittings by George Fischer, Asahi, or Orion, equal to George Fischer PPro-Seal, suitable for use in reverse osmosis/deionized (RO/DI) water systems. Natural virgin copolymer polypropylene with no added plasticizers, pigments or re-grind that is manufactured to schedule 80 wall thickness and is compliant with US Food and Drug Administration regulations 21.CFR 177.1520 Sections A1, B & C and conforms to ASTM D4101. Pipe shall be manufactured to the dimensions and tolerances of ASTM D1785. All fittings shall be packaged in polybags at the point of manufacturing to preserve pipe cleanliness. | XVI |
| 9. | Plenumline acid waste fittings and adapters. Fittings shall be third party certified to ASTM F 1673 and ASTM E84, and IAPMO approved. Connections containing EVA components are prohibited, meeting the requirements of ASTM E84 and UL723 | XVII |

G. Joint Materials:

<u>Type</u>	<u>Designation</u>
1. Premolded rubber gaskets Tyler Pipe Industries, TY-Seal or Multiple Seal, ASTM C564	a
2. Welded: Mechanical Contractors Association of America, Inc. Guidelines for Quality Piping Installation (1995), Section 2.1.O	b
3. Threaded: American Standard for Pipe Threads, ANSI B2.1	c
4. Soldered: ASTM B32 tin-antimony 95-5	e

5. Brazed: Silver alloy brazing equal to Silfos and Easy-Flo by Handy and Harman. The use of flux is prohibited f
6. No-Hub neoprene gasket and stainless steel corrugated shield, Tyler No-Hub coupling i
7. Butt-welded joint construction with an approved welding device, certified personnel and meeting the requirements of ASTM F1290/ASTM D2657 Section 9. All equipment should utilize electronically controlled heating elements for accurate welding temperatures. Tools should also incorporate planing units to face ends prior to heating. Butt-fusion equipment supplied shall weld joints based on force and/or pressure and not mechanical stops. m
8. Plenumline mechanical joints and adapters meeting the requirements of ASTM E84 and UL723, XVII. Connections containing EVA components are prohibited n

2.4 VALVES

A. General:

1. Valves shall be provided where indicated on the drawings and as herein specified.
2. Valves shall be placed in such manner as to be easily accessible for hand wheel operation and stuffing maintenance.
3. Install shut-off valves in piping where shown or where listed below:
 - a. To isolate all items of equipment.
 - b. To isolate motorized flow control valves.
 - c. To isolate branch lines and riser at mains.
4. Valve pipe connections shall be screw, solder or weld flange as required to be consistent with other parts of the piping system.
5. Where piping or equipment may subsequently need to be removed, provide valves with bodies having integral flanges or full lugs drilled and tapped to hold valve in place so that downstream piping or equipment can be disconnected and replaced with blank-off plate while valve is still in service.
6. Valves over ten (10) feet above standing level and above six (6) inches in size shall have chain wheel with chain extending to within six (6) feet of standing level. All wheel operated valves shall have an indicator to show the position of the disc or plug.
7. Where valves specified are not available in the pipe size noted on the drawing, the next larger size valve shall be provided.
8. Valves shall be provided for fire protection systems as specified in Division 21, Section "Fire Protection."

B. Balancing Valves:

1. Provide balancing valves where indicated and required to balance water flow through the piping system.
2. Balancing valves, 1 1/4 inches and larger, for systems piping shall be DeZurik as follows: PEC, flanged above two (2) inches with Buna filled PTFE U-ring seal and isobutene-isoprene plug facing, suitable for 250 degrees Fahrenheit continuous operation. Valves in chilled water systems may have seal and plug facing suitable for 180 degrees Fahrenheit. Valves six (6) inches and smaller shall have lever actuators and valves eight (8) inches and larger shall have gear operators. All actuators shall have adjustable memory stops.
3. Balancing valves one (1) inch and smaller shall be Armstrong Model CBV or as manufactured by TA Hydronics or approved equal.

C. Butterfly Valves:

1. Butterfly valves may be used in lieu of gate valves in chilled water and heating water systems size 2-1/2 inches and over.
2. Butterfly valves shall be Nibco, Centerline, DeZurik, Posi-Seal, or Jamesbury equal to Nibco Fig. No. 2000 lug body type, installed with welding neck companion flanges.
3. Valves shall have semi-steel or ductile iron lug body for flanged connection with alignment bolts, holes or guides, Type 416 stainless steel one (1) piece stem, upper and lower brass bushings, EPDM or nitrile (Buna-N) rubber liner, and aluminum bronze disc. Provide minimum two (2) inch extension neck on valves for insulated piping.
4. Pressure ratings shall be 150 pounds per square inch (psi) body; dead end bubble tight shut off for 200 pounds per square inch (psi) differential in either direction.
5. Actuators for valves six (6) inches and smaller shall be lever type with locking trigger with ten (10) position notched quadrant. Actuators on valves eight (8) inches and larger shall be heavy duty gear operators. All actuators shall have adjustable memory stops.
6. Butterfly valves shall not be used for steam, feedwater or condensate service.

D. Ball Valves:

1. Ball valves shall be used in all water systems size two (2) inches and smaller.
2. Ball valves shall be Nibco, Jamesbury, Apollo or Watts.
3. Three (3) piece ball valves sizes 1/2 inch to two (2) inch shall be used for all water piping systems to accommodate replacement of internal parts. Valves shall be equal to Nibco Figure No. 595-Y-66, swing out design, bronze body, full port, stainless steel ball, and stainless steel stem (ASTM A-276 Type 316), reinforced TFE seats. Body bolts and nuts shall be zinc dichromate plated steel and valve shall be suitable for 150 pounds per square inch saturated steam service. Valves shall be threaded or soldered to suit piping systems which they are installed.
4. Three (3) piece ball valves size 1/2 inch to two (2) inch shall be used for all steam and condensate piping systems to accommodate replacement of internal parts.

Valves shall be equal to Nibco Figure No. 590-CS-R-66, stainless steel trim (A-276 type 316) with threaded or socket weld ends to suit system wherein installed.

5. Valves shall be equipped with lever handle with extended stem for insulation thickness which shall indicate position of ball orifice and have stops for fully open and closed position. Construction shall be such that power actuator can be used. Ball opening shall be full pipe size.
6. Valve shall be suitable for flow in either direction and must be leak proof at all pressures up to 150 pounds per square inch gauge (psig) and temperatures from minus twenty (-20) degrees Fahrenheit to 350 degrees Fahrenheit in open or shut position.

E. Drain Valves:

1. Drain valves shall be ball type as hereinbefore specified with hose end adapter and shall be provided at low points of all piping systems, and where indicated, 3/4 inch minimum.

F. Gas Valves:

1. Shut-off valves for natural gas service shall be ball type Jamesbury Clincher Type 2000 or approved equal for sizes up to two (2) inch. Valve shall have screwed ends, brass body, and 316 stainless steel trim. Valves shall meet UL Guide Designation YRPV for gas shut-off valves.
2. Shut-off valves for natural gas service shall be ball type Jamesbury Series 5150 ANSI Class 150 or approved equal for sizes greater than two (2) inches. Valve shall be flanged ends, ductile iron body, and 316 stainless steel trim. Valves shall meet UL Guide Designation YRPV for gas shut-off valves.

G. Valve Schedule:

1. Unless otherwise specified, valves shall be Nibco, Stockham, or Crane equal to the Nibco figure numbers indicated below:
 - a. Domestic Hot, Cold, Tempered and Recirculated Water Systems:

Globe - Solder end	S-211-Y
Check - Solder end	S-413-Y
Gate - Flanged end	F-619
 - b. Chilled Water:

Gate - 2-1/2" and over	F-619
Globe - 2-1/2" and over	F-718-B
Globe - 2" and under	T-211-B
Check - 2-1/2" and over	F-918-B
Check - 2" and under	T-413-B
 - c. Steam Supply and Steam Condensate Return:

	Gate - 2-1/2" and over	F-637-33
	Gate 2" and under	T-124
	Globe - 2-1/2" and over	F-768-B
	Globe - 2" and under	T-235-Y
d.	Condensate Return Only:	
	Check - 2-1/2" and over	F-918-B
	Check - 2" and under	T-413-B
e.	Heating Water:	
	Gate - 2-1/2" and over	F-619
	Globe 2-1/2" and over	F-718-B
	Globe - 2" and under	T-211-B
	Globe - Solder end	S-211-Y
	Check - 2-1/2" and over	F-918-B
	Check - 2" and under	T-413-B
	Check - Solder end	S-413-B

2.5 PIPING SPECIALTIES

- A. Manual air vents shall be key-operated type installed as shown on drawings or as required for proper venting of equipment. Vents at top of vent chambers and coils shall be 1/4 inch ball valves.
- B. Pressure regulating valves on water fill lines serving hydronic systems shall be designed for 125 pounds per square inch gauge (psig) working pressure and set as required and shall be Watts Series U5B. Relief valves shall be Watts Series 174A, ASTM stamped for HVAC water systems.
- C. Backflow Prevention Assemblies
1. The backflow prevention assembly selection and installation shall be meet the requirements set by the University of Southern California Foundation for Cross-Connection Control and Hydraulic Research (USCFCCC & HR), SC Department of Health and Environmental Control (SC-DHEC), all current ICC plumbing codes and regulations, and local specifications.
 2. Reduced pressure backflow prevention assembly shall be Watts Series 909 or approved equal for domestic water piping systems 3/4" through 10".
 3. Double check valve backflow prevention assemblies shall be Watts Series 709 or approved equal for non-hazard domestic water piping systems 2 1/2" and larger, Watts Series 007 or approved equal for non-hazard domestic water piping systems 2" and smaller, and Watts Series 709 or approved equal for fire protection systems.
 4. Any reduced pressure or double check valve backflow prevention assembly installed in the vertical position must have been previously evaluated and approved by the University of Southern California Foundation for Cross-Connection Control and Hydraulic Research (USCFCCC & HR) for a vertical orientation.
 5. Vacuum breakers shall be Watts Series 288A for equipment and No. 8A for hose

bibbs.

- D. Automatic air vents on water systems shall be Sarco, Bell and Gossett, Taco or Metraflex equal to Sarco Type 13W, 150 pounds per square inch (psi). Provide shut-off valve on each vent. Vents above suspended ceilings shall have 1/4 inch soft copper drain line extended to nearest floor drain or service sink.
- E. Strainers shall be Mueller Steam Specialty Company, Inc., or approved equal, No. 351 for two (2) inch and smaller, No. 758 (125 lbs.) or No. 725 (250 lbs.) for 2-1/2 inch and larger. Basket strainers shall be Mueller Steam Specialty Company, Inc. or approved equal, No. 185. Provide valved blow-down connections on each strainer consisting of a ball valve set between two (2) short nipples. Blow-down valve shall be full size of strainer blow-down connection. Steam and condensate strainers shall be laid parallel to the floor to prevent the accumulation of condensate in the strainer body. Screens shall be stainless steel with perforations as follows:
- | | |
|--------------------------------------|------------------------|
| Water Service up to 2 inches | 1/32 inch perforations |
| Water Service 2.5 inches to 4 inches | 1/16 inch perforations |
| Water Service 5 inches and larger | 1/8 inch perforations |
| Steam Service | 3/64 inch perforations |
1. Contractor shall provide coarse construction strainers in each strainer or inline cone strainers in the piping system during equipment start-up periods. A list of construction strainers with their proposed location shall be submitted to the Architect for approval. After systems have been flushed clean and are fully operational construction strainers shall be removed and turned over to the Owner for accounting. Final strainer elements shall be installed after all construction strainers have been accounted for.
- F. Coil flowmeter fittings shall be Taco Sentinel or approved equal, brass construction suitable for 150 pounds per square inch gauge (psig) working pressure and 250 degrees Fahrenheit operating temperature and shall be equipped with brass quick-disconnect valves for connecting flowmeter. The fitting shall have a maximum head loss of one (1) foot water at design flow rate and shall have an accuracy of plus or minus five percent for water temperatures from fifty (50) degrees Fahrenheit to 215 degrees Fahrenheit. Provide one (1) Taco differential pressure gauge Part No. 7007 or approved equal, compatible with the flow meter fittings supplied.
- G. Flowmeters shall be equal to Rosemount Mass Probar or approved equal. Flow meter shall utilize an annubar to measure the complete flow profile. The electronics shall be mounted integral with the head of the unit. Unit shall bear Factory Mutual Approval. System accuracy shall be plus/minus 1.3% of mass flow rate. All wetted parts shall be 316 stainless steel with galls filled TFE O-rings and Teflon manifolds.
- H. Install wells in chilled water and heating water piping for automatic temperature control sensors. Exact locations and number of wells required shall be determined through coordination with the work required under Division 23, Section "Building Automation

and Temperature Control System".

I. HVAC Piping Pressure Gauges:

1. Shall be Ashcroft, Terrice, Crosby or Marsh equal to Ashcroft "Quality" Type 1010 or 1014, 4-1/2 inches diameter case, bottom or back connected for easy reading. Dial shall have black letters on white background.
2. Each gauge shall be mounted within six (6) feet of the floor on backboard or on pipe. Submit gauge locations and scale ranges for approval. Normal operating point shall occur at 1/3 to 2/3 of the gauges range. Pressure gauges shall be suitable for field calibration and be provided with pressure snubbers.
3. Provide Crane 1/4 inch ball valve where "gauge cocks" are indicated.
4. Select gauge such that at normal service the gauge pointer is at the middle half of the scale range.

J. Laboratory Gas Piping Pressure Gauges:

1. Gages shall be safety-type with rear blowout plug or panel, clear plastic cover, and sides and front consisting of one integral part.
2. Range shall be at least 1.2 times the system relief pressure.
3. Gages shall be installed with snubbers and 1/4 inch bronze needle valves.
4. All gages shall be rated for the specific gas, pressure rating, and ambient conditions.

K. Discharge from laboratory gas piping relief valves shall be piped full size and extended to the outside where required by code, standard, or drawings.

L. Thermometers shall be digital vari-angle thermometer manufactured by Weiss Instruments, Inc. or equal. Provide extension necks where services are insulated. The digital thermometers shall have the following characteristics:

1. Casing: Hi-impact ABS
2. Range: -50°F to 300°F
3. Display: 1/2" LCD digits, wide ambient formula
4. Accuracy: 1% of reading or 1°F, whichever is greater
5. Resolution: 1/10° between -19.9°F to 199.9°F
6. Recalibration: Through case potentiometer adjustment
7. Lux rating: 10 Lux (one foot-candle)
8. Update: 10 seconds
9. Ambient Operating Temperature: -30°F to 140°F
10. Ambient Temperature Error: Zero
11. Ambient Operating Humidity: 100%
12. Sensor: Glass passivated thermistor - NTC
13. Steam Assemblies:
 - a. INDUSTRIAL GLASS - Full conformance with Federal Spec GG-T-321D. Fully interchangeable with Industrial Glass Thermometers.

- b. BIMETALLIC - Full conformance with ASME B40.3-1990. Fully interchangeable with Bimetallic Dial Thermometers.

M. All gauge ports, nipples and fittings shall be brass. Steel is not acceptable.

2.6 TEST PLUGS

- A. Pressure and temperature test plugs where indicated or required shall be 1/4 inch npt fittings, suitable to receive either a 1/8 inch outside diameter (OD) temperature or pressure probe. Fittings shall be solid brass with Nordel valve core, fitted with a color coded marked cap with gasket. The entire assembly shall be rated at 1000 pounds per square inch gauge (psig). Plugs shall be manufactured by Peterson Equipment Company, Inc., Richardson, Texas, or Sisco P/T plugs.

2.7 STEAM SYSTEM SPECIALTIES

A. Steam System Strainers:

1. Provide Y Type strainers in compliance with Fluid Control Institute Standard 73-1, full size of connecting pipe. Provide integral blowdown connection.
2. Low & Medium Pressure Steam and Condensate Return:
 - a. Strainers shall be rated for 125 psig saturated steam.
 - b. Strainers 2 inches and larger shall be flanged, cast iron body. Strainers smaller than 2-inches shall be cast iron or bronze with screwed connections.
 - c. Strainer screens shall be type 304 stainless steel, free area not less than 2-1/2 times pipe area, with 20 mesh perforations.
 - d. Strainers shall be Spirax/Sarco type IT, CI-125 or F-125, or equal by Watts or Armstrong.
3. High Pressure Steam:
 - a. Strainers shall be rated for 250 psig saturated steam.
 - b. Strainers 2 inches and larger shall be flanged cast iron. Strainers smaller than 2-inches shall be cast iron, or bronze body with screwed connections.
 - c. Strainer screens shall be type 304 stainless steel, free area not less than 2-1/2 times pipe area, with 20 mesh perforations.
 - d. Strainers shall be Spirax / Sarco type IT, CI-250 or F-250, or equal by Watts or Armstrong.

B. Steam Traps:

1. Each type trap shall be the product of a single manufacturer. All trap bodies shall be constructed to permit ease of removal and service of working parts without disturbing connecting piping. Floats and linkages shall provide sufficient force to open trap valve over full operating pressure range available to the system. Unless

otherwise indicated on the drawings, traps shall be sized for capacities indicated at minimum pressure drop.

2. Steam Traps on Low Pressure Steam (15 psig and below):
 - a. Equipment or Process (with modulating control valve): Use Float and Thermostatic (F&T) type rated for 15 psi working pressure. Each trap shall be sized using 1 psi differential pressure at 2 times scheduled flow rate of equipment, based on a condensate leg of 18 inches at trap inlet and gravity flow to the main return line or receiver. Condensate may not be lifted to the return line unless otherwise approved by the Engineer. Traps shall be Spirax/Sarco UFT14 float & thermostatic steam trap with universal strainer connector with blowdown (parallel connection).
 - b. Main Line drips: Use balanced pressure thermostatic type rated for 15 psi working pressure. Main line drip traps shall be selected using 70 percent of design differential pressure at required flow. Provide trap sets at all low points and at 200 foot intervals on the horizontal main lines. Condensate may not be lifted to the return line unless otherwise approved by the Engineer. Traps shall be Spirax/Sarco UBP32 thermostatic steam trap with universal strainer connector with blowdown (bolt-on trap).

3. Steam Traps on Medium or High Pressure Steam (over 15 psig):
 - a. Equipment or Process (with modulating control valve): Use Float and Thermostatic (F&T) type rated for working pressure. Traps on equipment using 15 to 30 psig steam shall be sized for 3 times scheduled flow rate of equipment at 2 psig differential pressure. Traps on equipment using 30 psig steam and above shall be sized for 2 times scheduled flow rate of equipment at 5 psig differential pressure. Condensate may not be lifted to the return line unless otherwise approved by the Engineer. Traps shall be Spirax/Sarco UFT14 float & thermostatic steam trap with universal strainer connector with blowdown (parallel connection).
 - b. Main Line drips: Use Thermodynamic type on 15 psig and above. Traps shall be sized as indicated on plans. Main line drip traps shall be selected using 70 percent of design differential pressure. Provide drip trap sets at all low points and natural drainage points such as, ends of mains, bottoms of risers, and ahead of pressure regulators, control valves, isolation valves, expansion joints. On straight runs of pipe with no natural drainage points, install drip legs at 200 foot intervals on the horizontal main lines. Condensate may be lifted to the return line. Traps shall be Spirax/Sarco UTD52L thermodynamic steam trap with universal strainer connector with blowdown (bolt-on trap).

4. Float and Thermostatic (F&T) traps shall comply with ASTM A126, cast iron body and bolted cover, with replaceable stainless steel float, lever and valve assembly. Thermostatic air vent shall be balanced pressure, stainless steel or bronze bellows with stainless steel valve and seat. Float and thermostatic trap shall not be installed in a manner to lift condensate up to a return line. F & T trap shall be Spirax/Sarco FT-15 to FT-200 or equal by Hoffman Specialty or

- Armstrong.
5. Balanced pressure traps shall be maintenance-free and tamper-proof design of all stainless steel construction with forged body and drawn cover completely sealed against leakage. Operating element to be a solidly liquid-filled thermostatic capsule which self adjusts to all pressures to 435 psig. Trap shall vent air freely and withstand waterhammer, freezing and superheat. Balanced pressure trap shall be Spirax/Sarco BP32 or equal by Hoffman Specialty or Armstrong.
 6. Thermodynamic traps with integral strainers shall be stainless steel body, disc, insulating cap and integral strainer with blowdown connection, rated for 600 psig. Trap shall be Spirax/Sarco TD42L or equal by Hoffman Specialty or Armstrong.
 7. Universal connector (bolt-on) steam traps shall consist of stainless steel pipeline connector with integral strainer & blowdown which when installed remains in the line permanently. Stainless steel trap shall be attached to the connector by two bolts to enable simple and rapid installation and replacement. Bolting pattern on connector shall be universal among manufacturers and shall be capable of accepting thermodynamic, balanced pressure thermostatic, inverted bucket, or float & thermostatic steam traps. Universal traps shall be Spirax Sarco UTD52, UBP32, UFT14 or equal.
- C. Combination Vacuum Breaker/Air Vent: Cast iron body, balanced pressure bellows, stainless steel (renewable) valve and seat, rated 125 psig working pressure, 1/2-inch screwed connections. Vacuum breaker shall be stainless steel construction, including the body, threaded cap, valve and valve seat. Air vent shall be balanced pressure type that responds to steam pressure-temperature curve and vents air at any pressure. Combination vacuum breaker/balanced pressure thermostatic air vent shall be Spirax/Sarco VB-VS, or equal by Watson-McDaniel or Armstrong.
- D. Unions, Flanges and Couplings
1. Use unions for pipe 2 inches and smaller. 150 psig galvanized malleable iron, threaded.
 2. Use flanges for pipe 2 1/2" inches and larger. 150 psig forged steel, slip on.
 3. Gaskets: 1/16 inch thick, non-asbestos graphite fiber.
 4. Dielectric connections shall be union with galvanized or plated steel threaded end, copper solder and, water impervious isolation barrier.
- E. Steam pressure regulating valves shall be Spence Regulator Type ED or approved equal. Regulators shall have the capacity as indicated on the drawings.
- F. Relief valves for steam systems sizes two (2) inches and less shall be Spirax Sarco, ASME Standard 6000 Series or approved equal. Relief valves for steam systems sizes 2.5 inches and larger shall be Lonergan, ASME Standard D Series or approved equal.

2.8 DIELECTRIC FITTINGS

- A. General: Provide assembly or fitting with insulating material isolating joining of

dissimilar metals, to prevent galvanic action and stop corrosion.

- B. Description: Combination of copper alloy and ferrous; threaded, soldered, plain end, or weld neck types matching piping system materials.
- C. Insulating Material: Suitable for system fluid, pressure, and temperature.
- D. Dielectric Unions: Factory-fabricated, union assembly, for 250 psig minimum working pressure at 180 deg. F.
- E. Dielectric Flange Insulating Kits: Field assembled, companion flange assembly, full face or ring type. Components include neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers. Provide Class 150 or Class 300 flanges to match system pipe requirements.
- F. Dielectric Couplings: Galvanized steel coupling with inert and non-corrosive, thermoplastic lining, threaded with 300 psig minimum working pressure at 225 deg. F.
- G. Dielectric Nipples: Electroplated steel nipple with inert and non-corrosive, thermoplastic lining, threaded with 300 psig minimum working pressure at 225 deg. F.

2.9 FLEXIBLE CONNECTORS

- A. General: Provide stainless steel braided flexible connectors with design pressure and temperature rating meeting or exceeding the test pressures and operating temperatures of the systems in which they are installed. Pipe sizes 2-inch and smaller shall be socket welded or threaded matching system requirements. Pipe sizes above 2-inch shall be Class 150 or Class 300 flanged matching system requirements.
- B. Stainless steel hose / Steel pipe, flexible connectors: Corrugated, stainless steel inner tubing covered with stainless steel single wire braid. Include steel nipples or steel flanges welded to hose. Minimum length shall be three times pipe diameter up to 4-inch pipe size and two times pipe diameter up to 18-inch pipe size.

2.10 PIPE ANCHORS

- A. All pipe lines shall be anchored where specified herein, indicated on drawings and where required to prevent uncontrolled movement. Anchors shall be constructed of steel sections and plates, assembled by bolting or welding and secured to the building structure by means of bolts, clamps or welding. Anchors shall prevent both axial and lateral movement of the lines. Anchor vertical pipes by means of clamps welded to pipe and secured to wall or floor construction. Submit details of anchors for approval.
- B. Anchor piping adjacent to flexible pipe connectors to prevent connector from expanding against its restraining bolts and also to keep the pipe on both sides of the connector in

alignment.

2.11 EXPANSION

- A. All piping shall be so installed that it will in no way be distorted or strained by expansion or contraction. Except as noted, all expansion and contraction shall be taken up by means of swing joints, loops, bends or long offsets. Swing joints made up with at least three (3) elbows shall be provided in branches from mains in runouts. Size loops for the total pipe expansion without cold springing, but field cold spring 1/2 the pipe on expansion corrected for ambient temperature.
- B. Where expansion joints are indicated or required, select joints with a traverse of 150 percent of the pipe expansion from an ambient of forty (40) degrees Fahrenheit to the maximum system operating temperature.
- C. Expansion joints two (2) inches and larger shall have flanged ends, except when installed in copper piping systems.
- D. All expansion joints shall be suitable for minimum operating pressure and temperature of 150 pounds per square inch (psi) and 300 degrees Fahrenheit respectively.
- E. Expansion joints shall be of the following types:
 - 1. Corrugated Type - Flexonics "Low-Corr" joints for pipes three (3) inches and larger. Flexonics Model H or HB for pipes smaller than three (3) inches.
 - 2. Slip Type - Flexonics "Slip Pakt" with anchor base.
- F. Submit, for approval, manufacturers' shop drawings of each expansion joint provided depicting length of pipe, location of anchors and guides, calculated expansion offset and type of joint employed.

2.12 PIPE GUIDES

- A. Install pipe guides where indicated on drawings or where required for proper installation of expansion loop. Limit use of guides with expansion loop to points shown or where required to prevent buckling of pipe whether indicated or not.
- B. Do not use pipe guides as pipe supports.
- C. Provide factory made cast semi-steel or other heavy fabricated steel consisting of a bolted two (2)-section outer cylinder and base with a two (2)-section guiding spider welded or bolted tight to the pipe, of sufficient size to clear pipe insulation and long enough to prevent over-travel of spider in cylinder. Furnish a guide sleeve of a length not less than the length of pipe expansion plus the spider length.

- D. When installed in cooling systems, guides must permit the application of thermal insulation.

2.13 MISCELLANEOUS MATERIALS FOR SUPPORTS, HANGERS, ANCHORS AND GUIDES

- A. The Contractor shall provide all miscellaneous materials required to properly install all supports, hangers, anchors and guides, including:
 - 1. Steel Plates, Shapes and Bars: Provide products complying with ASTM A36.
 - 2. Cement Grout: Portland Cement (ASTM C 150, Type I or Type III) and clean uniformly graded, natural sand (ASTM C 404, Size No. 2). Mix at a ratio of 1.0 part cement to 3.0 parts sand, by volume, with minimum amount of water required for placement and hydration.
 - 3. Heavy-Duty Steel Trapezes: Fabricate from steel shapes selected for loads required; weld steel in accordance with AWS standards.

PART 3 - EXECUTION

3.1 CLEANING, FLUSHING, INSPECTING

- A. General: Clean exterior surfaces of piping systems of superfluous materials, and prepare for application of specified coatings (if any.) Clean interior of pipe by mechanical means to remove welding slag, metal filings, dirt, and debris. Flush out piping systems to the satisfaction of the Owner before proceeding with required tests. Inspect each run of each system for completion of joints, supports, and accessory items.
 - 1. Inspect Power Piping in accordance with procedures of ASME B31.1.
- B. The Contractor shall submit a detailed pipe flushing plan detailing the efforts to be taken to ensure a completely clean piping system. Any damage to existing or new equipment or components shall be repaired or replaced at the Contractor's expense to the satisfaction of the Owner.
- C. The Contractor shall clean and flush all installed piping systems with a clean water solution with additives formulated to assist in the removal of welding slag, metal filings, oil, and grease. Flushing operations shall maintain a minimum velocity of six feet per second for a minimum four hour time frame. Repeat flushing operations to the satisfaction of the Owner and until flushing water is completely clear. System pumps may be utilized for flushing operations with fine mesh start-up screens. Clean screens often and replace with final system screens at completion of flushing operations. Provide temporary equipment bypasses for all components where metal slag and filings are prone to collect. The Contractor shall provide all temporary equipment and piping necessary to complete the flushing operations.
- D. Refill and vent water systems being sure to add water after venting to completely fill system.

- E. Provide water treatment services as indicated in other Division 23 specification Sections.

3.2 PIPING INSTALLATION

- A. Install piping without undue stress or strain in locations shown and run parallel to the lines of the building, except to grade them as specified in neat and workmanlike manner using a minimum of fittings. Provide such fittings, valves and accessories as may be required to meet the conditions of installation. Contractor shall inform himself fully regarding any peculiarities and limitations of space available for installation of material under each section of specifications. Install piping to suit necessities of clearance with ducts, conduits, and other work, and so as not to interfere with any passages or doorways and allow sufficient head room at all places. Use proper reducing fittings for changing piping sizes.
- B. Cut pipes accurately to measurements established in the field in a neat and workmanlike manner without damage or without forcing or springing. Perform cutting by means of an approved type of mechanical cutter of the wheel type where practicable. Ream pipe after cutting to remove all burrs.
- C. Because of the small scale of the drawings, it is not possible to indicate all offsets, fittings and accessories that may be required. Carefully investigate the architectural and structural conditions affecting the work, and arrange such work accordingly, providing such fittings, and accessories as may be required to meet such conditions. Drawings (plans, schematics, and diagrams) indicate the general location arrangement and restrictions of the piping systems. Location and arrangement of piping layout shall take into consideration pipe sizing and friction loss, expansion, pump sizing, and other design considerations. So far as practical, install piping as indicated on the Contract Drawings unless deviations to layout are approved on the Coordination Drawings. The Contract Drawings are diagrammatic in nature and are not welding fit-up documents. The Contractor is responsible for a complete installation. Refer to individual system specifications for requirements for coordination drawing submittals.
- D. Install at low points of gas piping and at the foot of each riser and each drip, a "T" fitting and six (6) inch long capped drip pocket of same size and riser or drip. Grade horizontal gas pipe to prevent traps. Pipe all green gas vents to the exterior as required by Code. Make all joints with graphite and oil and in accordance with National Fuel Gas Code requirements.
- E. Install unions and flanges where shown and on each side of all pieces of equipment and other similar items, and in such a manner that the unions can be readily disconnected. Do not place any union or flange in a location which will be inaccessible after completion of the project unless so shown on drawings or specified.
 - 1. Unions in steel pipe 2 1/2 inches and smaller, shall be 250 pound malleable iron, brass seat type. Use 150 pound forged steel flanges for piping three (3) inches and larger. Gaskets shall be 1/8 inch thick.

2. Unions in copper pipe two (2) inches and smaller shall be wrought copper with red bronze ring nut. Use 150 pound ASME copper flanges for piping 2 1/2 inches and larger. Use dielectric unions or couplings where nonferrous metal is joined to ferrous metal.
- F. Use reducing fittings, eccentric where required to prevent pocketing of air and water or both, to make changes to pipe sizes.
- G. HVAC piping shall be installed plumb, level, and square with low point drains and high point vents. Steam, condensate, drain and sanitary waste and vent piping shall be sloped per code.
- H. Contractor shall fully coordinate the installation of all piping systems with all other trades including sheet metal, electrical, sprinkler, ceiling systems, etc.

3.3 JOINTS

A. Steel Pipe Joints:

1. Threaded Pipe Joints, 2” and Smaller: Thread pipe with tapered pipe threads in accordance with ANSI B1.20.1. Cut threads full and clean using sharp dies. Ream threaded ends to remove burrs and restore full inside diameter. Apply pipe joint lubricant or sealant suitable for the service for which the pipe is intended on the male threads at each joint and tighten joint to leave not more than 3 threads exposed. Align threads at point of assembly. Tighten joint with wrench. Do not use pipe or pipe fittings with threads that are damaged or corroded. Do not use pipe sections that have cracked or open welds. Comply with the provided pipe material classification requirements for allowance of threaded pipe within each service type. Threaded pipe will not be allowed for high temperature hot water service.
2. Pipe Larger Than 2”:
 - a. Weld Pipe joints in accordance with ASME Code for Building Services Piping, 31.9. Bevel weld end to end. Sleeve welds shall not be permitted.
 - b. Install flanges on all valves, apparatus, and equipment. Weld pipe flanges to pipe ends in accordance with ASME Code for Building Services Piping. Clean flange faces and install gaskets. Tighten bolts gradually and uniformly using a torque wrench to torque specified by manufacturer or flange and sequence flange bolts, to provide uniform compression of gaskets. Use suitable lubricants on bolt threads.

B. Non-Ferrous Pipe Joints:

1. Brazed and Soldered Joints: For copper tube and fitting joints, braze joints in accordance with ANSI B31.31.0 – Standard Code for Pressure Piping, Power Piping and ANSI B9.1 – Standard Safety Code for Mechanical Refrigeration.

2. Thoroughly clean tube surface and inside surface of the cup of the fittings, using very fine emory cloth, prior to making soldered or brazed joints. Wipe tube and fittings clean and apply flux. Flux shall not be used as the sole means for cleaning tube and fitting surfaces.
- C. Weld pipe joints in accordance with ASME Code for Building Services Piping, B31.9. Weld piping in accordance with recognized industry practice and as follows:
1. Weld pipe joints only when ambient temperature is above 0 degree F.
 2. Bevel pipe ends at a 37.5 degree angle, smooth rough cuts, and clean to remove slag, metal particles, and dirt.
 3. Use pipe clamps or tack-weld joints with 1” long welds; 4 welds for pipe sizes to 10”, 8 welds for pipe sizes 12” to 20”.
 4. Build up welds with stringer-bead pass, followed by hot pass, followed by cover or filler pass. Eliminate valleys at center and edges of each weld. Weld by procedures which will ensure elimination of unsound or unfused metal, cracks, oxidation, blow-holes, and non-metallic inclusions.
 5. Do not weld out piping system imperfections by tack-welding procedures; refabricate to comply with requirements.
- D. Flanged Joints: Match flanges within piping system, and at connections with valves and equipment. Clean flange faces and install gaskets. Tighten bolts to provide uniform compression of gaskets.
- E. Hubless Cast-Iron Joints: Comply with coupling manufacturer’s installation instructions.

3.4 WORKMANSHIP

- A. Cut pipes accurately to measurements established at structure. Install pipes without springing or forcing.
- B. Clear windows, doors, and other openings with all pipes and ductwork.
- C. Arrange pipes to permit expansion and contractions without misalignment or damage.
- D. During construction all openings in piping and equipment shall be closed with caps or plugs to keep out all foreign matter and to prevent leakage.
- E. All piping in finished spaces shall be run concealed unless otherwise indicated.

3.5 WELDING

- A. Refer to Division 23, Section “Mechanical and Electrical General Provisions”.

3.6 SLEEVES AND PLATES

- A. Sleeves shall be provided by the trade installing the pipes 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 passing through all floor slabs and concrete, plaster, gypsum, or masonry wall construction.
- C. Where pipe motion due to expansion and contraction will occur, make sleeves of sufficient diameter to permit free movement of pipe. Where sleeves pass insulated pipes, the sleeves shall be large enough to pass the pipe 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 wall.
 - 2. Terminate sleeves two (2) inches above finished floors.
- D. Submit for approval shop drawings showing size, type, and location of all sleeves and penetrations through poured concrete walls. See Architectural Drawings for extent and location of such walls.
- E. All pipe sleeves shall be constructed of Schedule 40 steel pipe unless otherwise indicated on the drawings.
- F. See drawings for additional sleeve requirements.
- G. 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. Caulk the annular space with elastic caulk compound or as noted to make tight.
- H. Where watertight sleeves are indicated, provide Link Seal rubber seals, as manufactured by Thunderline Corporation, between pipes and sleeves, or provide sleeves as detailed.

3.7 STEAM SYSTEMS

- A. Locate and orient valves to permit proper operation and access for maintenance of packing, seat and disc. Generally locate valve stems in overhead piping in horizontal position. Provide a union adjacent to one end of all threaded end valves. Control valves require eccentric reducers to connect to pipe sizes shown on the drawing.

- B. Provide full line size strainers as indicated and ahead of all steam traps, pressure regulating/reducing valves, and temperature control/regulating valves unless integral strainer is provided. Provide each strainer with a valved blow-off, full size of blow-off connection. Strainers installed in steam piping systems shall be oriented in the side position.
- C. Install steam traps with union or flanged connection on both ends of trap with shut-off valves, inlet strainer and outlet check valve. Install steam traps in accessible locations as close as possible to connected equipment, but not more than 48” from equipment. Provide dirt leg with blow down as recommended by manufacturer. Install drip traps close to drip leg. Sized drip legs at vertical risers same size as pipe and extend beyond rise. Size drip legs at other locations same diameter as main, up to 5”. In steam mains 6” and larger, dirt leg size can be reduced, but in no case less than 4” NPS.
- D. Install steam pressure gauges with siphons and isolation valves both upstream and downstream of pressure reducing valves, heat exchangers, condensate return pumps, and at other locations indicated on the drawings.
- E. Install premanufactured accessories and equipment in accordance with the manufacturer's instructions and recommendations.

3.8 FLOW METER FITTINGS

- A. Locate and arrange piping, both upstream and downstream of fitting to conform to the manufacturer's published literature.
- B. When water flow is measured in horizontal pipe, locate the connection nipples at or slightly above the horizontal centerline of the pipe to minimize the entrance of gases and impurities.
- C. Provide each fitting with an integral tab, or a metal tag on a stainless steel wire, extending outside the pipe covering, and stamp or print in a plainly visible position the manufacturer's name and address; the model number of the meter to which it is to be connected; the name, number or location of the equipment served; the specified rate of flow and the multiplier (including unity, where applicable) to be applied to the meter reading.
- D. Provide fittings with shutoff valves and with quick connecting hose fittings for portable meters.

3.9 TESTS

- A. The following tests shall be conducted by the Contractor and all piping shall be proven tight in the presence of the Architect or his representative. These tests shall be conducted before any insulation is installed and any insulation installed prior to tests shall be

removed. Provide all equipment and labor required. Tests shall be at least four (4) hours in duration, after all piping has been proven tight. Piping may be tested in sections as approved by the Architect. Tests shall be as specified herein and a written test report shall be submitted to the Architect within two (2) days following each individual test. All test reports shall be included in the operation and maintenance manuals.

- B. The domestic water piping shall be hydrostatically tested to 150 pounds per square inch gauge (psig). All openings in the water piping shall be plugged; the system, or portion thereof, filled with water, and tested with a pump to a pressure of 150 pounds per square inch gauge (psig). Domestic water system piping shall be disinfected after tests in accordance with Baltimore City and Maryland State Health Department Requirements.
- C. The sanitary and miscellaneous drain systems shall be hydrostatically tested. Tests shall be as required by code and as a minimum shall comprise of the plugging of all openings in the lines, filling the system (or portion thereof), with water until all joints are proven tight. Piping shall be tested with a minimum head of ten (10) feet of water.
- D. All heating water, chilled water and steam piping shall be hydrostatically tested to 1-1/2 times the system working pressure or a minimum of 100 pounds per square inch gauge (psig), whichever is greater.
- E. Fire protection system shall be tested in accordance with applicable NFPA Standards. Refer to Division 15, Section "Fire Protection".
- F. Gas piping shall be tested to 1-1/2 times the system working pressure or a minimum of 50 pounds per square inch gauge (psig), whichever is greater. Test procedure shall meet the requirements of the National Fuel Gas Code and applicable local codes. Test procedure shall also satisfy the local code authority or enforcement agency.
- G. All heating water, chilled water and steam piping systems shall be filled with water and thoroughly flushed clean of foreign matter after erection and before connection of equipment.
- H. After heating water and chilled water systems have received their final filling, employ a qualified water testing laboratory to analyze the water and to provide proper treatment to bring the pH to a level between 6.5 and 7.25. Furnish three (3) certified copies of the test report to Architect. Include the test report data, water analysis, any treatment provided for initial treatment, and recommended type of continuous treatment to be provided for the make-up water to the systems.

3.10 STERILIZATION

- A. Domestic water system piping shall be disinfected in accordance with State of South Carolina Health Department requirements and Section 610 of the 2009 International Plumbing Code. A written test report shall be submitted to the Owner and Architect within five (5) days following the sterilization process and before occupancy is granted.

All written reports shall be included in the operation and maintenance manuals.

- B. After final testing for leaks, all new domestic water lines shall be thoroughly flushed by Contractor to remove foreign material. Before placing the systems in service, Contractor shall engage a qualified water service Contractor to sterilize the new water lines. Sterilization shall include as a minimum the following procedure:
1. Through a ¾” hose connection in the main entering the building, pump in sufficient sodium hypochlorite to produce a free available chlorine residual of not less than 200 parts per million. The Contractor shall provide plumbing connections and power for pumping chlorine into the system.
 2. Proceed upstream from the point of chlorine application opening all faucets and taps until chlorine is detected. Close faucets and taps when chlorine is evident.
 3. When chlorinated water has been brought to every faucet and tap with a minimum concentration of 200 parts per million chlorine, retain this water in the system for three (3) hours. CAUTION: Over-concentration of chlorine and more than three (3) hours of retention may result in damage to piping system which shall be replaced by the Contractor at no additional cost.
 4. At the end of the retention period, no less than 100 parts per million of chlorine shall be present at the extreme end of the system.
 5. Proceed to open all faucets and taps and thoroughly flush all new lines until the chlorine residual in the water is less than 1.0 parts per million.
 6. Obtain representative water samples, at least two (2), from the system for analysis by a recognized bacteriological laboratory.
 7. If the samples tested for coliform organisms is negative, a letter and laboratory report shall be submitted by the water service organization to the Contractor, certifying successful completion of the sterilization.
 8. If any samples tested indicate the presence of coliform organism, the entire sterilization procedure shall be repeated.

3.11 MOLD AND CONDENSATION PREVENTION

- A. Piping Systems: Cold piping systems (such as cold water) shall not be operated prior to insulation and vapor barrier installation in order to prevent condensation on the piping.
- B. Air Systems: Air handling systems shall not be operated at supply air temperatures below fifty (50) degrees F and all supply air ductwork shall be insulated prior to operation. Coils shall be insulated to prevent condensation when heating valve is closed. Air systems shall not be operated in portions of the building not yet fully enclosed, where systems can be exposed to warm, humid air conditions.
- C. Room thermostats shall not be set lower than sixty-eight (68) degrees F. Programmable thermostats shall be set to prevent lower temperature setting from the exterior of the thermostat by room occupants.
- D. Contractor shall notify the Architect immediately if signs of condensation or mold are

discovered.

END OF SECTION

SECTION 230548 - MECHANICAL VIBRATION, SOUND AND SEISMIC CONTROLS

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.
- B. The 2009 International Building Code and SEI/ASCE 7-05 Standard apply to all work associated with the seismic installation of all new mechanical and electrical equipment. Refer to Architectural and Structural drawings for seismic loads and additional seismic information.

1.2 SCOPE

- A. This section includes requirements for items of equipment, materials and procedures which are common to more than one section of Division 22 and 23. This section applies to all sections of Divisions 22 and 23.

1.3 SUMMARY

- A. This Section includes the following:
 - 1. Elastomeric isolation pads and mounts.
 - 2. Restrained elastomeric isolation mounts.
 - 3. Freestanding and restrained spring isolators.
 - 4. Housed spring mounts.
 - 5. Elastomeric hangers.
 - 6. Spring hangers.
 - 7. Spring hangers with vertical-limit stops.
 - 8. Thrust limits.
 - 9. Pipe riser resilient supports.
 - 10. Resilient pipe guides.
 - 11. Freestanding and restrained air spring isolators.
 - 12. Restrained vibration isolation roof-curb rails.
 - 13. Seismic snubbers.
 - 14. Restraining cables.
 - 15. Steel and inertia vibration isolation equipment bases.
 - 16. Certification of seismic restraint designs and installation supervision.
 - 17. Certification of seismic attachment of housekeeping pads.

- B. Work includes vibration control devices, materials, and related items for mechanical and electrical systems. Perform all work as shown on the drawings and as specified herein to provide complete vibration isolation systems in proper working order.
- C. The requirements of Division 23, Section “Mechanical and Electrical General Provisions” shall apply to work specified under this section.

1.4 DEFINITIONS

- A. A_v : Effective peak velocity related acceleration coefficient.
- B. OSHPD: Office of Statewide Health Planning & Development for the State of California. OSHPD assigns a unique anchorage preapproval "R" number to each seismic restraint it tests. The number describes a specific device applied as tested.
- C. Life Safety Systems:
 - 1. All systems involved with fire protection.
 - 2. All systems involved with and/or connected to emergency power supply including all generators, transfer switches, transformers and all flowpaths to fire protection and/or emergency lighting systems.
 - 3. All life support systems.
 - 4. Fresh air relief systems on emergency control sequence including air handlers, conduit, duct, dampers, etc.
 - 5. All life safety equipment has an asterisk on the equipment schedule.
- D. Positive Attachment: A positive attachment is defined as a cast-in anchor, a drill-in wedge anchor, a double sided beam clamp loaded perpendicular to a beam, or a welded or bolted connection to structure. Single sided "C" type beam clamps for support rods of overhead piping, ductwork, fire protection, electrical conduit, bus duct, or cable trays, or any other equipment are not acceptable on this project as seismic anchor points.
- E. Transverse Bracing: Restraint(s) applied to limit motion perpendicular to the centerline of the pipe, duct or conduit.
- F. Longitudinal Bracing: Restraint(s) applied to limit motion parallel to the centerline of the pipe, duct or conduit.
- G. Failure: For the purposes of this project, failure is defined as the discontinuance of any attachment point between equipment or structure, vertical permanent deformation greater than 1/8" and/or horizontal permanent deformation greater than 1/4".

1.5 SUBMITTALS

- A. Product Data: Include load deflection curves for each vibration isolation device.

- B. Shop Drawings: Signed and sealed by the manufacturer's qualified professional engineer. Before ordering any products, submit shop drawings of the items listed below. The shop drawings must be complete when submitted, be based on equipment actually purchased and must be presented in a clear, easily understood form. Incomplete or unclear presentation of shop drawings may be reason for rejection of the submittal. Include the following:
1. Product Description: A complete description of products to be supplied, including product data, dimensions, specifications, and installation instructions.
 2. Selection Data: Detailed selection data for each vibration isolator supporting equipment, including:
 - a. Equipment identification mark;
 - b. Isolator type;
 - c. Actual load;
 - d. Static deflection expected under the actual load
 - e. Specified minimum static deflection.
 3. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases. Seismic restraint calculations must be provided for all connections of equipment to the structure. Calculations must be stamped by the manufacturer's registered professional engineer with at least five years of seismic design experience, licensed in the state of the job location.
 4. 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.
 5. Vibration Isolation Base Details: Detail fabrication, 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.
 6. Seismic-Restraint Details: Detail fabrication and attachment of seismic restraints and snubbers. Show anchorage details and indicate quantity, diameter, and depth of penetration of anchors.
 7. Submittals for Interlocking Snubbers: Include load deflection curves up to 1/2-inch deflection in x, y, and z planes.
 8. Seismic restraint calculations.
 9. Provide Approved Agencies Certificate of Compliance meeting Seismic Category D for all components. Tests shall include anchorage, structural and on line capability from analytical or shaker test method.
- C. Submission of samples may be requested for each type of vibration isolation device. After approval, samples will be returned for installation at the job if requested. All costs associated with submission of samples shall be borne by the Contractor.

- D. Welding certificates.
- E. Manufacturer Seismic Qualification Certification: Submit certification that all specified equipment will withstand seismic forces identified in "Performance Requirements" Article above. Include the following:
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculations.
 - 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."
 - 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.

1.6 MANUFACTURER RESPONSIBILITIES

- A. Manufacturer of vibration isolation and seismic restraint equipment shall have the following responsibilities:
 - 1. Determine vibration isolation and seismic restraint sizes and locations.
 - 2. Provide piping and equipment isolation systems and seismic restraints as scheduled or specified.
 - 3. Guarantee specified isolation system deflection.
 - 4. Provide installation instructions, drawings and field supervision to assure proper installation and performance.
 - 5. Provide certification by a licensed engineer employed by the manufacturer that all mounts and restraints meet the project requirements for seismic loading.
- B. Substitution of internally isolated mechanical equipment in lieu of the specified isolation of this Section must be approved for individual equipment units and is acceptable only if above acceleration loads are certified in writing by the equipment manufacturer and stamped and sealed by a licensed civil or structural engineer.

1.7 RELATED WORK

- A. Housekeeping Pads
 - 1. Housekeeping pad reinforcement and monolithic pad attachment to the structure details and design shall be prepared by the restraint vendor if not already indicated on the drawings.
 - 2. Housekeeping pads shall be coordinated with restraint vendor and sized to provide a minimum edge distance of ten (10) bolt diameters all around the outermost

anchor bolt to allow development of full drill-in wedge anchor ratings. If cast-in anchors are to be used, the housekeeping pads shall be sized to accommodate the ACI requirements for bolt coverage and embedment.

B. Supplementary Steel

1. Provide any incidental materials and supplementary support steel for all equipment, piping, ductwork, roof mounted equipment, etc., such as mounting brackets, attachments and other accessories, that may be needed to meet the requirements stated herein, even if not expressly specified or shown on the drawings, at no additional cost.

C. Attachments

1. Contractor shall supply restraint attachment plates cast into housekeeping pads, concrete inserts, double sided beam clamps, etc. in accordance with the requirements of the vibration vendor's calculations.

1.8 QUALITY ASSURANCE

- A. Seismic-restraint devices shall have horizontal and vertical load testing and analysis performed according to OSHPD and shall bear anchorage preapproval "R" number, from OSHPD or 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. Testing and calculations must include both shear and tensile loads and 1 test or analysis at 45 degrees to the weakest mode.
- B. Seismic restraints for mechanical systems shall comply with 2009 IBC and ASCE 7-05.
- C. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel."
- D. Verify correctness of equipment model numbers and conformance of each component with manufacturer's specifications.
- E. Should any rotating or electrical equipment cause excessive noise or vibration when properly installed on the specified isolators, the Contractor shall be responsible for rebalancing, realignment, or other remedial work required to reduce noise and vibration levels. Excessive is defined as exceeding the manufacturer's specifications for the unit in question.
- F. Upon completion of the work, the Architect shall inspect the installation and shall inform the installing contractor of any further work that must be completed. Make all

adjustments as directed by the Architect that result from the final inspection. This work shall be done before vibration isolation systems are accepted.

- G. The contractor shall provide a quality assurance plan prepared by a registered design professional for all mechanical, plumbing and electrical equipment and systems. The plan shall include the provisions of the 2009 International Building Code, per section 1705.2 and 1705.3. The plan shall be submitted to the Architect for review and approval. The contractor shall coordinate the requirements of the plan with the Owner and shall cooperate with the Owner's Seismic Quality Assurance coordinator.

1.9 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into base. Concrete, reinforcement, and formwork requirements are specified in Division 3.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

1.10 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. Seismic Snubber Units: Furnish replacement neoprene inserts for all snubbers.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 VIBRATION ISOLATORS

- A. Manufacturers:
 - 1. Ace Mounting Co., Inc.
 - 2. Amber/Booth Company, Inc.
 - 3. B-Line Systems, Inc.
 - 4. California Dynamics Corp.
 - 5. Isolation Technology, Inc.
 - 6. Kinetics Noise Control, Inc.

7. Mason Industries, Inc.
8. Vibration Eliminator Co., Inc.
9. Vibration Isolation Co., Inc.
10. Vibration Mountings & Controls/Korfund.

B. General:

1. Select vibration isolating units for the lowest operating speed of equipment, so designed that natural frequency of equipment and base mass is not less than 1.5 times the lowest operating frequency of the moving equipment, but not a multiple or harmonic of the base frequency. Furnish vibration isolation producing a uniform loading and deflection even when equipment weight is not evenly distributed, vibration isolation shall be stable during starting and stopping of equipment without excessive traverse and eccentric movement of equipment.
2. Concrete pads under the isolation units shall be reinforced. Use concrete having a minimum compressive strength of 2,500 pounds per square inch and structural reinforcing bars conforming to ASTM A-615 Grade 60.
3. The installed vibration isolation system for each floor or ceiling mounted item of equipment shall have a maximum lateral motion under equipment start up and shut down conditions of 1/4 inch. Motions in excess shall be restrained by approved spring type mounting.
4. All electrical connections, drain connections, etc., made to equipment which rests on vibration isolators, shall be sufficiently flexible to permit the equipment to be properly isolated.
5. The type of isolation, base, and minimum static deflection shall be as required for each specific equipment application, but not less than that specified herein when supported on a solid concrete structural slab having a thickness of not less than four (4) inches. If vibration isolators with a deflection greater than the minimum specified are required to meet the noise criteria for the adjacent spaces, suitable isolation system shall be submitted. Should vibration isolators installed for the equipment prove inadequate to prevent transmission of equipment vibrations to the building structure or limit equipment vibration originated noise in the building spaces to acceptable levels, the isolators shall be replaced with units having the largest deflection that can be practicably installed.
6. Where designated in the schedules, spring and combination rail and spring isolation supports are for installation with equipment structurally built or supported on a rigid structural steel frame suitable for these types of isolation. Where these types of isolation are not suitable for the equipment construction or operation, the equipment shall be mounted on a structural steel base as herein specified.
7. Equipment affected by wind pressure or with operating weight different from installed weight shall have built-in adjustable vertical stops to prevent rising of equipment when weight is removed. (Equipment containing liquid such as boilers, cooling towers, and chilled water refrigeration units shall have vertical stops.)
8. All springs installed out-of-doors shall be cadmium-plated, zinc electroplated or powder-coated after fabrication. Hardware and other metal parts shall be cadmium-plated or galvanized. Galvanizing shall meet ASTM Salt Spray Test Standards and Federal Test Standard No. 14.

9. All isolators installed out-of-doors shall have base plates with bolt holes for fastening the isolators to the support members.
 10. Isolator types are scheduled to establish minimum standards. At the Contractor's option, labor-saving accessories can be an integral part of isolators supplied to provide initial lift of equipment to operating height, hold piping at fixed elevations during installation and initial system filling operations, and similar installation advantages. Accessories and seismic restraint features must not degrade the isolation performance of the isolators.
 11. Static deflection of isolators shall be as provided in the EXECUTION section and as shown on the drawings. All static deflections stated are the minimum acceptable deflection for the mounts under actual load. Isolators selected solely on the basis of rated deflections are not acceptable and will be disapproved.
- C. Elastomeric Isolator Pads: Oil- and water-resistant elastomer or natural rubber, arranged in single or multiple layers, molded with a nonslip pattern and galvanized steel baseplates of sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.
1. Material: Standard neoprene.
 2. Durometer Rating: 40.
 3. Number of Layers: 1 or 2.
- D. Elastomeric Mounts: Double-deflection type, with molded, oil-resistant rubber or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code otherwise identify to indicate capacity range.
1. Durometer Rating: 40.
- E. Restrained Elastomeric Mounts: All-directional elastomeric mountings with seismic restraint.
1. Materials: Cast-ductile-iron housing containing two separate and opposing, molded, bridge-bearing neoprene elements that prevent central threaded sleeve and attachment bolt from contacting the casting during normal operation.
 2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing 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 the 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 100 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 restraint.
1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to wind loads or if weight is removed; factory-drilled baseplate bonded to 1/4-inch thick, elastomeric isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
 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 the rated vertical stiffness.
 5. 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 before contacting a resilient collar.
- I. Elastomeric Hangers: Double-deflection type, with molded, oil-resistant rubber or neoprene 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 the 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.

- 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 the 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.
- L. 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 equipment.
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. 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 the 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.
- M. Pipe Riser Resilient Support: All-directional, acoustical pipe anchor consisting of 2 steel tubes separated by a minimum of 1/2-inch thick, 60-durometer 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.
- N. Resilient Pipe Guides: Telescopic arrangement of 2 steel tubes separated by a minimum of 1/2-inch thick, 60-durometer neoprene. Factory set guide height with a shear pin to allow vertical motion due to pipe expansion and contraction. Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.3 RESTRAINED VIBRATION ISOLATION ROOF-CURB RAILS

A. Manufacturers:

1. Amber/Booth Company, Inc.
2. California Dynamics Corp.
3. Isolation Technology, Inc.
4. Kinetics Noise Control, Inc.
5. Mason Industries, Inc.
6. Vibration Eliminator Co., Inc.
7. Vibration Isolation Co., Inc.
8. Vibration Mountings & Controls/Korfund.

B. Description: Factory-assembled, fully enclosed, insulated, air- and watertight curb rail designed to resiliently support equipment and to withstand 125-mph wind impinging laterally against side of equipment. The roof curbs shall be built to seismically contain the rooftop equipment. Curb shall have anchorage preapproval "R" from OSHPD in the state of California attesting to the maximum certified horizontal and vertical load ratings.

C. Lower Support Assembly: Sheet-metal "Z" section containing adjustable and removable steel springs that support upper floating frame. Upper frame shall provide continuous support for equipment and shall be captive to resiliently resist wind and seismic forces. Lower support assembly shall have a means for attaching to building structure and a wood nailer for attaching roof materials, and shall be insulated with a minimum of 2 inches of rigid, glass-fiber insulation on inside of assembly.

D. Spring Isolators: Adjustable, restrained spring isolators shall be mounted on 1/4-inch-thick, elastomeric vibration isolation pads and shall have access ports, for level adjustment, with removable waterproof covers at all isolator locations. Isolators shall be located so they are accessible for adjustment at any time during the life of the installation without interfering with the integrity of the roof.

1. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic restraint.
 - a. Housing: Steel with resilient vertical-limit stops and adjustable equipment mounting and leveling bolt.
 - b. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - c. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - d. Lateral Stiffness: More than 80 percent of the rated vertical stiffness.
 - e. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
2. Elastomeric Isolator Pads: Oil- and water-resistant elastomer or natural rubber, arranged in single or multiple layers, molded with a nonslip pattern and galvanized

steel baseplates of sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.

- a. Material: Standard neoprene.
 - b. Durometer Rating: 40.
 - c. Number of Layers: 1 or 2.
- E. Snubber Bushings: All-directional, elastomeric snubber bushings at least 1/4 inch thick.
- F. Water Seal: Continuous galvanized sheet metal with EPDM seals at corners, attached to upper support frame, extending down past wood nailer of lower support assembly, and counterflashed over roof materials.

2.4 SEISMIC-RESTRAINT DEVICES

- A. Manufacturers:
1. Amber/Booth Company, Inc.
 2. B-Line Systems, Inc.
 3. California Dynamics Corp.
 4. Kinetics Noise Control, Inc.
 5. Loos & Co., Inc.; Cableware Technology Division.
 6. Mason Industries, Inc.
 7. TOLCO Incorporated.
 8. Unistrut Diversified Products Co.; Wayne Manufacturing Division.
 9. Vibration Eliminator Co., Inc.
 10. Vibration Isolation Co., Inc.
 11. Vibration Mountings & Controls/Korfund.
- B. Resilient Isolation Washers and Bushings: 1-piece, molded, bridge-bearing neoprene complying with AASHTO M 251 and having a durometer of 40, plus or minus 5, with a flat washer face.
- C. Seismic 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: 1-piece, molded, bridge-bearing neoprene complying with AASHTO M 251 and having a durometer of 40, plus or minus 5.
- D. Restraining Cables: Galvanized steel aircraft cables with end connections made of steel assemblies that swivel to final installation angle and utilize two clamping bolts for cable engagement.

- E. Anchor Bolts: Seismic-rated, drill-in, and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488/E 488M.
- F. General Requirements:
1. Equipment, piping, ductwork and conduit shall be braced and supported in accordance with International Building Code, 2009 - Chapter 16.
 2. This Contractor shall provide the services of a professionally registered Seismic consultant to perform duties indicated below. The Contractor shall submit with his bid, the hourly billing rate for their Seismic consultant to provide additional services beyond the specified scope..
- G. Mechanical Equipment:
1. All equipment bases and mounting tabs shall be provided integral to the equipment and designed to distribute Seismic loads without failure. Equipment bases mounting tabs shall be certified by the manufacturer to be in accordance with the requirements of this specification.
 2. The size, type and quantity of anchors and fasteners required to anchor the equipment will be provided in accordance with the Seismic consultant.
 3. Equipment submittals shall include Seismic anchoring details.
- H. HVAC Ductwork:
1. Attachments and supports for HVAC ductwork systems shall be designed to meet the force and displacement provisions of SEI/ASCE 7-05 Standard.
- I. Piping
1. Attachments and supports for piping systems shall be designed to meet the force and displacement provisions of SEI/ASCE 7-05 Standard.
- J. Mechanical Equipment, Attachments and Supports
1. Attachments and supports for mechanical equipment shall be designed to meet the force and displacement provisions of SEI/ASCE 7-05 Standard.
- K. The Seismic details indicated on the drawings are not intended to limit the Contractor. Alternated methods of support, attachment and bracing must be designed by the Seismic Consultant and submitted to the Architect for review.
- L. Sprinkler and standpipe system piping shall be supported and braced in accordance with NFPA 13 and NFPA 14.

2.5 VIBRATION ISOLATION EQUIPMENT BASES

A. Manufacturers:

1. Amber/Booth Company, Inc.
2. California Dynamics Corp.
3. Isolation Technology, Inc.
4. Kinetics Noise Control, Inc.
5. Mason Industries, Inc.
6. Vibration Eliminator Co., Inc.
7. Vibration Isolation Co., Inc.
8. Vibration Mountings & Controls/Korfund.

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. 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 angles 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 field-applied, 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. 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 angles 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.

2.6 RESILIENT PENETRATION SLEEVE/SEAL

- ### A.
- Resilient penetration sleeve/seals shall be field-fabricated from a pipe or sheet metal section that is 1/2 inch to 3/4 inch larger than the penetrating element in all directions around the element, and shall be used to provide a sleeve through the construction penetrated. The sleeve shall extend one (1) inch beyond the penetrated construction on each side. The space between the sleeve and the penetrating element shall be packed with glass fiber or mineral wool to within 1/4 inch of the ends of the sleeve. The

remaining 1/4 inch space on each end shall be filled with acoustical sealant to form an airtight seal. The penetrating element shall be able to pass through the sleeve without contacting the sleeve. Alternatively, prefabricated sleeves accomplishing the same result are acceptable.

2.7 RESILIENT LATERAL SUPPORTS

- A. These units shall either be a standard product of the vibration isolation mounting manufacturer, or be custom fabricated from standard components. These units shall incorporate neoprene isolation elements that are specifically designed to provide resilient lateral bracing of ducts or pipes.

2.8 FLEXIBLE DUCT CONNECTIONS

- A. Flexible duct connections shall be made from coated fabric. The clear space between connected parts shall be a minimum of three (3) inches and the connection shall have a minimum of 1.5 inches of slack material.

2.9 FLEXIBLE PIPE CONNECTIONS

- A. Flexible pipe connections shall be fabricated of multiple plies of nylon cord, fabric, and neoprene; and shall be vulcanized so as to become inseparable and homogeneous. Flexible connections shall be formed in a double sphere shape, and shall be able to accept compressive, elongating, transverse, and angular movements.
- B. The flexible connections shall be selected and specially fitted, if necessary, to suit the system temperature, pressure, and fluid type. In addition, suitable flexible connections should be selected which do not require rods or cables to control extension of the connector.
- C. Connectors for pipe sizes two (2) inches or smaller shall have threaded female union couplings on each end. Larger sizes shall be fitted with metallic flange couplings.

2.10 GROMMETS:

- A. Grommets shall be specially formed to prevent bolts from directly contacting the isolator base plate, and shall be sized so that they will be loaded within the manufacturer's recommended load range.
- B. Grommets shall either be custom made by combining a neoprene washer and sleeve, or a manufactured product:

2.11 ACOUSTICAL SEALANT:

- A. Sealants for acoustical purposes as described in this specification shall be silicone or a

nonsetting sealants.

2.12 FLEXIBLE ELECTRICAL CONNECTIONS

A. Type A:

1. Flexible Electrical Connection Type A shall be a prefabricated unit incorporating a flexible and watertight outer jacket, grounding strap, plastic inner sleeve to maintain smooth wire way, and end hubs with tapered electrical threads to fit standard threaded rigid metal conduit.
2. Flexible Electrical Connection Type A shall be Crouse-Hinds "XD Expansion/Deflection Coupling", Spring City Electrical Mfg. Co. "Type DF Expansion and Deflection Fitting", or approved equal.

B. Type B:

1. Flexible Electrical Connection Type B shall be field fabricated using a minimum two (2) foot length of flexible conduit or cable.

C. Type C:

1. Flexible Electrical Connection Type C shall be field fabricated using a minimum equal four (4) foot length of flexible conduit or cable.

2.13 FACTORY FINISHES

A. 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 electrogalvanized. Hot-dip galvanized metal components for exterior use.
3. Baked enamel 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, 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 APPLICATION:

A. General:

1. Refer to the PRODUCTS section of this specification for vibration isolation devices identified on the drawings or specified herein.
2. The static deflections of all isolators specified herein are the minimum acceptable deflections for the mounts under actual load. Isolators selected solely on the basis of rated deflection are not acceptable and will be disapproved.

B. Major Equipment:

1. Unless otherwise shown or specified, all floor-mounted major equipment shall be set on four (4) inch high concrete housekeeping pads provided under another Division. Housekeeping pads shall rest on a structural floor and shall be reinforced with steel rods and interconnected with floor. See Architectural or Structural drawings for details.
2. Types and minimum static deflections of vibration isolation devices for major equipment items shall be as specified hereinafter.
3. Flexible duct connections shall be installed at all fan unit intakes, fan unit discharges, and wherever else shown on the drawings.
4. Flexible pipe connections shall be installed at all pipe connections to equipment and machines with rotating parts.
5. Electrical connections to vibration-isolated equipment shall be flexible, as called for in the electrical portion of this specification.
6. Thrust restraints shall be installed on all suspended fans and on all floor-mounted fans developing three (3) inches or more of static pressure, unless the horizontal component of the thrust force can be demonstrated to be less than ten (10) percent of the equipment weight.
7. Each electric motor shall be mounted on the same foundation as the driven machine. Piping connections, including strainer at pumps, shall be supported on the same foundation as the pumps.

C. Miscellaneous Mechanical Equipment:

1. Miscellaneous pieces of mechanical equipment such as converters, pressure reducing stations, dryers, strainers, storage tanks, condensate receiver tanks, and expansion tanks which are connected to isolated piping systems shall be vibration-isolated from the building structure by neoprene pad or neoprene isolators (selected for 0.1" static deflection) unless their position in the piping system requires a higher degree of isolation as called for under Pipe Isolation.

D. Pipes:

1. All chilled water, heating water, steam, and drain piping that is connected to vibration-isolated equipment shall be isolated from the building structure at their first three support points.
2. Piping shall be isolated from the building structure by means of vibration isolators, resilient lateral supports, and resilient penetration sleeve/seals.
3. Isolators for the first three support points adjacent to connected equipment shall achieve one half the specified static deflection of the isolators supporting the connected equipment. When the required static deflection of these isolators is greater than 1/2 inch, spring neoprene isolators shall be used. When the required static deflection is less than or equal to 1/2 inch, neoprene isolators shall be used. All other pipe support isolators within the specified limits shall be either neoprene achieving at least 1/4 inch static deflection.
4. Where lateral support of pipes is required within the specified limits, this shall be accomplished by use of resilient lateral supports.
5. Pipes within the specified limits that penetrate the building construction shall be isolated from the building structure by use of resilient penetration sleeve/seals.
6. Provide flexible pipe connections as called for under Major Equipment above and wherever shown on the drawings.
7. All pipe risers within mechanical rooms over three (3) inches in diameter shall be isolated under each pipe riser floor support with either two layers of 3/4 inch thick, maximum 50 durometer neoprene pads or with load bearing plates or neoprene mounts with a minimum 0.2 inch static deflection.

E. Ductwork:

1. All sheet metal ducts and air plenums that are connected to vibration-isolated equipment shall be isolated from the building structure at their first three support points by neoprene isolators. All isolators shall achieve 0.1 inch minimum static deflection.
2. Ducts within the specified limits that penetrate the building construction shall be isolated from the building structure by use of resilient penetration sleeve/seals.
3. Flexible duct connections shall be provided as called for above under Major Equipment and wherever shown on the drawings.

F. Mechanical Equipment:

1. Electrical connections to vibration isolated mechanical equipment shall be made using flexible electrical connections Type A or Type C.

3.3 INSTALLATION

A. Install thrust limits at centerline of thrust, symmetrical on either side of equipment.

B. General:

1. Locations of all vibration isolation devices shall be selected for ease of inspection and adjustment as well as for proper operation.

2. Installation of vibration isolation equipment shall be in accordance with the manufacturer's instructions.
3. In all cases, isolated electrical equipment shall be positioned so that it is free standing and does not come in rigid contact with the building structure or other systems.
4. Isolators:
 - a. All vibration isolators shall be aligned squarely above or below mounting points of the supported equipment.
 - b. Isolators for equipment with bases shall be located on the sides of the bases which are parallel to the equipment shaft unless this is not possible because of physical constraints.
 - c. Locate isolators to provide stable support for equipment, without excess rocking. Consideration shall be given to the location of the center of gravity of the system and the location and spacing of the isolators. If necessary, a base with suitable footprint shall be provided to maintain stability of supported equipment, whether or not such a base is specifically called for herein.
 - d. If a housekeeping pad is provided, the isolators shall bear on the housekeeping pad and the isolator base plates shall rest entirely on the pad.
 - e. Hanger rods for vibration-isolated support shall be connected to structural beams or joists, not the floor slab between beams and joists. Provide suitable intermediate support members as necessary.
 - f. Vibration isolation hanger elements shall be positioned as high as possible in the hanger rod assembly, but not in contact with the building structure, and so that the hanger housing may rotate a full 360 degrees about the rod axis without contacting any object.
 - g. Parallel running pipes may be hung together on a trapeze that is isolated from the building. Isolator deflections must be the greatest required by the provisions for pipe isolation for any single pipe on the trapeze. Do not mix isolated and unisolated pipes on the same trapeze.
 - h. Pipes, ducts and equipment shall not be supported from other pipes, ducts and equipment.
 - i. Resiliently isolated pipes, ducts and equipment shall not come in rigid contact with the building construction or rigidly supported equipment.
 - j. The installed and operating heights of equipment vibration-isolated with floor spring and neoprene travel limited isolators or roof isolators or with roof curb or roof rail isolation bases shall be identical. Limit stops shall be out of contact during normal operation. Adjust isolators to provide 1/4 inch clearance between the limit stop brackets and the isolator top plate, and between the travel limit nuts and travel limit brackets.
 - k. Adjust all leveling bolts and hanger rod bolts so that the isolated equipment is level and in proper alignment with connecting ducts or pipes.
 - l. Roof isolators shall be installed in strict accordance with the manufacturer's instructions.
5. Bases:

- a. No equipment unit shall bear directly on vibration isolators unless its own frame is suitably rigid to span between isolators and such direct support is approved by the equipment manufacturer. This provision shall apply whether or not a base frame is called for on the schedule. In the case that a base frame is required for the unit because of the equipment manufacturer's requirements and is not specifically called for on the equipment schedule, a base frame recommended by the equipment manufacturer shall be provided at no additional expense.
 - b. Unless otherwise indicated, there is to be a minimum operating clearance of one (1) inch between steel rails, steel frame bases or inertia bases and the floor beneath the equipment. The isolator mounting brackets shall be positioned and the isolators adjusted so that the required clearance is maintained. The clearance space shall be checked by the Contractor to ensure that no construction debris has been left to short circuit or restrict the proper operation of the vibration isolation system.
 - c. Roof curb and roof rail isolation bases shall be installed in strict accordance with the manufacturer's instructions.
6. Flexible Duct Connections:
- a. Sheet metal ducts and plenum openings shall be squarely aligned with the fan discharge, fan intake, or adjacent duct section prior to installation of the flexible connection, so that the clear length is approximately equal all the way around the perimeter. Flexible duct connections shall not be installed until this provision is met. There shall be no metal-to-metal contact between connected sections, and the fabric shall not be stretched taut.
7. Flexible Pipe Connections:
- a. Install flexible pipe connections in strict accordance with the manufacturer's instructions.
8. Thrust Restraints:
- a. Thrust restraints shall be attached on each side of the fan at the vertical centerline of thrust. The two rods of the thrust restraint shall be parallel to the thrust force. This may require custom brackets or standoffs. The body of the thrust restraint shall not come in contact with the connected elements. Thrust restraints shall be adjusted to constrain equipment movement to the specified limit.
9. Grommets:
- a. Where grommets are required at hold down bolts of isolators, bolt holes shall be properly sized to allow for grommets. The hold down bolt assembly shall include washers to distribute load evenly over the grommets. Bolts and washers shall be galvanized.

10. Resilient Penetration Sleeve/Seals:

- a. Maintain an airtight seal around the penetrating element and prevent rigid contact between the penetrating element and the building structure. Fit the sleeve tightly to the building construction and seal airtight on both sides of the construction penetrated with acoustical sealant.

11. Flexible Electrical Connections:

- a. Type C connections shall be installed in a grossly slack "U" shape or a 360 degree loop.
- b. Rigid conduit on the isolated-equipment side of the flexible connection, and the flexible connection itself, shall not be tied to the building construction or other rigid structures.

- C. Install seismic snubbers on isolated equipment. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
- D. Install restraining cables at each trapeze and individual pipe hanger. At trapeze anchor locations, shackle piping to trapeze. Install cables so they do not bend across sharp edges of adjacent equipment or building structure.
- E. Install steel angles or channel, sized to prevent buckling, clamped with ductile-iron clamps to hanger rods for trapeze and individual pipe hangers. At trapeze anchor locations, shackle piping to trapeze. Requirements apply equally to hanging equipment. Do not weld angles to rods.
- F. Install resilient bolt isolation washers on equipment anchor bolts.

3.4 EQUIPMENT BASES

- A. Fill concrete inertia bases, after installing base frame, with 3000-psi concrete; trowel to a smooth finish.
 1. Cast-in-place concrete materials and placement requirements are specified in Division 3.
- B. Concrete Bases: Anchor equipment to concrete base according to supported equipment manufacturer's written instructions for seismic codes at Project site.
 1. 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 the base.
 2. Install epoxy-coated anchor bolts for supported equipment 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 supported equipment.
 5. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
 6. Cast-in-place concrete materials and placement requirements are specified in Division 3.

3.5 ADJUSTING

- A. Adjust isolators after piping systems have been filled and 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. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop.
- D. Adjust air spring leveling mechanism.
- E. Adjust active height of spring isolators.
- F. Adjust snubbers according to manufacturer's written recommendations.
- G. Adjust seismic restraints to permit free movement of equipment within normal mode of operation.
- H. Torque anchor bolts according to equipment manufacturer's written recommendations to resist seismic forces.

3.6 CLEANING

- A. After completing equipment installation, inspect vibration isolation and seismic-control devices. Remove paint splatters and other spots, dirt, and debris.

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 Division 1.

3.8 VIBRATION ISOLATOR AND SEISMIC-RESTRAINT SCHEDULE

Vibration Isolation Schedule

<u>Equipment</u>	<u>Isolation Type</u>	<u>Base Deflection</u>	<u>Base Type</u>	<u>Remarks</u>
Fan in AHU's	Floor Spring Neoprene	1.5"	Base-Inertia Base	Thrust Restraints
LAB Vacuum Pumps	Floor Neoprene	0.4"	---	Under Skid
LAB Air Compressors	Floor Neoprene	0.4"	---	Under Skid
Roof Mounted Laboratory Exhaust Fan	Floor Spring Neoprene	1.5"	Base-Inertia Base	Match existing laboratory exhaust fan installation
Rooftop Perchloric Fan	Restrained Vibration Isolation Roof-Curb Rail	1.5"	---	-----
In-Line Pumps	Flexible Neoprene	0.25"	---	-----
Air Compressor and Vacuum Pump Flexible Piping Connectors	Flexible Metallic Hoses	---	---	-----
First Three (3) Pipe Hangers near Isolated Equipment	Spring Hangers	1.5"	---	-----
First Two (2) Pipe Hangers near Non-Isolated Equipment	Spring Hangers	1.0"	---	-----

3.9 SEISMIC INSTALLATION INSPECTION

- A. On completion of installation of all vibration isolation and seismic restraint devices herein specified, a representative of the isolation materials manufacturer shall inspect the completed system and report in writing any installation errors, improperly selected isolation or restraint devices, or other faults that could affect the performance of the system. Contractor shall submit a report to the Architect, including the manufacturer's representative's final report, indicating all isolation reported as properly installed or requiring correction, and include a report by the Contractor on steps taken to properly complete the isolation work.
- B. All special inspections must be performed in accordance with IBC 2009 and as specified herein.
- C. Continuous inspection: The full-time observation of work by an approved special inspector pursuant to IBC 2009 section 1704. The following pieces of equipment require these inspections:

1. All equipment using combustible or toxic energy sources.
 2. All electric motors, transformers, switchgear unit substations and motor control centers.
 3. Reciprocating and rotating type machinery.
 4. Pipe, 3" & larger.
 5. Tanks, heat exchangers & pressure vessels.
- D. Periodic inspection: intermittent observation of work by an approved special inspector of the following pieces of equipment in compliance with IBC section 1704.
1. Isolator units for seismic isolation systems.
 2. All flammable, combustible and highly toxic piping and their associated mechanical systems.
 3. All ductwork containing hazardous materials.
 4. All electrical components for standby or emergency power systems.

END OF SECTION 15070

SECTION 230550 - VARIABLE FREQUENCY DRIVES (VFD)

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.
- B. Division 16 – Electrical Requirements applies to this section with additions and modifications specified herein.

1.2 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C80.1 (1990) Rigid Steel Conduit - Zinc Coated)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 1 (1995) Hard-Drawn Copper Wire

ASTM B 8 (1995) Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

INSTITUTE OF ELECTRICAL AND ELECTRONIC ENGINEERS (IEEE)

IEEE 519 (1992) Recommended Practices & Requirements for Harmonic Controls in Electrical Power Systems

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA FU 1 (1986) Low Voltage Cartridge Fuses

NEMA ICS 6 (1963) Industrial Control and Systems Enclosures

NEMA KS 1 (1990) Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)

NEMA MG 1 (1993; Rev. 1-2) Motors and Generators

NEMA MG 10 (1994) Energy Management Guide for Selection and Use of Fixed Frequency Medium AC Squirrel-Cage Polyphase Induction Motors

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (1996) National Electrical Code

UNDERWRITERS LABORATORIES INC. (UL)

UL 50 (1995; Bul. 1996) Safety Enclosures for Electrical Equipment

UL 198C (1986; Bul. 1991, 1992, 1993, 1994, and 1996, R 1993) High-Interrupting-Capacity Fuses, Current-Limiting Types

UL 508 (1993; Bul. 1993, 1994, and 1995, R 1994) Industrial Control Equipment

1.3 RELATED DOCUMENTS

- A. Division 26 – Electrical Requirements applies to this section with additions and modifications specified herein.

1.4 SUBMITTALS

- A. Submit the following in accordance with Section 01303 - "Submittal Procedures".
 - 1. Variable Frequency Drives.
 - 2. Voltage Distortion Design Limit Calculations.
 - 3. Circuit Breakers.
 - 4. Optional Bypass Switch
- B. Operation and Maintenance Manuals
 - 1. Variable Frequency Drives

1.5 QUALITY ASSURANCE

- A. In each standard referred to herein, consider the advisory provisions to be mandatory, as though the word "shall" has been substituted for "should" wherever it appears. Interpret references in these standards to "authority having jurisdiction," or words of similar meaning, to mean Owner.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Materials, equipment, and devices shall, as a minimum, meet requirements of UL, where UL standards are established for those items, and requirements of NFPA 70. All VFD's shall be 6 pulse.
- B. 6 pulse VFD Manufacturers: Subject to compliance with project requirements, manufacturers offering products that may be incorporated into the Work include:
 - 1. Asea Brown Brover
 - 2. Allen Bradely
 - 3. Cutler Hammer
 - 4. Robicon
 - 5. Square D
 - 6. Toshiba
 - 7. Siemens
 - 8. ABB

2.2 VARIABLE SPEED MOTOR CONTROLLERS

- A. Controllers shall be solid state 6 pulse width modulated with adjustable frequency and voltage, 3-phase output capable of driving standard NEMA Class B induction motors. The drives shall utilize diode bridge rectifying circuitry with pulse width modulation DC to AC convertors. Silicon controlled rectifiers (SCR) shall not be used in the rectifying circuitry. The drives shall be designed to be used on variable torque loads and shall be capable of providing sufficient torque to allow the motor to break away from rest upon first application of power.
- B. The variable speed motor controller shall convert 460 volt or 200 volt as indicated on the drawings plus or minus 10 percent, three phase, 60 Hz (plus or minus 2 Hz) utility power to adjustable voltage/frequency, three phase, ac power for stepless motor control from 5 percent to 105 percent of base speed.
- C. The variable speed drive shall produce an adjustable ac voltage/frequency output for complete motor speed control. The variable speed drive shall be automatically controlled by a grounded electronic control signal. The variable speed drive shall be self contained, totally enclosed in a NEMA MG 1 ventilated cabinet and capable of operation between **32** and **104** degrees **F**. The variable speed drive maximum output current rating shall be equal to or exceed the motor nameplate full load. Variable speed drive shall be 95 percent efficient at 100 percent rated output power, 60 Hz. The displacement power factor shall be 0.95 or higher under all speed and load conditions.
- D. Each controller shall be factory tested at maximum watts (HP), rated full load current and at an ambient temperature of **104** degrees **F** for a period of not less than 24 hours. If a

component fails, it shall be replaced and the test restarted for the full time period. A certified copy of the factory Test Report shall be furnished to the Chief Engineer prior to shipping the controller to the job site.

E. Governing Requirements

1. Variable speed drives shall conform to the following requirements:
 - a. The variable speed drive and options shall comply with the applicable requirements and the standards of the American National Standards Institute (ANSI).
 - b. Variable speed drive and option design and construction thereof shall comply with all applicable provisions of NFPA 70, Article 430, Sections A-L.
 - c. Each manufacturer shall be responsible for receiving all design parameters on the contract drawings from the Contractor. Using the information received from the Contractor the drive system shall not create voltage distortion exceeding the Total Harmonic Distortion: five (5) percent. Per IEEE 519, if the distortion limits as defined will be exceeded then input line filters or isolation transformer shall be provided to reduce the distortion to within the above mentioned standard.

F. Quality Assurance: To ensure quality the variable speed drive shall be subject to the following tests:

1. The integrated circuits shall undergo a 50-hour "burn-in" to test reliability. During the "burn-in" the temperature shall be cycled between 32 and 158 degrees F.
2. The completed unit shall undergo a fully loaded 1-hour "burn-in."
3. The unit shall be subject to a series of in-plant quality controlled inspections before approval for shipment from manufacturer's facilities.

G. Service:

1. The variable speed drive shall be supplied with the following:
 - a. One-year parts and labor warranty.
 - b. A troubleshooting guide to help the building operator determine what steps must be taken to correct any problem that may exist in the system.

H. Basic Features to be located on a keypad accessible from the front of the drive.

1. Isolated power for control circuits.
2. Three position "manual-off-automatic" selector switch, red "running" pilot light and a manual reset push button installed in cover.
3. Adjustable current limiting circuitry to provide soft motor starting. Maximum starting current shall not exceed 200 percent of motor full load current.
4. Independent acceleration and deceleration time adjustment, manually adjustable

- from 2 to 30 seconds. (Set timers to the equipment manufacturer's recommend time in the above range).
5. Provide 4 to 20 ma current follower circuitry for interface with mechanical sensor devices.
 - a. Manual/Auto speed reference switch.
 - b. Minimum/maximum adjustable speeds.
 - c. Manual Speed potentiometer.
 - d. Electronic speed potentiometer through front mounted keypad
 - e. Main circuit breaker capable of being locked out with two padlocks.
 - f. Linear timed acceleration and deceleration for soft starting/stopping.
 - g. 3-63 Hz controlled speed range. (Factory set at 15 Hz minimum).
 6. Automatic frequency adjustment from 20 Hz to 60 Hz.
 7. Provide circuitry to initiate an orderly shutdown and automatic restart after the motor stops spinning and when conditions are corrected. The controller shall not be damaged by the following electrical disturbances:
 - a. Incorrect phase sequence.
 - b. Single phasing.
 - c. Overvoltage in excess of 15 percent.
 - d. Undervoltage in excess of 5 percent.
 - e. Running overcurrent above 115 percent (shall not automatically reset for this condition).
 - f. Instantaneous overcurrent above 150 percent (shall not automatically reset for this condition).
 - g. Surge voltage in excess of 1,000 volts.
 - h. Short duration power outages of 12 cycles or less (i.e. distribution line switching, generator testing, automatic transfer switch operations).
 8. Controllers shall include a door interlocked non-fused switch which will disconnect all input power.
 9. Provide two normally open (N.O.) and two normally closed (N.C.) dry contacts rated 120 volts, 10 amperes, 60 HZ for remote indication of the following:
Controller system shutdown will auto restart, system shutdown without auto restart and system running.
 10. Incorporate into each control circuit a 120-volt, time delay relay (On delay), adjustable from 0.3 - 10 minutes, with transient protection.
 11. Controller shall be incorporated in standard size units installed in wall mounted or free standing enclosures.
 12. The VFD's shall be able to start into a spinning motor. The VFD's shall be able to determine the motor speed in any direction and resume operation without tripping. If the motor is spinning in the reverse direction, bring the motor to a controlled stop, and then accelerate the motor in the present method of starting.

I. Control Functions

1. All VFD's programmable parameters shall be adjustable from a digital operator keypad located on the front door of the VFD. Parameters shall include:
 - a. Programmable maximum and minimum frequency limits.
 - b. Programmable acceleration and deceleration times.
 - c. Programmable carrier frequencies, V/Hz, and critical frequency avoidance lockout.
 - d. Programmable electronic overload and torque limits.
 - e. Programmable multiple attempt restart.
 - f. Programmable job, thread and preset speeds.
 - g. Programmable keypad lockout and factory default overrides.
 2. The VFD's shall be additionally equipped with a digital operator station mounted on the enclosure front door. Control operator devices and indication lights shall include:
 - a. Digital speed control.
 - b. Hand-Off-Auto control selector switch.
 - c. LED status lights for HOA position.
 - d. Local - remote speed control selector switch.
- J. The VFD's shall have the following system interfaces:
1. Inputs
 - a. Single isolated process control speed reference interface to receive and isolate 0-10 Vdc or 4-20 mAdc signals.
 - b. Dedicated terminal blocks for interface with remote start contact and remote safety trips.
 - c. 120 VAC control to allow VFD's to interface with remote contacts at a distance up to 500 feet and with three-wire control.
 2. Outputs
 - a. Two (2) analog output signals 0-10 Vdc for external metering.
 - b. Run relay with an isolated set of eight (8) programmable form C contacts.
 - c. Dry contact outputs to indicate protective function trip.
- K. Monitoring and Displays
1. The VFD's shall have a 40-character vacuum fluorescent display indicating monitored functions as described in the following paragraph.
 - a. Input current. (3 phases)
 - b. Input voltage. (3 phases)
 - c. Output current. (3 phases)
 - d. Output voltage. (3 phases)

- e. Output frequency.
- f. Kilowatts.
- g. Drive temperature.
- h. Operational timer.
- i. Date.
- j. Elapsed time meter.
- k. Motor rpm.
- l. Ten (10) most recent trips.

L. Protection Functions

1. The VFD's shall have the following protective features:
 - a. Speed compensated electronic motor overload current.
 - 1) Current limits to 100 percent design by slowing down motor.
 - 2) Instantaneous Electronic Trip - automatically shutdown motor if current exceed 120 percent of design or phase-to-phase output short circuit occurs.
 - 3) The variable speed drive shall restart automatically under all failure scenarios and shall send a restart alarm signal after three restart attempts. Restart scenarios shall include, but are not limited to the following: When the input line returns to normal after an event of intermittent power outage, phase loss, or overvoltage shutdown.
 - b. Undervoltage.
 - c. Overfrequency.
 - d. Overtemperature.
 - e. Ground Fault.
 - f. Dc bus protection.
 - g. Inrush current limit (adjustable 50 to 150%).
 - h. Input and output phase loss.
 - i. Fast acting current limiting fuses (Class J) ahead of the input non-fused disconnect switch shall be provided on the input side of the VFD's to protect against fault currents up to 200,000 A sym.
 - j. Insensitive to incoming power phase.
 - k. Isolated 115 volt control circuit and dedicated control transformer.
 - l. Line-to-line fault protection.
 - m. Line-to-ground short circuiting and accidental motor grounding protection.
 - n. Output thermal overload relay trip.
 - o. Overspeed.
 - p. Three skip frequencies of frequency avoidance bands (field selectable).
 - q. Input AC line reactor.
 - r. For motor leads between 100-300 feet from the VFD output, drives shall include an output LRC filter rated to limit the dv/dt at the motor leads to a peak of 1,000 volts. An output LRC filter may not be required if the manufacturer can provide test data indicating dv/dt values below 1,000 volts

Manufacturer's choosing not to provide output filters will need approval from the Engineer. Test data shall be provided with the product submittals. If the test data is not accepted by the Engineer, the Manufacturer will be responsible for proving an output filter. Filters shall be factory mounted within the VFD enclosure.

- s. Output line reactor shall reduce the dv/dt output voltage at the motor terminals to a peak for 1,500 volts. The reactor shall be iron core construction, copper windings with 3% impedance. Insulation shall be Class H with UL listed, dielectric strength of 4,000 volts, **240 [115]** degrees F [C] rise line Reactors shall protect the motors from motor leads in excess of 300 feet. Filters shall be factory mounted within the VFD enclosure.
2. Additional Features shall be provided as follows:
 - a. The VFD's shall include serial communications. All VFD programming, monitoring and diagnostic functions shall be available via this link. Communications protocol shall be provided to allow direct communications with the automatic temperature controller (ATC) or direct digital controller (DDC), refer to controls requirements in these specifications. The VFD's shall be addressable should more than one VFD occupy the same serial network.
 - b. Programmable PID/set-point control via the digital keypad. Proportional, integral and derivative gains shall be tunable while the drive is running. An RS232-C, RS-422 or RS-485 port shall be available.
 - c. The VFD's shall be equipped with an input non-fused disconnect switch. The switch shall be interlocked with enclosure doors to prevent access to the VFD's unless the switch is in the open position. The disconnect switch shall have provisions for padlocking the open position.
 - d. Laminated plastic nameplate engraved with customer's identifying name or number for the drive.
 - e. Manual bypass switch shall provide a means to manually switch a single motor from drive control to bypass (across the line) operation. Separate contactors are provided for drive output and bypass operation, and are electrically operated. A Class 20 overload shall be provided for motor protection. A door mounted "Drive/off/Bypass/Test" selector switch with "Drive Mode" and "Bypass Mode" pilot lights mounted in the front door. In the DRIVE position, the motor is operated at an adjustable speed from the drive. In the OFF position, the motor and drive are disconnected. In the BYPASS position, the motor is operated at full speed from the AC power line and power is disconnected from the drive so that service can be performed. In the TEST position, the motor is operated at full speed from the AC line power. This allows the drive to be given an operational test while continuing to run the motor at full speed in Bypass. Customer supplied normally closed contacts shall be interlocked with the drives safety trip circuitry to stop the motor whether in DRIVE or BYPASS mode in case of an external safety fault. The bypass circuit shall be separately enclosed in a NEMA-1 compartment or cabinet from the VFD.

- M. The variable speed drive has the following adjustments available via keypad located on the faceplate of a single, regulator printed circuit board.
1. Minimum speed: 0-75 percent.
 2. Maximum speed: 105 percent.
- N. The variable speed drive shall be self contained, totally enclosed in an enclosure and capable of operation between 32 and 104 degrees F. All VFD components shall be factory mounted and wired in a dead-front grounded enclosure. Enclosures shall be NEMA MG 1 ventilated cabinet for indoor applications and NEMA 3R for outdoor applications. If a freestanding enclosure is provided, it shall be suitable for mounting on a concrete housekeeping pad (indoors) or rooftop equipment curb (outdoors). All indoor enclosures shall be designed to accept top entry line and top exit load cables.
1. NEMA 3R enclosures shall be provided with a shield that protects the unit from heating effects of indirect sunlight. A filtered inlet, fan-controlled exhaust, and thermostatically controlled heater shall be supplied to ensure that required enclosure ambient conditions are maintained (32-104 degrees F) and help prevent condensation in cool, damp environments.. A high temperature option shall be provided for locations that can reach up to 120 degrees F..

2.3 EQUIPMENT APPURTENANCES

A. Attachments:

1. All necessary bolts, nuts, washers, bolt sleeves, and other types of attachments for the installation of the equipment shall be furnished with the equipment. Bolts shall conform to the requirements of ASTM A 307 and nuts shall be hexagonal of the same quality as the bolts used. Threads shall be clean-cut and shall conform to ASME B1.1. Bolts, nuts, and washers shall be zinc coated after being threaded, by the hot-dip process conforming to ASTM A 123, ASTM A 153 as appropriate.

B. Tools:

1. A complete set of all special tools which may be necessary for the adjustment, operation, maintenance, and disassembly of all equipment shall be furnished. Special tools are considered to be those tools which because of their limited use are not normally available, but which are necessary for the particular equipment. Special tools shall be high-grade, smooth, forged, alloy, tool steel. All tools shall be delivered at the same time as the equipment to which they pertain. The Contractor shall properly store and safeguard such tools until completion of the work, at which time they shall be delivered to the Owner.

C. Shop Painting:

1. All equipment customarily finished in the shop shall be thoroughly cleaned,

primed, and given two finish coats of paint at the factory in accordance with the recommendations of the manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Electrical installations shall conform to requirements of NFPA 70 and to requirements specified herein.
- B. All variable speed drives must be installed in conditioned spaces designed to meet the manufacturer's requirements for temperature limitations. Generally, if the units are placed in attics or in mechanical rooms with heating equipment, mechanical ventilation is not enough to prevent variable speed drive shutdown on high temperature. Locate the variable speed drives in a separate room that can be air-conditioned. If this is done, the DDC controls should also be located in this room or supply conditioned air directly on the drive or near it. This can provide localized conditions that are suitable to the operation of the variable speed drive.

3.2 FIELD QUALITY CONTROL

- A. Furnish test equipment and personnel and submit written copies of test results. Give Owner 5 working days notice prior to each test.
- B. Devices Subject to Manual Operation:
 - 1. Each device subject to manual operation shall be operated at least five times, demonstrating satisfactory operation each time.

3.3 TESTS

- A. After installation of the pumps, VFD's, and appurtenances is complete, an operating test shall be performed to assure that the VFD operates properly. The VFD manufacturer's representative shall supervise a running field test in the presence of the Owner for a minimum of two hours for each VFD installed. The manufacturer's representative shall ensure the proper operation of each unit in manual and automatic modes over complete operating range without objectionable noise or vibration from any parts. Test shall verify all manual and automatic controls function properly and all electrical protection devices, safeties, and trips work properly. If any deficiencies are revealed, such deficiencies shall be corrected and the tests shall be reconducted.

3.4 MANUFACTURER'S FIELD SERVICE

- A. The Contractor shall obtain the services of a manufacturer's representative experienced in the installation, adjustment, and operation of the equipment. The representative shall supervise the installation, adjustment, and testing of the equipment for one, eight hour

day. Service shall be provided in addition to training requirements.

3.5 DEMONSTRATION

- A. Upon completion of the work and at a time designated by the Owner, the services of one or more factory training service engineers of the VFD manufacturer shall be provided by the Contractor for a period of not less than one 8-hour day to instruct the Owner's personnel in the operation and maintenance of the VFD's.

END OF SECTION

SECTION 230593 - TESTING AND BALANCING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and General Requirements, apply to work specified in this Section.

1.2 SUMMARY

- A. This Section includes TAB to produce design objectives for the following:

- 1. Air Systems:
 - a. Constant-volume air systems.
 - b. Variable-air-volume systems.
- 2. Hydronic Piping Systems:
 - a. Variable-flow systems.
- 3. Steam systems.
- 4. HVAC equipment quantitative-performance settings.
- 5. Laboratory fume hood airflow balancing.
- 6. Exhaust hood airflow balancing.
- 7. Space pressurization testing and adjusting.
- 8. Existing systems TAB.
- 9. Verifying that automatic control devices are functioning properly.
- 10. Reporting results of activities and procedures specified in this Section.

1.3 DEFINITIONS

- A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.
- B. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to design quantities.
- C. Barrier or Boundary: Construction, either vertical or horizontal, such as walls, floors, and ceilings that are designed and constructed to restrict the movement of airflow, smoke, odors, and other pollutants.
- D. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat

is withdrawn from a person's skin than is normally dissipated.

- E. NC: Noise criteria.
- F. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.
- G. RC: Room criteria.
- H. Report Forms: Test data sheets for recording test data in logical order.
- I. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.
- J. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.
- K. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
- L. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.
- M. TAB: Testing, adjusting, and balancing.
- N. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.
- O. Test: A procedure to determine quantitative performance of a system or equipment.
- P. Testing, Adjusting, and Balancing (TAB) Firm: The entity responsible for performing and reporting TAB procedures.

1.4 QUALIFICATIONS

- A. Work included in this section must be performed by an independent testing and balancing agency and an approved member of the Associated Air Balance Council (AABC) who shall provide a complete and comprehensive total system balance process to test, adjust, and balance the air and water systems for this project. Submit the name of the air balance firm for approval within thirty (30) days after award of contract. See Section 15000 for approved Contractors.
- B. If the Contractor fails to submit the name of an acceptable agency within the specified time, the Architect will select a firm to accomplish the work, and the selection shall be

binding at no additional cost to the Owner.

- C. All work shall be performed under direct supervision of a qualified engineer. All instruments used shall be accurately calibrated and maintained in good working order. If requested, calibration tests of equipment to be used shall be performed in the presence of the Architect.
- D. Submit for review and approval within ten (10) working days after the notice to proceed, the names of the personnel who will be responsible for the work and those who will actually perform the testing and balancing and their qualification, which shall demonstrate that they have balanced and tested systems of comparable size and complexity.

1.5 SUBMITTALS

- A. Certified TAB Reports: Submit six copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.
- B. Warranties specified in this Section.

1.6 QUALITY ASSURANCE

- A. TAB Firm Qualifications: Engage a TAB firm certified by either AABC or NEBB.
- B. TAB Conference: Meet with Owner's and Architect's representatives on approval of TAB strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of TAB team members, equipment manufacturers' authorized service representatives, HVAC controls installers, and other support personnel. Provide seven days' advance notice of scheduled meeting time and location.
 - 1. Agenda Items: Include at least the following:
 - a. Submittal distribution requirements.
 - b. The Contract Documents examination report.
 - c. TAB plan.
 - d. Work schedule and Project-site access requirements.
 - e. Coordination and cooperation of trades and subcontractors.
 - f. Coordination of documentation and communication flow.
- C. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:
 - 1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
 - 2. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.

- D. TAB Report Forms: Use standard forms from AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."
- E. Instrumentation Type, Quantity, and Accuracy: As described in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" and NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."
- F. Instrumentation Calibration: Calibrate instruments at least every six months or more frequently if required by the instrument manufacturer.
 - 1. Keep an updated record of instrument calibration that indicates date of calibration and the name of party performing instrument calibration.

1.7 PROJECT CONDITIONS

- A. 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.

1.8 COORDINATION

- A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.
- B. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.
- C. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.9 WARRANTY

- A. National Project Performance Guarantee: If AABC standards are used, provide a guarantee on AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" forms stating that AABC will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee includes the following provisions:
 - B. Special Guarantee: If NEBB standards are used, provide a guarantee on NEBB forms stating that NEBB will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents.

- C. Guarantee includes the following provisions:
 - 1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
 - 2. Systems are balanced to optimum performance capabilities within design and installation limits.

1.10 TEST PROCEDURE

- A. System may be tested in sections when approved by the Architect.
- B. When testing and balancing involve the building temperature control systems, cooperate with the temperature control subcontractor to achieve the desired results.
- C. At the time of final inspection, recheck in the presence and at the request of the Architect not to exceed ten (10) percent of the previously recorded readings from the certified report selected at random from the log by the Architect.
- D. Permanently mark the settings of valves, dampers, and other adjustment devices so that adjustment can be restored if disturbed at any time. Do not permanently mark devices before final acceptance.
- E. Perform all tests in accordance with AABC standard procedures. Any deviation from same must be approved by the Architect.
- F. Should the basic system or any of its components fail to meet contract requirements, and thereby make the testing and balancing work invalid, notify the Architect and stop all tests until such time that the failure is corrected.

PART 2 - PRODUCTS

2.1 TEST INSTRUMENTS

- A. Use instruments of equal or better quality than those described in the technical portions of Associated Air Balance Council--"National Standards for Testing and Balancing Heating, Ventilating and Air Conditioning Systems, Fifth Edition 1989.
- B. Instruments used for balancing air and water systems must have been calibrated within a period of six (6) months prior to balancing.
- C. List in the report types, serial numbers, and dates of calibration of all instruments used in the final air and water balance tests.
- D. Instrumentation shall include, as a minimum, the following items of equipment:

1. Pressure gauges and fittings.
2. Dry bulb and wet bulb thermostats.
3. Contact pyrometer.
4. Portable flow meter and, if required, orifice plates.
5. Pitot tube and manometers.
6. Alnor Velometer with attachments.
7. Amprobe.
8. Tachometer.
9. Special wrenches and tools.

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.
 1. Contract Documents are defined in the General and Supplementary Conditions of Contract.
 2. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- B. Examine approved submittal data of HVAC systems and equipment.
- C. Examine project record documents described in Division 1 Section "Project Record Documents."
- 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 curves. 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. Calculate system effect factors to reduce the performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.
- F. Examine system and equipment installations to verify that they are complete and that

testing, cleaning, adjusting, and commissioning specified in individual Specification Sections have been performed.

- G. Examine system and equipment test reports.
- H. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- I. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.
- J. Examine HVAC equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- K. Examine terminal units, such as variable-air-volume boxes, to verify that they are accessible and their controls are connected and functioning.
- L. Examine strainers for clean screens and proper perforations.
- M. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.
- N. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- O. Examine equipment for installation and for properly operating safety interlocks and controls.
- P. Examine automatic temperature system components to verify the following:
 - 1. Dampers, valves, and other controlled devices are operated by the intended controller.
 - 2. Dampers and valves are in the position indicated by the controller.
 - 3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.
 - 4. Automatic modulating and shutoff valves, including two-way valves and three-way mixing and diverting valves, are properly connected.
 - 5. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
 - 6. Sensors are located to sense only the intended conditions.
 - 7. Sequence of operation for control modes is according to the Contract Documents.

8. Controller set points are set at design values.
9. Interlocked systems are operating.
10. Changeover from heating to cooling mode occurs according to indicated values.

Q. 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 system readiness 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 design 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 Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and this Section.
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to the insulation Specifications for this Project.
- C. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, 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. All air distribution systems including supply, return, outdoor air and exhaust ductwork shall be tested and balanced.
- B. 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.
- C. Prepare schematic diagrams of systems' "as-built" duct layouts.
- D. For variable-air-volume systems, develop a plan to simulate diversity.
- E. Determine the best locations in main and branch ducts for accurate duct airflow measurements.
- F. Check the airflow patterns from the outside-air louvers and dampers and the return- and exhaust-air dampers, through the supply-fan discharge and mixing dampers.
- G. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- H. Verify that motor starters are equipped with properly sized thermal protection.
- I. Check dampers for proper position to achieve desired airflow path.
- J. Check for airflow blockages.
- K. Check condensate drains for proper connections and functioning.
- L. Check for proper sealing of air-handling unit components.
- M. Check for proper sealing of air duct system.
- N. Where the system cannot be properly balanced or equipment tested due to system deficiencies such as inability to properly adjust fan speeds, improperly sized motors, excessively noisy equipment, malfunctioning controls, excessively out of balance air distribution system branch runs, and similar items, furnish to the Architect in writing a list of the deficiencies prior to the submission of the test report.
- O. Verify operation of each room thermostat serving variable air volume terminal units over full range of heating and cooling to insure proper sequence of control of the variable air volume operator and reheat coil valve.
- P. Field test maximum and minimum air volumes of all variable air volume terminal units

and record final settings. Check factory settings of regulators and controllers before tests. Reset to the scheduled air volumes if required.

- Q. Work in conjunction with the Automatic Temperature Control Contractor and Architect to establish maximum and minimum settings on all variable air volume fans.

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by the fan manufacturer.
1. Measure fan static pressures to determine actual static pressure as follows:
 - a. Measure outlet static pressure as far downstream from the fan as practicable 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 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.
 2. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
 - a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.
 3. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Compare actual system effect factors with calculated system effect factors to identify where variations occur. Recommend corrective action to align design and actual conditions.
 4. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes.
 5. 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 modes 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 static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.

- a. Where sufficient space in submains 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. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submains and branch ducts to design airflows within specified tolerances.
- C. Measure terminal 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 terminal outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using 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 maximum set-point 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 outside-air dampers at minimum, and 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 duct 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 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 as described for constant-volume air systems.

- a. If air outlets are out of balance at minimum airflow, report the condition but leave the outlets balanced for maximum airflow.
6. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outside airflow. Adjust the fan and balance the return-air ducts and inlets 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 adequate static pressure is maintained at the most critical unit.
8. Record the final fan performance data.

3.7 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

- A. Prepare test reports with pertinent design data and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against approved pump flow rate. Correct variations that exceed plus or minus 5 percent.
- B. Prepare schematic diagrams of systems' "as-built" piping layouts.
- C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
 1. Open all manual valves for maximum flow.
 2. Check expansion tank liquid level and tank pressure.
 3. Check makeup-water-station pressure gage for adequate pressure for highest vent.
 4. Check flow-control valves for specified sequence of operation and set at indicated flow.
 5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type, unless several terminal valves are kept open.
 6. Set system controls so automatic valves are wide open to heat exchangers.
 7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
 8. Check air vents for a forceful liquid flow exiting from vents when manually operated.
- D. Where liquid flow balancing cannot be accomplished due to system deficiencies such as excessive or lack of pumping head, inadequately sized motors, pressure drops not determinable or similar problems, prepare a list of such deficiencies and the suggested system modifications and furnish to the Architect in writing and prior to submission of test report for necessary action.

3.8 PROCEDURES FOR HYDRONIC SYSTEMS

- A. Measure water flow at pumps. Use the following procedures, except for positive-displacement pumps:
 - 1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
 - 2. Check system resistance. With all valves open, read pressure differential across the pump and mark the pump manufacturer's head-capacity curve. Adjust pump discharge valve until design water flow is achieved.
 - 3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on the pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
 - 4. Report flow rates that are not within plus or minus 5 percent of design.
- B. Set calibrated balancing valves, if installed, at calculated presettings.
- C. Measure flow at all stations and adjust, where necessary, to obtain first balance.
 - 1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.
- D. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than design flow.
- E. Adjust balancing stations to within specified tolerances of design flow rate as follows:
 - 1. Determine the balancing station with the highest percentage over indicated flow.
 - 2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
 - 3. Record settings and mark balancing devices.
- F. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures, including outdoor-air temperature.
- G. Measure the differential-pressure control valve settings existing at the conclusions of balancing.

3.9 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

- A. Balance systems with automatic two and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for

hydronic systems.

3.10 PROCEDURES FOR STEAM SYSTEMS

- A. Measure and record upstream and downstream pressure of each piece of equipment.
- B. Measure and record upstream and downstream steam pressure of pressure-reducing valves.
- C. Check the setting and operation of automatic temperature-control valves, self-contained control valves, and pressure-reducing valves. Record the final setting.
- D. Check the settings and operation of each safety valve. Record settings.
- E. Verify the operation of each steam trap.

3.11 GENERAL PROCEDURES FOR EQUIPMENT

- A. Conduct performance tests only after the air and water systems have been balanced and the proper flow rates established.
- B. Test and record capacity of heat transfer equipment including all coils. Air side and water side capacities must agree within five (5) percent of each other. Include the manufacturer's rated capacity at the test operating conditions with the report. Perform tests where possible at design conditions. If tests are not performed under design conditions, interpolate results to determine capacity at full load operating conditions.
- C. Calculate efficiency of pumps and fans by recognized methods using test data.
- D. Test refrigeration equipment to determine heat extracted from or heat added to the building by the equipment and the heat ejected from the device. Record date, time and outside weather conditions including ambient dry bulb, wet bulb, wind speed and direction, cloud cover, rain, and any special conditions pertinent to the test.

3.12 PROCEDURES FOR MOTORS

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
 - 1. Manufacturer, model, and serial numbers.
 - 2. Motor horsepower rating.
 - 3. Motor rpm.
 - 4. Efficiency rating.
 - 5. Nameplate and measured voltage, each phase.
 - 6. Nameplate and measured amperage, each phase.

7. Starter thermal-protection-element rating.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass for the controller to prove proper operation. Record observations, including controller manufacturer, model and serial numbers, and nameplate data.

3.13 PROCEDURES FOR HEAT-TRANSFER COILS

A. Water Coils: Measure the following data for each coil:

1. Entering- and leaving-water temperatures.
2. Water flow rate.
3. Water pressure drop.
4. Dry-bulb temperatures of entering and leaving air.
5. Wet-bulb temperatures of entering and leaving air for cooling coils.
6. Airflow.
7. Air pressure drop.

3.14 PROCEDURES TEMPERATURE TESTING

- A. During TAB, report the need for adjustment in temperature regulation within the automatic temperature-control system.
- B. Measure indoor wet- and dry-bulb temperatures every other hour for a period of two successive eight-hour days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied.
- C. Measure outside-air, wet- and dry-bulb temperatures.

3.15 PROCEDURES FOR LABORATORY FUME HOODS

- A. Before performing laboratory fume hood testing, measure, adjust and record the supply airflow and airflow patterns of each supply air outlet that is located in the same room as the hood. Adjust the air outlet flow pattern to minimize turbulence and to achieve the desired airflow patterns at the face and inside the hood. Verify that adequate makeup air is available to achieve the indicated flow of the hood.
- B. Measure, adjust, and record the airflow of each laboratory fume hood by duct Pitot-tube traverse with the laboratory fume hood sash in the design open position.
1. For laboratory fume hoods installed in variable exhaust systems, measure, adjust, and record the hood exhaust airflow at maximum and at minimum airflow conditions.
 2. For laboratory fume hoods designed with integral makeup air, measure, adjust, and

record the exhaust and makeup airflow.

- C. For laboratory fume hoods that are connected to centralized exhaust systems using automatic dampers, adjust the damper controller to obtain the indicated exhaust airflow.
- D. After balancing is complete, do the following:
 - 1. Measure and record the static pressure at the hood duct connection with the hood operating at indicated airflow.
 - 2. Measure and record the face velocity across the open sash face area. Measure the face velocity at each point in a grid pattern. Perform measurements at a maximum of 12 inches between points and between any point and the perimeter of the opening.
 - a. For laboratory fume hoods designed to maintain a constant face velocity at varying sash positions, also measure and record the face velocity at 50 and 25 percent of the design open sash position.
 - b. Calculate and report the average face velocity by averaging all velocity measurements.
 - c. Calculate and report the exhaust airflow by multiplying the calculated average face velocity by the sash open area. Compare this quantity with the exhaust airflow measured by duct Pitot-tube traverse. Report differences.
 - d. If the average face velocity is less than the indicated face velocity, retest the average face velocity and adjust hood baffles, fan drives, and other parts of the system to provide the indicated average face velocity.
 - 3. Check each laboratory fume hood for the capture and containment of smoke by using a hand-held emitting device. Observe the capture and containment of smoke flow pattern across the open face and inside the hood. Make adjustments necessary to achieve the desired results.
- E. With the room and laboratory fume hoods operating at indicated conditions, perform an "as-installed" performance test of the laboratory fume hood according to ASHRAE 110. Test each laboratory fume hood(s) and document the test results.

3.16 PROCEDURES FOR EXHAUST HOODS

- A. Measure, adjust, and record the airflow of each exhaust hood. Measure airflow by duct Pitot-tube traverse. If a duct Pitot-tube traverse is not possible, explain why, in the report, and explain the test method used.
- B. After balancing is complete, do the following:
 - 1. Measure and record the static pressure at the hood exhaust-duct connection.
 - 2. Check the hood for capture and containment of smoke using a smoke emitting device. Observe the smoke pattern. Make adjustments to achieve optimum

results.

3.17 PROCEDURES FOR SPACE PRESSURIZATION MEASUREMENTS AND ADJUSTMENTS

- A. Before testing for space pressurization, observe the space to verify the integrity of the space boundaries. Verify that windows and doors are closed and applicable safing, gaskets, and sealants are installed. Report deficiencies and postpone testing until after the reported deficiencies are corrected.
- B. Measure, adjust, and record the pressurization of each room, each zone, and each building by adjusting the supply, return, and exhaust airflows to achieve the indicated conditions.
- C. Measure space pressure differential where pressure is used as the design criteria, and measure airflow differential where differential airflow is used as the design criteria for space pressurization.
 - 1. For pressure measurements, measure and record the pressure difference between the intended spaces at the door with all doors in the space closed. Record the high-pressure side, low-pressure side, and pressure difference between each adjacent space.
 - 2. For applications with cascading levels of space pressurization, begin in the most critical space and work to the least critical space.
 - 3. Test room pressurization first, then zones, and finish with building pressurization.
- D. To achieve indicated pressurization, set the supply airflow to the indicated conditions and adjust the exhaust and return airflow to achieve the indicated pressure or airflow difference.
- E. For spaces with pressurization being monitored and controlled automatically, observe and adjust the controls to achieve the desired set point.
 - 1. Compare the values of the measurements taken to the measured values of the control system instruments and report findings.
 - 2. Check the repeatability of the controls by successive tests designed to temporarily alter the ability to achieve space pressurization. Test overpressurization and underpressurization, and observe and report on the system's ability to revert to the set point.
 - 3. For spaces served by variable-air-volume supply and exhaust systems, measure space pressurization at indicated airflow and minimum airflow conditions.
- F. In spaces that employ multiple modes of operation, such as normal mode and emergency mode or occupied mode and unoccupied mode, measure, adjust, and record data for each operating mode.
- G. Record indicated conditions and corresponding initial and final measurements. Report

deficiencies.

3.18 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

- A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.
 - 1. Measure and record the operating speed, airflow, and static pressure of each fan.
 - 2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
 - 3. Check the refrigerant charge.
 - 4. Check the condition of filters.
 - 5. Check the condition of coils.
 - 6. Check the operation of the drain pan and condensate drain trap.
 - 7. Check bearings and other lubricated parts for proper lubrication.
 - 8. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.

- B. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished.
 - 1. New filters are installed.
 - 2. Coils are clean and fins combed.
 - 3. Drain pans are clean.
 - 4. Fans are clean.
 - 5. Bearings and other parts are properly lubricated.
 - 6. Deficiencies noted in the preconstruction report are corrected.

- C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.
 - 1. Compare the indicated airflow of the renovated work to the measured fan airflows and determine the new fan, speed, filter, and coil face velocity.
 - 2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
 - 3. If calculations increase or decrease the airflow and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated airflow and water flow rates. If 5 percent or less, equipment adjustments are not required.
 - 4. Air balance each air outlet.

3.19 TEMPERATURE-CONTROL VERIFICATION

- A. Verify that controllers are calibrated and commissioned.

- B. Check transmitter and controller locations and note conditions that would adversely affect control functions.
- C. Record controller settings and note variances between set points and actual measurements.
- D. Check the operation of limiting controllers (i.e., high- and low-temperature controllers).
- E. Check free travel and proper operation of control devices such as damper and valve operators.
- F. Check the sequence of operation of control devices. Note air pressures and device positions and correlate with airflow and water-flow measurements. Note the speed of response to input changes.
- G. Check the interaction of electrically operated switch transducers.
- H. Check the interaction of interlock and lockout systems.
- I. Check main control supply-air pressure and observe compressor and dryer operations.
- J. Record voltages of power supply and controller output. Determine whether the system operates on a grounded or nongrounded power supply.
- K. Note operation of electric actuators using spring return for proper fail-safe operations.

3.20 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: As Work progresses, prepare 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.

3.21 FINAL REPORT

- A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in three-ring binder, tabulated and divided into sections by tested and balanced systems.

- B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.
 - 1. Include a list of the instruments used for procedures, along with proof of calibration.

- C. Final Report Contents: In addition to the certified field report data, include the following:
 - 1. Fan curves.
 - 2. Manufacturers' test data.
 - 3. Field test reports prepared by system and equipment installers.
 - 4. Other information relative to equipment performance, but do not include Shop Drawings and Product Data.

- D. General Report Data: In addition to the form titles and entries, include the following data in the final report, as applicable:
 - 1. Title page.
 - 2. Name and address of TAB firm.
 - 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 firm 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, type size, and fittings.
 - 14. Notes to explain why certain final data in the body of reports varies from indicated values.
 - 15. Test conditions for fans and pump performance forms, including the following:
 - a. Settings for outside-, 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.
- E. 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 outside, 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.
- F. Air-Handling Unit Test Reports: For air-handling units with coils, include the following:
1. Unit Data: Include the following:
 - 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. Sheave dimensions, center-to-center and amount of adjustments in inches.
 - j. Number of belts, make, and size.
 - k. Number of filters, type, and size.
 2. Motor Data:
 - a. 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. Sheave dimensions, center-to-center and amount of adjustments in inches.
 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. 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. Outside airflow in cfm.
- j. Return airflow in cfm.
- k. Outside-air damper position.
- l. Return-air damper position.
- m. Vortex damper position.

G. 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
- 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. Airflow rate in cfm.
- b. Average face velocity in fpm.
- c. Air pressure drop in inches wg.
- d. Outside-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.
- l. 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.

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. Sheave dimensions, center-to-center and amount of adjustments in inches.
2. Motor Data:
 - a. 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. Sheave dimensions, center-to-center and amount of adjustments in inches.
 - g. Number of belts, make, and size.
 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 airflow rate in cfm.
 - h. Indicated velocity in fpm.
 - i. Actual airflow rate in cfm.
 - j. Actual average velocity in fpm.
 - k. Barometric pressure in psig.
- J. Air-Terminal-Device Reports:
1. Unit Data:

- a. System and air-handling unit identification.
 - b. Location and zone.
 - c. Test apparatus used.
 - d. Area served.
 - e. Air-terminal-device make.
 - f. Air-terminal-device number from system diagram.
 - g. Air-terminal-device type and model number.
 - h. Air-terminal-device size.
 - i. Air-terminal-device effective area in sq. ft..
 2. Test Data: (Indicated and actual values):
 - a. Airflow rate in cfm.
 - b. Air velocity in fpm.
 - c. Preliminary airflow rate as needed in cfm.
 - d. Preliminary velocity as needed in fpm.
 - e. Final airflow rate in cfm.
 - f. Final velocity in fpm.
 - g. Space temperature in deg F.
- K. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:
 1. Unit Data:
 - a. System and air-handling unit identification.
 - b. Location and zone.
 - c. Room or riser served.
 - d. Coil make and size.
 - e. Flowmeter type.
 2. Test Data: (Indicated and Actual Values):
 - a. Airflow rate in **cfm**.
 - b. Entering-water temperature in deg F.
 - c. Leaving-water temperature in deg F.
 - d. Water pressure drop in feet of head or psig.
 - e. Entering-air temperature in deg F.
 - f. Leaving-air temperature in deg F.
- L. Instrument Calibration Reports:
 1. Report Data:
 - a. Instrument type and make.
 - b. Serial number.
 - c. Application.

- d. Dates of use.
- e. Dates of calibration.

3.22 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. Randomly 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. Measure sound levels at two locations.
 - e. Measure space pressure of at least 10 percent of locations.
 - f. Verify that balancing devices are marked with final balance position.
 - g. Note deviations to the Contract Documents in the Final Report.

B. Final Inspection:

1. After initial inspection is complete and evidence 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.
2. TAB firm test and balance engineer shall conduct the inspection in the presence of Architect.
3. Architect shall randomly select measurements documented in the final report to be rechecked. The 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 the 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.
6. TAB firm shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes and resubmit the final report.
7. Request a second final inspection. If the second final inspection also fails, Owner shall contract the services of another TAB firm to complete the testing and balancing in accordance with the Contract Documents and deduct the cost of the services from the final payment.

3.23 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional testing and balancing 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 testing, inspections, and adjusting during near-peak summer and winter conditions.

END OF SECTION 230593

SECTION 230700 – MECHANICAL SYSTEMS INSULATION

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. Work included in this section is the thermal insulating done in the field, on the Division 21, 22 and 23 systems as specified herein.
- B. Work excluded in this Section are the following:
 - 1. Thermal building insulation.
 - 2. Sound absorbing duct lining.
- C. The requirements of Division 23, Section “Mechanical and Electrical General Provisions” shall apply to the work specified under this Section.

1.3 DEFINITIONS

- A. The k factor means the number of British thermal units of heat transmitted per (sq. ft.) (Fahrenheit temperature difference) through a material with flat, parallel sides one (1) inch apart. The material shall be tested and rated according to ASTM Test Method C-177.
- B. Unless otherwise specified, the term "concealed", as used in this specification, shall include all items hidden from normal sight. This includes items within furred spaces, pipe and duct shafts, above suspended ceilings and within return air plenums.
- C. Unless otherwise specified, the work "exposed" shall refer to all work other than "concealed" work.
- D. Unless otherwise specified, the term "exterior", as used in this specification, shall include all items being or situated outside.
- E. Unless otherwise specified, the term "conditioned", as used in this specification, shall be a heated or cooled space, or both, within a building and, where required, provided with

humidification or dehumidification means, so as to be capable of maintaining a space condition falling within the comfort envelope set forth in ASHRAE 55.

1.4 SUBMITTALS

- A. Provide shop drawings in accordance with Division 23, Sections “Mechanical and Electrical General Provisions” and the General Requirements which shall include all insulation, jackets, finishes, corner beads, pump covers, etc. Shop drawings shall additionally describe each system or component to be insulated, insulation type and thickness, and method of installation.
- B. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).
- C. LEED Submittals:
 - 1. Product Data for Credit EQ 4.1: For adhesives and sealants, documentation including printed statement of VOC content and chemical components.
- D. 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.
 - 6. Detail application of field-applied jackets.
 - 7. Detail application at linkages of control devices.

1.5 MOCK-UPS

- A. Mockups: Before installing insulation of any type, build mockups for each type of insulation and finish listed below to demonstrate quality of insulation application and finishes. Build mockups according to the following requirements, using materials indicated for the completed Work:
 - 1. Include the following mockups:
 - a. One 10-foot section of 2” straight pipe and duct run.
 - b. One 90-degree pipe and duct elbow.
 - c. One pipe and duct tee fitting.
 - d. One 2” valve.
 - e. Four support hangers, including hanger shield and insert.

2. Build mockups with cutaway sections to allow observation of application details for insulation materials, mastics, attachments, and jackets.
3. Build mockups in the location indicated or, if not indicated, as directed by Architect.
4. Notify Architect seven (7) days in advance of dates and times when mockups will be constructed.
5. Obtain Architect's approval of mockups before starting insulation application.
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 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 and inspecting 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.

1.7 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields.
- 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.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All insulating materials, including adhesives, jackets and coatings, to be used on the project must be delivered to the building in the manufacturer's unopened container and must bear the manufacturer's stamp or label giving name of manufacturer, brand and description of material.
- B. After the necessary tests have been conducted to prove the water and air systems tight, all piping, ductwork and equipment to be insulated shall be thoroughly cleaned and then covered. Insulation materials shall be the product of Owens Corning, CSG, Schuller or Armacell equal to the products specified herein.

2.2 TYPES OF INSULATION

A. Type I - Pipe Insulation:

- 1. Provide heavy density fiberglass pipe insulation with vapor barrier jacket. The k factor shall not be more than 0.23 at seventy-five (75) degrees Fahrenheit mean temperature. Insulation shall be equal to Johns Manville Micro-Lok meeting ASTM C 547 with FSK jacket.

B. Type II - Pipe Insulation:

- 1. Provide closed cell elastomeric tubular insulation with built-in vapor barrier. The k factor shall not be more than 0.25 at seventy-five (75) degrees Fahrenheit mean temperature. Insulation shall be equal to Armacell AP Armaflex or AP Armaflex SS. The use of polyethylene, polyolefin or engineered polymer insulation is prohibited.

C. Type IV - Duct Insulation:

- 1. Provide blanket type lightweight fiberglass duct insulation with vapor barrier facing. The compressed k-factor shall not exceed 0.27 at seventy-five (75) degrees Fahrenheit mean temperature and a minimum installed R-Value of 6.0 (hr•ft²•°F)/Btu. Insulation shall be equal to Johns Manville flexible fiberglass blanket Microlite XG Formaldehyde-free Type 100 meeting ASTM C 553 with factory-applied FSK facing.

D. Type V - Duct and Equipment Insulation:

- 1. Provide board type fiberglass insulation with vapor barrier facing. The k factor shall not exceed 0.22 at seventy-five (75) degrees Fahrenheit mean temperature,

and the density shall not be less than 6.0 pounds per cubic foot (pcf). Insulation shall be equal to Johns Manville 817 Spin-Glas meeting ASTM C 612 with FSK facing.

E. Type VI - Equipment Insulation:

1. Provide board type fiberglass insulation, unfaced. The k factor shall not exceed 0.23 at seventy-five (75) degrees Fahrenheit mean temperature and the density shall not be less than 3.0 pounds per cubic foot (pcf). Insulation shall be equal to Johns Manville 814 Series Spin-Glas meeting ASTM C 612.

F. Type VII - Equipment or Exterior Duct Insulation:

1. Provide flexible elastomeric thermal sheet insulation with built-in vapor barrier. The k factor shall not exceed 0.27 at seventy-five (75) degrees Fahrenheit mean temperature. Insulation shall be equal to Armacell AP Armaflex or AP Armaflex SA.

G. Type IX - Equipment Insulation:

1. Provide flexible board type fiberglass insulation, unfaced. The k factor shall not exceed 0.28 at 150 degrees Fahrenheit mean temperature. Insulation shall be equal to Johns Manville pipe and tank insulation.

H. Type XI – Fire Barrier Insulation

1. Provide patented inorganic blanket encapsulated with scrim reinforced foil insulation with k-factor of 0.21. Wrap shall be rated as a shaft alternative per UL 1978. Insulation shall be equal to 3M Fire Barrier Insulation 15A.

I. Type XII – Piping Insulation

1. Provide rigid closed-cell polyisocyanurate thermal insulation with vapor retarder over pipe insulation and 0.030 inch thick PVC (polyvinylchloride) rolled jacketing. The insulation shall have a density of 2 lb/ft³, the k factor shall not be more than 0.18 (aged 6-months) at seventy-five (75) degrees Fahrenheit mean temperature and the minimum R-value of 5.6 hr*ft²*F/BTU (aged 6-months). Polyisocyanurate pipe insulation shall be manufactured by Dyplast, Dow Chemical Company, Elliott Company, or Duna USA equal to Dyplast dP-ISO-C1.

2.3 ADHESIVES, SEALERS AND COATINGS

- A. The vapor barrier on all insulation systems shall be maintained at all times. Any penetration into the vapor barrier shall be sealed vapor tight. All joints, fittings etc shall be sealed vapor tight.

- B. 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. They shall not corrode, soften or otherwise attach such material in either the wet or dry state and must be suitable for the service temperatures.
- C. Any cement, sealer or coating used shall be resistant to vermin and mold and shall be durable. It shall not discolor on aging; and where applied on the final surface of the insulation, it shall be light in color and be capable of being painted.
- D. For indoor applications:
 - 1. Use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- E. Adhesives, coatings and compounds shall be equal to the following:
 - 1. Vapor barrier adhesive for sealing joints on pipe and duct insulation - Foster 85-75.
 - 2. Adhesive for installing canvas jackets - Foster 30-36.
 - 3. Adhesive for installing duct insulation - Foster 85-20 and 81-91.
 - 4. Adhesive for installing cellular-glass insulation - Foster Brand 81-84.
 - 5. Adhesive for installing elastomeric insulation - Foster Brand 85-75, Armaflex 520.
 - 6. Adhesive for installing mineral-fiber insulation - Foster Brand 85-60/85-70, Childers CP-127.
 - 7. Adhesive for ASJ, FSK and PVDC jackets - Foster Brand 85-50, Childers CP-82.
 - 8. Joint sealants for cellular-glass insulation - Foster Brand 30-45, Childers CP-76.
 - 9. FSK and metal jacket flashing sealants - Foster Brand 95-44, Childers CP-76.
 - 10. ASJ, vinyl, PVDC, and PVC jacket flashing sealants - Childers Brand CP-76
 - 11. Two coats of WB Armaflex finish or glass mesh with mastic for all Armaflex located outside.

2.4 FABRIC JACKETS

- A. All exposed piping, ductwork, and equipment in addition to the insulation jackets specified, shall be covered with an additional UL listed jacket of eight (8) ounce canvas. This shall be in addition to the insulation jackets and aluminum weatherproof jacket specified.

2.5 FITTING AND VALVE COVERS

- A. Pipe fittings and valves shall be insulated with Zeston premold one (1) piece PVC insulated fitting cover and factory precut insulation. Fittings shall have edges of one (1) piece cover sealed with Zeston vapor barrier pressure sensitive tape.

2.6 METALLIC COMPONENTS

- A. Staples shall be outward clinching type of 304 or 316 stainless steel.
- B. Bands shall be galvanized steel, aluminum, brass, or nickel-copper alloy, of 3/4 inch nominal width. The band thickness, exclusive of coating, shall be not less than 0.005 inch for steel and nickel copper alloy, 0.007 inch for aluminum, and 0.01 inch for brass.
- C. Wire shall be fourteen (14) gauge, nickel-copper alloy or copper clad steel, or sixteen (16) gauge, soft annealed, galvanized steel.
- D. Wire netting used for exposed surfaces of insulation that is to be cement finished shall be twenty-two (22) gauge, one (1) inch galvanized mesh, with continuous twenty-six (26) gauge galvanized steel corner beads having 2-1/2 inch wings.
- E. Protect external corners on insulation of ducts and equipment exposed in occupied spaces by corner beads two (2) inches by two (2) inches, .016 inch thick aluminum adhered to heavy duty Kraft paper.
- F. All exterior piping and ductwork shall be additionally covered with a sixteen (16) mil embossed aluminum weatherproof jacket. Jacketing shall be ITW's Lock-On (Childers) type with an integrally bonded polysurlyn moisture retarder over the entire surface in contact with the insulation. Jackets are to be fabricated with continuous modified Pittsburg Z-lock on the longitudinal seam and each butted section of jacketing shall be joined and sealed with factory fabricated butt strap and sealant. Fittings shall be insulated and weatherproofed using similar materials.

2.7 INSULATION SCHEDULE:

- A. Insulation materials furnished must meet the minimum thickness requirements of National Voluntary Consensus Standard 90.1 (current accepted edition), "Energy Efficient Design of New Buildings" of the American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE).

Service	Type	Thickness
B. Domestic Water Pipe (Hot, Cold, Tempered, & Recirc.)	I	1"
Optional sizes 1" and smaller	I	½"
C. Domestic Water Piping Concealed in Walls and Cabinet Enclosures	II	½"
D. Air Conditioning Condensate	I	1"

	Optional	II	½"
E.	Chilled Water Supply and Return		
	1. 1 ¼" or smaller	II	1"
	2. 1 ½" and larger	XII	1 ½"
	3. 1 ½" and larger (exterior, above-grade)	XII	2"
F.	Heating Water Supply and Return		
	1. 1 ½" or smaller	I	1"
	2. 2" and larger	I	2"
G.	Air Conditioning Supply and Outdoor Air Ductwork		
	1. Concealed	IV	2"
	2. Exposed or in Shafts	V	2"
	3. Air Device Bodies	V	1"
H.	Air Conditioning Return Ductwork		
	1. Concealed (shafts only)	IV	2"
	2. Exposed	V	1"
I.	Air Conditioning Exhaust Ductwork		
	1. 2-hr Fired Rated in Chase	XI	1 ½"
	2. Laboratory Exhaust Ductwork	XI	1 ½"

PART 3 - EXECUTION

3.1 GENERAL:

- A. All insulation shall be installed by skilled workmen regularly engaged in this type of work.
- B. Insulation shall be continuous at all hangers, hanger rods, supports, sleeves and openings. Continuous vapor barrier must be provided for all cold surfaces. Insulation shall be sealed where it terminates because of a valve, union, flange, etc.

- C. Provide continuous insulation and jacketing when passing thru interior wall, floor, and ceiling construction.
 - 1. At Through Penetration Firestops: Coordinate insulation densities with the requirements of approved firestop system being installed.
 - 2. Insulation densities required by approved firestop system may vary with the densities specified in this Section. When this occurs use the higher density insulation.
- D. Do not intermix different insulation materials on individual runs of piping or ductwork.
- E. Arrange to permit expansion and contraction without causing damage to insulation or surface.
- F. Actual insulation thickness must be at least equal to the minimum specified in the schedule at all locations including supports in contact with cold surfaces. Where the manufacturer's rated or nominal thickness is less than the minimum specified, a thicker material or more layers will be requested so that the stated minimum thickness will be attained or exceeded.
- G. Install insulation materials in a first class manner with smooth and even surfaces. Scrap pieces of insulation shall not be used where a full length section will fit.
- H. Unless otherwise specified herein, the application of all insulation materials, accessories and finishes shall be in accordance with the manufacturer's published recommendations.
- I. Insulation materials shall not be applied until all surfaces to be covered are clean and dry; all foreign material, such as rust, scale, dirt, etc., has been removed, and where specified, surfaces have been painted. Insulation shall be clean and dry when installed and during the application of any finish. The insulation on pipe fittings, valves and pipe joints shall not be installed before the piping is tested and approved.
- J. Omit insulation of the following unless directed otherwise.
 - 1. Brass or copper pipe specified to be chrome plated.
 - 2. Traps and pressure reducing valves, relief piping from safety valves, and unions, flanges and expansion joints on heating water system.
 - 3. All fire protection piping.
 - 4. Existing adjacent insulation.
 - 5. ASME stamps, manufacturer's nameplates.
 - 6. Access plates on fan housings.
 - 7. Cleanouts or handholes.
 - 8. Components within factory preinsulated HVAC equipment.
 - 9. Factory - preinsulated flexible ductwork and HVAC equipment.
 - 10. Vibration - isolating connections.

- K. Replace and repair insulation disturbed by testing and balancing procedures required under Division 23, Section “Testing and Balancing”.

3.2 PIPE INSULATION

- A. High density pipe saddles shall be provided at all points of support as hereinbefore specified.
- B. Insulate all valves and strainers. Use premolded covers and factory precut insulation where applicable. Unions and flanges shall not be insulated except on cold services.
- C. Insulate valves up to and including bonnets, except for cold water valves which shall be insulated over packing nuts in a manner to permit removal for adjustment and repacking.
- D. Insulate strainers in a manner to permit removal of the basket without disturbing the insulation of the strainer. Obtain Architect's approval of installation method.
- E. Insulate all exposed piping under lavatories and sinks with a white, fitted/molded antimicrobial undersink pipe cover equal to Truebro Lav Guard 2. Cover shall have internal, E-Z Tear-To-Fit trim feature for square, clean trimming (internal ribs) and built-in, concealed E-Z Grip fasteners (no cable-tie fasteners allowed).
- F. Application - Type I Insulation:
 - 1. Insulate all pipes in a neat and workmanlike manner. Seal all longitudinal laps of jackets and staple every six (6) inches. Where the piping operates below ambient temperature, the staples shall be coated with vapor barrier adhesive. All butt joints shall be wrapped with a three (3) inch minimum wide strip of jacketing material securely sealed in place.
 - 2. Insulate valves and fittings with pre-cut blanket type fiberglass insulation and PVC covers as specified. Insulation shall be of the same thickness as that on adjoining pipe. The ends of the insulation shall be tucked snugly into the throat of the fitting and the edges adjacent to the pipe covering tufted and tucked, fully insulating the pipe fitting. The one (1) piece PVC fitting cover shall then be secured by stapling, tack fastening, banding or taping the ends to the adjacent pipe covering. Chilled water supply and return piping and cold water systems piping shall be insulated as above and have all seam edges of the cover sealed with ZESTON vapor barrier adhesive mastic. The circumferential edges of cover shall be wrapped with ZESTON vapor barrier pressure sensitive color matching tape. The tape shall extend over the adjacent pipe insulation and overlap itself at least two (2) inches on the downward side.
 - 3. Where fittings are operating above ambient they may, in lieu of the preceding paragraph, be covered with a three (3) hour, hydraulic setting, combination insulating and finishing cement having k factor not greater than 0.87 at a mean temperature of 200 degrees Fahrenheit. The thickness of this cement shall be such that the surface is substantially flush with the pipe covering. Where the insulation

terminates at a fitting that is not covered, the end of the insulation shall be beveled off with this same cement. All fittings insulated in this manner shall be covered by a fabric jacket as specified, which shall be cemented down with lagging adhesive.

4. Where expansion joints are required to be insulated, they shall be covered with readily removable sections of insulation of same composition and thickness as provided for adjacent piping.

G. Application - Type II Insulation:

1. The material shall be slit lengthwise to permit installation or slipped over pipe before connections are made. Self-seal insulation may also be installed.
2. All joints and seams must be thoroughly bonded, both mechanically and hermetically, by the adhesive recommended by the insulation manufacturer. Also, the manufacturer's recommendations shall be followed as to the adhesive to use where the insulation needs bonding to metal or other material used for any surface treatment where a finish coat of paint is required.
3. All penetrations of the insulation must be thoroughly sealed so that the insulation itself will form a complete vapor barrier. Insulation shall run continuous at hangers and supports to form a complete vapor barrier. Wherever the insulation terminates, the edges shall be sealed to the metal.
4. Insulation shall be extended to stop valves under plumbing fixtures and/or within cabinets. Water and waste lines serving handicap plumbing fixtures shall be insulated and painted to match adjacent surface.

H. Application -Type XII Insulation:

1. Insulation shall be fabricated in required shapes from bun stock in accordance with ASTM C-450 "Standard Practice for Prefabrication and Field Fabrication of Thermal Insulating Fitting Covers for NPS Piping, Vessel Lagging, and Dished Head Segments" and C-585 "Standard Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System)". Insulation shall be factory fabricated by a qualified fabricator from bun stock.
2. Fittings, such as valves, valve stations, flanges, 90° and 45° elbows, and tees shall be two piece flycut or routed as the preferred fabrication method. For diameters too large for flycutting or routing, the pieces shall be fabricated in two halves with each half made up of mitered sections. Both methods shall be in accordance with ASTM C-450 and ASTM C-585.
3. Adhesives, Joint Sealers and Mastics
 - a. Solvent based adhesives, joint sealers and mastics may be used in contact with ISO-C1 insulation. Mastics shall remain flexible at the lowest expected ambient temperature.
 - b. Joint sealers for sealing joints of insulation shall be vapor retarder type, moisture and water resistant, non hardening, and flexible with a service temperature range from -275°F to +200°F.
 - c. A vapor retarder type joint sealer shall be applied on insulation longitudinal joints and butt joints to prevent moisture and moisture vapor infiltration.

Such joint sealers are Fosters 95-50 sealer or approved equal. Please consult joint sealer manufacturer for recommended products

- d. Solvent or water adhesives may be used to attach the vapor barrier to the outer surface of the ISO-C1. Refer to the vapor barrier installation guidelines. Consult adhesive manufacturer's literature for instructions on handling adhesives including required operating temperatures. Potential adhesives for use in this application include:

- 1) Childers CP 88 adhesive (solvent based)
- 2) Foster 81-05 adhesive (solvent based)
- 3) Foster 85-50 adhesive (water based)
- 4) Foster 85-60 adhesive (water based)

4. Vapor Retarder

- a. The Vapor Retarder be factory or field applied to the outer surface of the pipe insulation. A double layer vapor retarder design shall be used for cryogenic and LNG applications, with the secondary vapor retarder applied between the outer most foam insulation layer and the next inner layer of foam insulation. Refer to Figure 2 in Appendix B for details.
- b. Vapor retarder shall have a maximum permeance of 0.01 perm and shall be equivalent to Venture Wrap or Venture Clad products or Insulrap 50 Laminated Vapor Retarder for Pipe Insulation. Refer to ASTM standards C-755 and C-1136 for information on selection and specification of vapor retarders. Refer to product literature and installation guidelines from the vapor retarder manufacturer for recommended application instructions.
- c. Elbows and fittings shall be wrapped with vapor retarder tape with a 50% overlap.
- d. For other laminated membrane type vapor retarders, consult manufacturer's literature and installation guidelines.

5. Installation

- a. Dyplast recommends insulation shall be fabricated with shiplap or tongue and groove longitudinal joints and shiplap ends.
- b. Install pre-fabricated insulation fittings on elbows, tees, and valves. Insulation shall be the same thickness as pipe sections and fabricated with shiplap ends and shiplap or tongue and groove longitudinal joints.
- c. Insulation shall be secured to the pipe with 3/4" wide fiber reinforced tape.
- d. Insulation shall be secured with fiber reinforced tape prior to installation of the vapor retarder material when vapor retarder is field applied.
- e. Outer layer insulation and vapor retarder shall be secured with fiber reinforced tape. Use a 25% circumferential overlap on 12" centers when vapor retarder is factory applied to insulation. Fiber tape shall be applied to the exterior of the insulation/vapor retarder system.
- f. All insulation shall be tightly butted and free of voids and gaps at all joints. Vapor retarder must be continuous. All fasteners and bands shall be neatly aligned and overall work must be of high quality appearance and

- workmanship.
- g. Vapor stops shall be used on either side of valves frequently removed for servicing, valve stations left exposed, or odd fittings, elbows, tees, etc. where the chance of moisture infiltration is high.
 - h. The vapor retarder shall have a maximum permeance of 0.01 perm and shall be equivalent to Venture wrap or Venture Clad products or Insulrap 50 Laminated Vapor Retarder.
 - i. Vapor Retarder Film should be cut to length longitudinally and wrapped around the circumference of the pipe with lap joint and installed facing downward avoiding the placement of the joint at the top or bottom of the pipe. Lap joint to be sealed using liquid adhesive. Butt joints shall be covered with Vapor Retarder Tape. Spiral wrap configuration can be used in lieu of the above installation. Spiral wrapping will require adhesive placed on one edge of the vapor retarder as it is wrapped over the previous layer.
 - j. Elbows and fittings shall be wrapped with Vapor Retarder Tape or covered with a mastic type vapor retarder product. Vapor Retarder Tape is to be wrapped in a spiral configuration. If using mastic type vapor retarder at fittings and elbows, form mastic so that fitting covers can be applied true and tight.
 - k. On factory applied Vapor Retarder Film, lap joint to be sealed with SSL tape. All vapor retarder surfaces should be cleaned and free of dust, grease, oil, etc before application of the SSL tape to ensure good adhesion between the tape and vapor retarder. Refer to Figure 7 in Appendix. For other types of factory applied vapor retarders, consult manufacturer's recommendations on installation.
 - l. Before jacketing can be installed on a portion of the piping, the vapor retarder system on that portion must be complete and continuous.

3.3 DUCT INSULATION

- A. Provide accessories as required to prevent distortion and sagging of duct insulation. Provide welded pins, adhesive clips and wire ties as recommended by the manufacturer and directed by the Architect.
- B. Insulation shall cover all standing seams and metal surfaces. Provide corner beading on all exposed ducts.
- C. Staples shall be sealed to maintain vapor barrier.
- D. Neatly cut insulation at dampers, temperature control sensors, and controllers. Butter exposed edges with approved mastic coating.
- E. Application - Type IV Insulation:
 - 1. Insulation shall be cut slightly longer than perimeter of duct to insure full thickness at corners. All insulation shall be applied with edges tightly stitched with staples. Provide vapor barrier mastic sealer at seam. The insulation shall be additionally

secured to the bottom of all square ducts eighteen (18) inches or wider by means of welded pins and speed clips. The protruding ends of the pins shall be cut off flush after the speed clips have been applied. The vapor barrier facing shall be thoroughly sealed where the pins have pierced through with a tape of the same material by applying a vapor barrier adhesive to both surfaces as recommended by the manufacturer.

2. All hanger rods, support members, joints and penetrations of the vapor barrier shall be sealed with full thickness insulation and vapor barrier mastic sealer. All cuts or tears shall be sealed with strips of the aluminum foil tape and vapor barrier adhesive.

F. Application - Type V Insulation:

1. All insulation shall be applied with edges tightly butted. Insulation shall be impaled on pins welded to the duct and secured with speed clips. Spacing of pins shall be as required to hold insulation firmly in place but not less than one (1) pin per square foot, and pins shall be placed within three (3) inches of each corner of insulation. All joints and penetrations of the vapor barrier shall be sealed with a three (3) inch wide strip of the same material, applied with Foster 85-75, or to both surfaces as recommended by the adhesive and vapor barrier mastic sealer manufacturer.
2. If, through space or size restriction or other causes, the welded pin method is impossible, the insulation shall be secured to the duct with adhesive such as Foster 81-91 or equal. The adhesive shall cover the entire surface of the sheet metal when applied to underside of horizontal duct but may be applied in strips or spots for application to top and sides with a minimum of fifty (50) percent coverage.

3.4 FABRIC JACKET

- A. Apply jacket to insulated breeching and equipment. Onto the dry cement surface apply a brush coat of Foster Sealfas 30-36 at the rate of sixty (60) to seventy (70) square feet per gallon. Embed into wet coating the canvas jacket, smoothed out to avoid wrinkles and overlap all seams a minimum of two (2) inches. Apply a second brush coat of Sealfas 30-36 to the entire surface at the rate of sixty (60) to seventy (70) square feet per gallon.
- B. Where jacket is to be installed on piping, apply Foster 30-36 adhesive to the canvas jacket by dipping to completely wet and saturate the canvas. While wet, position on the pipe insulation and pull tight, bond, lap and smooth out all wrinkles. Finish with a sealer coat of adhesive.

END OF SECTION 230700

SECTION 230900 – BUILDING AUTOMATION AND TEMPERATURE CONTROL SYSTEM

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.
- B. All work of this Division shall be coordinated and provided by the single Central Control and Monitoring System (CCMS) Contractor.

1.2 SCOPE

- A. The work of this Division shall be as required by the Specifications, Point Schedules and Drawings.
- B. Provide a complete Central Control and Monitoring System (CCMS) for monitoring and control of mechanical, lab room and electrical equipment as specified. 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 CCMS for the Discovery Building be compatible with the existing building and USC campus wide CCMS network in all respects. The existing CCMS network is Johnson Controls Metasys.
- C. 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.
- D. 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 MUSC network.
- E. 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 ten concurrent users.

- F. 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.
- G. The primary focus of the Central Control and Monitoring System (CCMS) will be to monitor and control the new HVAC system components including, lab room air valves, air handling units, fans, heat exchangers, coils, valves, pumps, variable speed drives, etc. The system shall be expandable to serve future equipment, systems, and auxiliary field devices.
- H. CCMS contractor 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.
- I. 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 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 MUSC 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

existing Metasys 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 connected to the MUSC 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 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 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 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.

2.2 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 CCMS shall annunciate diagnostic alarms indicating system failures and non-normal 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.
 - a) Weekly schedules shall be provided for each group of equipment with a specific time use schedule.
 - b) 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:
 - 1) Any point, physical or calculated, may be designated for trending. Three methods of collection shall be allowed:
 - a) Defined time interval.
 - b) 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.

2.3 NETWORK AUTOMATION ENGINES (NAE)

A. Network Automation Engine (NAE):

1. 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.
2. Automation network – The NAE shall reside on the automation network and shall support a subnet of system controllers.
3. 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.
4. 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.
5. 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.
6. 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.

2.4 DIRECT DIGITAL CONTROLLERS (DDC)

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. VAV Modular Assembly (VMA):

1. The VAV Modular Assembly shall provide both standalone and networked direct digital control of pressure-independent, variable air volume terminal units. It shall address both single and dual duct applications.
2. The VAV Modular Assembly shall communicate over the FC Bus using BACnet Standard protocol SSPC-135, Clause 9.
3. The VAV Modular Assembly shall have internal electrical isolation for AC power, DC inputs, and MS/TP communications. An externally mounted isolation transformer shall not be acceptable.
4. The VAV Modular Assembly shall be a configurable digital controller with integral differential pressure transducer and damper actuator. All components shall be connected and mounted as a single assembly that can be removed as one piece.
5. The VAV Modular Assembly shall be assembled in a plenum-rated plastic housing with flammability rated to UL94-5VB.
6. The integral damper actuator shall be a fast response stepper motor capable of stroking 90 degrees in 30 seconds for quick damper positioning to speed commissioning and troubleshooting tasks.
7. The controller shall determine airflow by dynamic pressure measurement using an integral dead-ended differential pressure transducer. The transducer shall be maintenance-free and shall not require air filters.
8. Each controller shall have the ability to automatically calibrate the flow sensor to eliminate pressure transducer offset error due to ambient temperature / humidity effects.
9. The controller shall utilize a proportional plus integration (PI) algorithm for the space temperature control loops.
10. Each controller shall continuously, adaptively tune the control algorithms to improve control and controller reliability through reduced actuator duty cycle. In addition, this tuning reduces commissioning costs, and eliminates the maintenance costs of manually re-tuning loops to compensate for seasonal or other load changes.
11. The controller shall provide the ability to download and upload VMA configuration files, both locally and via the communications network. Controllers shall be able to be loaded individually or as a group using a zone schedule generated spreadsheet of controller parameters.
12. Control setpoint changes initiated over the network shall be written to VMA non-volatile memory to prevent loss of setpoint changes and to provide consistent operation in the event of communication failure.
13. The controller firmware shall be flash-upgradeable remotely via the

- communications bus to minimize costs of feature enhancements.
14. The controller shall provide fail-soft operation if the airflow signal becomes unreliable, by automatically reverting to a pressure-dependent control mode.
 15. The controller shall interface with balancer tools that allow automatic recalculation of box flow pickup gain (“K” factor), and the ability to directly command the airflow control loop to the box minimum and maximum airflow setpoints.
 16. Controller performance shall be self-documenting via on-board diagnostics. These diagnostics shall consist of control loop performance measurements executing at each control loop’s sample interval, which may be used to continuously monitor and document system performance. The VMA shall calculate exponentially weighted moving averages (EWMA) for each of the following. These metrics shall be available to the end user for efficient management of the VAV terminals.
 - a. Absolute temperature loop error.
 - b. Signed temperature loop error.
 - c. Absolute airflow loop error.
 - d. Signed airflow loop error.
 - e. Average damper actuator duty cycle.
 17. The controller shall detect system error conditions to assist in managing the VAV zones. The error conditions shall consist of:
 - a. Unreliable space temperature sensor.
 - b. Unreliable differential pressure sensor.
 - c. Starved box.
 - d. Actuator stall.
 - e. Insufficient cooling.
 - f. Insufficient heating.
 18. The controller shall provide a flow test function to view damper position vs. flow in a graphical format. The information would alert the user to check damper position. The VMA would also provide a method to calculate actuator duty cycle as an indicator of damper actuator runtime.
 19. The controller shall provide a compliant interface for ASHRAE Standard 62.1 (indoor air quality), and shall be capable of resetting the box minimum airflow based on the percent of outdoor air in the primary air stream.
 20. The controller shall comply with ASHRAE Standard 90.1 (energy efficiency) by preventing simultaneous heating and cooling, and where the control strategy requires reset of airflow while in reheat, by modulating the box reheat device fully open prior to increasing the airflow in the heating sequence.
 21. Inputs:
 - a. Analog inputs with user defined ranges shall monitor the following analog signals, without the addition of equipment outside the terminal controller cabinet:
 - 1) 0-10 VDC Sensors.
 - 2) 1000ohm RTDs.

- 3) NTC Thermistors.
 - b. Binary inputs shall monitor dry contact closures. Input shall provide filtering to eliminate false signals resulting from input “bouncing.”
 - c. For noise immunity, the inputs shall be internally isolated from power, communications, and output circuits.
 - d. Provide side loop application for humidity control.
22. Outputs:
- a. Analog outputs shall provide the following control outputs:
 - 1) 0-10 VDC
 - b. Binary outputs shall provide a SPST Triac output rated for 500mA at 24 VAC.
 - c. For noise immunity, the outputs shall be internally isolated from power, communications, and other output circuits.
23. Application Configuration:
- a. The VAV Modular Assembly shall be configured with a software tool that provides a simple Question/Answer format for developing applications and downloading.
24. Sensor Support:
- a. The VAV Modular Assembly shall communicate over the Sensor-Actuator Bus (SA Bus) with a Network Sensor.
 - b. The VMA shall support an LCD display room sensor.
 - c. The VMA shall also support standard room sensors as defined by analog input requirements.
 - d. The VMA shall support humidity sensors defined by the AI side loop.
- D. 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" NPT 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 than 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: +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. Building Differential Air Pressure Applications (-1" to +1" 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 differential pressure or air 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) -1.00 to +1.00 w.c. input differential pressure ranges. (Select range appropriate for system application)
 - 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: Johnson Controls and Setra.
5. Low Differential Air Pressure Applications (0" to 5" 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 differential pressure or air 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) (0.00 - 1.00" to 5.00") w.c. input differential pressure ranges. (Select range appropriate for system application.)
 - 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: Johnson Controls and Setra.
6. Medium Differential Air Pressure Applications (5" to 21" w.c.)
- a. The pressure transmitter shall be similar to the Low Air Pressure Transmitter, except that the performance specifications are not as severe. Differential pressure transmitters shall be provided that meet the following performance requirements:

- 1) Zero & span: (c/o F.S./Deg. F): .04% including linearity, hysteresis and repeatability.
 - 2) Accuracy: 1% F.S. (best straight line) Static Pressure Effect: 0.5% F.S. (to 100 PSIG.
 - 3) Thermal Effects: <+.033 F.S./Deg. F. over 40°F. to 100°F. (calibrated at 70°F.).
- 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: Johnson Controls and Setra.
- E. Flow Monitoring:
1. Air Flow Monitoring:
 - a. Fan Inlet Air Flow Measuring Stations:
 - 1) At the inlet of each fan and near the exit of the inlet sound trap, airflow traverse probes shall be provided that shall continuously monitor the fan air volumes and system velocity pressure.
 - 2) Each traverse probe shall be of a dual manifolded, cylindrical, type 3003 extruded aluminum configuration, having an anodized finish to eliminate surface pitting and unnecessary air friction. The multiple total pressure manifold shall have sensors located along the stagnation plane of the approaching airflow. The manifold should not have forward projecting sensors into the air stream. The static pressure manifold shall incorporate dual offset static tops on the opposing sides of the averaging manifold so as to be insensitive to flow-angle variations of as much as + 20° in the approaching air stream.
 - 3) The airflow traverse probe shall not induce a measurable pressure drop, nor shall the sound level within the duct be amplified by its singular or multiple presence in the air stream. Each airflow-measuring probe shall contain multiple total and static pressure sensors placed at equal distances along the probe length. The number of sensors on each probe and the quantity of probes utilized at each installation shall comply with the ASHRAE Standards for duct traversing.
 - 4) Airflow measuring stations shall be manufactured by Air Monitor Corp., Tek-Air Systems, Inc., Ebtron, or Dietrich Standard.
 - b. Duct Air Flow Measuring Stations:
 - 1) Each device shall be designed and built to comply with, and provide results in accordance with, accepted practice as defined for system

testing in the ASHRAE Handbook of fundamentals, as well as in the Industrial Ventilation Handbook.

- 2) Airflow measuring stations shall be fabricated of 14-gauge galvanized steel welded casing with 90 Deg. connecting flanges in configuration and size equal to that of the duct into which it is mounted. Each station shall be complete with an air directionalizer and parallel cell profile suppressor (3/4" maximum cell) across the entering air stream and mechanically fastened to the casing in such a way to withstand velocities up to 6000 feet per minute. This air directionalizer and parallel cell honeycomb suppressor shall provide 98% free area, equalize the velocity profile, and eliminate turbulent and rotational flow from the air stream prior to the measuring point.
- 3) The total pressure measurement side (high side) will be designed and spaced to the Industrial Ventilation Manual 16th Edition, Page 9-5. The self-averaging manifolding will be manufactured of brass and copper components.
- 4) The static pressure sensing probes (low side) shall be bullet-nosed shaped, per detailed radius, as illustrated in Industrial Ventilation Manual 16th Edition, Page 9-5.
- 5) The main take-off point from both the total pressure and the static pressure manifolds must be symmetrical.
- 6) Total and static pressure manifolds shall terminate with external ports for connection to control tubing. An identification label shall be placed on each unit casing, listing model number, size, area, and specified airflow capacity.
- 7) Acceptable manufacturers: Air Monitor Corp., Tek-Air, Ebtron, and Dietrich Standard.

c. Static Pressure Traverse Probe:

- 1) Duct static traverse probes shall be provided where required to monitor duct static pressure. The probe shall contain multiple static pressure sensors located along exterior surface of the cylindrical probe.
- 2) Acceptable manufacturers: Cleveland Controls.

d. Shielded Static Air Probe:

- 1) A shielded static pressure probe shall be provided at each end of the building. The probe shall have multiple sensing ports, an impulse suppression chamber, and airflow shielding. A suitable probe for indoor and outdoor locations shall be provided.

2. 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.

F. 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.

G. 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.
- 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. Two-position 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.
 - e. Two-position or open/closed actuators shall accept 24 or 120 VAC power supply 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:

- a. Control pilot relays shall be of a modular plug-in design with retaining springs or clips.
- b. Mounting Bases shall be snap-mount.
- c. DPDT, 3PDT, or 4PDT relays shall be provided, as appropriate for application.
- d. Contacts shall be rated for 10 amps at 120VAC.
- e. Relays shall have an integral indicator light and check button.
- f. Acceptable manufacturers: Johnson Controls, Lectro.

C. Electronic Signal Isolation Transducers:

1. A signal isolation transducer shall be provided whenever an analog output signal from the CCMS 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 signal from a remote system.
2. The signal isolation transducer shall provide ground plane isolation between systems.
3. Signals shall provide optical isolation between systems.
4. Acceptable manufacturers: Advanced Control Technologies.

2.8 LABORATORY AIRFLOW CONTROL

A. General

1. Description

- a. A laboratory airflow control system shall be furnished and installed to control the airflow into and out of laboratory rooms. The exhaust flow rate of a laboratory fume hood shall be controlled precisely to maintain a constant average face velocity into the fume hood at either a standard/in-use or standby level based on an operator's presence in front of the fume hood. The laboratory control system shall vary the amount of make-up/supply air into the room to operate the laboratories at the lowest possible airflow rates necessary to maintain temperature control, achieve minimum ventilation rates and maintain laboratory pressurization in relation to adjacent spaces (positive or negative). The laboratory airflow control system shall be capable of operating as a standalone system or as a system integrated with the Building Management System (BMS). An optional locally mounted user interface terminal shall be available to allow room-level control variables to be displayed, and where appropriate, edited to adjust control operation.

2. Acceptable Manufacturers

- a. The plans and specifications for the laboratory airflow control system are

based on systems and equipment manufactured by Phoenix Controls Corporation.

- b. The laboratory airflow system provider shall be an entity that designs, develops, manufactures and sells products and services to control the environment and airflow of critical spaces using a Quality Management System registered to ISO 9001:2000.
- c. In strict accordance with this specification, alternative laboratory airflow control systems and equipment shall only be considered for approval provided that the equipment be equal in every respect to the operational characteristics, capacities and intent of control sequences specified herein. Approval to bid does not relieve the laboratory airflow control system supplier from complying with the minimum requirements or intent of this specification.
- d. The engineer and owner shall be the sole judges of quality and equivalence of equipment, materials, methods and life cycle cost.
- e. Only those systems specifically named in this specification or by addendum shall be considered for approval. Other systems submitted after the bid opening will be returned without review.

3. Preventive Maintenance:

- a. The laboratory airflow control system supplier shall provide at no additional cost to the Owner during and after the warranty period, five years of required preventative maintenance on all airflow sensors (e.g., pitot tube, flow cross, orifice ring, air bar, hot wire, vortex shedder, side wall sensors, etc.,) and flow transducers provided under this section. Airflow sensors shall be removed, inspected, and cleaned annually during the first five years period to prevent inaccuracies due to long term buildup from corrosion, lab tissues, wet or sticky particles, or other materials that foul the sensor. If impractical to remove the airflow sensors, the laboratory airflow control system supplier shall include in the proposal the cost of supplying and installing duct access doors, one for each sensor. The transducer shall be checked and recalibrated annually to insure long-term accuracy. Note that auto-zero recalibration of transducers is not acceptable as a substitute for annual recalibration.

4. Warranty Period

- a. Warranty shall commence upon the date of shipment and extend for a period of 36 months, whereupon any defects in materials or laboratory airflow control system performance shall be repaired by the supplier at no cost to the owner.

B. System Performance Requirements

1. Airflow Control System Description

- a. Each laboratory shall have a dedicated laboratory airflow control system. Each dedicated laboratory airflow control system shall support a minimum of 20 network controlled airflow devices.
- b. The laboratory airflow control system shall employ individual average face velocity controllers that directly measure the area of the fume hood sash opening and proportionally control the hood's exhaust airflow to maintain a constant face velocity over a minimum range of 20% to 100% of sash travel. The corresponding minimum hood exhaust flow turndown ratio shall be 5 to 1.
- c. The hood exhaust airflow control device shall respond to the fume hood sash opening by achieving 90% of its commanded value within one second of the sash reaching 90% of its final position (with no more than 5% overshoot/undershoot) of required airflow. Rate of sash movement shall be from one to one and one-half feet per second.
- d. The hood exhaust airflow control device shall be switched automatically between in-use and standby levels based on the operator's presence immediately in front of the hood. A presence and motion sensor shall activate the switching. The airflow control device shall achieve the required in-use commanded value in less than one second from the moment of detection with no more than a 5% overshoot or undershoot.
- e. The laboratory airflow control system shall maintain specific airflow ($\pm 5\%$ of signal within one second of a change in duct static pressure) regardless of the magnitude of the pressure change, airflow change or quantity of airflow control devices on the manifold (within 0.6" to 3.0" wc).
- f. The laboratory airflow control system shall use volumetric offset control to maintain room pressurization. The system shall maintain proper room pressurization polarity (negative or positive) regardless of any change in room/system conditions, such as the raising and lowering of any or all fume hood sashes or rapid changes in duct static pressure. Systems using differential pressure measurement or velocity measurement to control room pressurization are unacceptable.
- g. The laboratory airflow control system shall maintain specific airflow ($\pm 5\%$ of signal) with a minimum 16 to 1 turndown to ensure accurate pressurization at low airflow and guarantee the maximum system diversity and energy efficiency.

2. Airflow Control Sound Specification

- a. Unless otherwise specified, the airflow control device shall not exceed the sound power levels in Tables 1, 2 and 3.
- b. If the airflow control device cannot meet the sound power level specification, a properly sized silencer or sound attenuator must be used. All silencers must be of a packless design (constructed of at least 18 gauge 316L stainless steel when used with fume hood exhaust) with a maximum pressure drop at the device's maximum rated flow rate not to exceed 0.20 inches of water.
- c. All proposed airflow control devices shall include discharge, exhaust and

radiated sound power level performance.

Table 1. Exhaust Airflow Control Device Sound Power Level (Airborne)

	Exhaust Sound Power Level in dB (re: 10 ⁻¹² watts)					
Octave Band Number	2	3	4	5	6	7
Center Frequency in Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz
1000-50 cfm Device						
800 cfm @ 0.6" wc	63	55	52	54	50	49
200 cfm @ 0.6" wc	46	42	38	37	32	25
800 cfm @ 3.0" wc	73	70	64	66	65	60
200 cfm @ 3.0" wc	51	52	51	50	52	51
1500-100 cfm Device						
1200 cfm @ 0.6" wc	65	58	53	56	52	52
400 cfm @ 0.6" wc	50	45	38	39	37	31
1200 cfm @ 3.0" wc	72	70	62	65	64	60
400 cfm @ 3.0" wc	55	57	55	53	56	55
3000-200 cfm Device						
2400 cfm @ 0.6" wc	63	56	55	58	54	55
800 cfm @ 0.6" wc	51	45	41	42	39	34
2400 cfm @ 3.0" wc	74	71	65	69	67	63
800 cfm @ 3.0" wc	58	58	56	56	59	58

Table 2. Supply Airflow Control Device Sound Power Level (Airborne)

	Discharge Sound Power Level in dB (re: 10 ⁻¹² watts)					
Octave Band Number	2	3	4	5	6	7
Center Frequency in Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz
1000-50 cfm Device						
800 cfm @ 0.6" wc	62	57	54	58	54	51
200 cfm @ 0.6" wc	45	46	42	44	40	34
800 cfm @ 3.0" wc	72	71	67	75	72	68
200 cfm @ 3.0" wc	53	56	54	58	56	54
1500-100 cfm Device						
1200 cfm @ 0.6" wc	63	59	55	60	54	53

400 cfm @ 0.6" wc	53	49	44	49	45	39
1200 cfm @ 3.0" wc	72	73	69	77	72	68
400 cfm @ 3.0" wc	58	63	61	63	60	57
3000-200 cfm Device						
2400 cfm @ 0.6" wc	64	60	58	63	56	56
800 cfm @ 0.6" wc	52	48	47	52	46	41
2400 cfm @ 3.0" wc	75	75	72	78	73	70
800 cfm @ 3.0" wc	59	62	62	66	62	60

Table 3. Supply Airflow Control Device Sound Power Level (Radiated)

	Radiated Sound Power Level in dB (re: 10 ⁻¹² watts)					
Octave Band Number	2	3	4	5	6	7
Center Frequency in Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz
1000-50 cfm Device						
800 cfm @ 0.6" wc	44	41	45	41	36	34
200 cfm @ 0.6" wc	33	28	31	29	26	20
800 cfm @ 3.0" wc	53	53	56	57	55	53
200 cfm @ 3.0" wc	41	38	41	39	39	37
1500-100 cfm Device						
1200 cfm @ 0.6" wc	47	53	40	42	38	36
400 cfm @ 0.6" wc	35	39	31	34	33	26
1200 cfm @ 3.0" wc	52	60	54	60	59	53
400 cfm @ 3.0" wc	42	44	43	46	46	42
3000-200 cfm Device						
2400 cfm @ 0.6" wc	58	56	45	47	43	42
800 cfm @ 0.6" wc	45	43	36	39	37	29
2400 cfm @ 3.0" wc	69	68	60	65	63	57
800 cfm @ 3.0" wc	54	53	48	51	50	48

C. System Components

1. Usage Based Control® Equipment

- a. For variable air volume (VAV) systems, a sash sensor shall be provided to measure the height of each vertically moving fume hood sash. A sash sensor

- shall also be provided for horizontal overlapping sashes. Control systems employing sidewall-mounted velocity sensors shall be unacceptable.
- b. A presence and motion sensor shall be provided to determine an operator's presence in front of a hood by detecting the presence and/or motion of an operator, and to command the laboratory airflow control system from an in-use operating face velocity (e.g., 100 fpm) to a standby face velocity (e.g., 60 fpm) and vice versa.
 - 1) The sensor shall define a detection zone that extends approximately 20" (50 cm) from the front of the fume hood. If the sensor does not detect presence and/or motion in its detection zone within five seconds, it shall command the system to the user-adjustable standby face velocity. When the sensor detects the presence and/or motion of an operator within the detection zone, it shall command the system to the in-use face velocity within one second.
 - 2) The sensor shall have a control circuit that adapts to its specific surroundings and adjusts automatically for inanimate objects placed within its detection zone. It shall map the area into memory and, after a period of five minutes, nullify the image of the inanimate object and return to a standby mode. When operators enter and leave the zone, the unit shall adjust automatically between in-use and standby modes. If the inanimate object is moved or taken out of the zone, the unit shall re-map the area automatically.
 - 3) Wide area motion detectors (on the hood or room level) shall be unacceptable.
 - c. The airflow at the fume hood shall vary in a linear manner between two adjustable minimum and maximum flow set points to maintain a constant face velocity throughout this range. A minimum volume flow shall be set to assure flow through the fume hood even with the sash totally closed.
 - d. A fume hood monitor shall be provided to receive the sash sensor output and presence and/or motion signal. This same monitor shall generate an exhaust airflow control signal for the appropriate airflow control device in order to provide a constant average face velocity. Audible and separate visual alarms shall be provided for both flow alarm and emergency exhaust conditions.

2. Airflow Control Device—General

- a. The airflow control device shall be a venturi valve.
- b. The valve assembly manufacturer's Quality Management System shall be registered to ISO 9001:2000.
- c. The airflow control device shall be pressure independent over its specified differential static pressure operating range. An integral pressure independent assembly shall respond and maintain specific airflow within one second of a change in duct static pressure irrespective of the magnitude of pressure and/or flow change or quantity of airflow controllers on a manifolded system.
- d. The airflow control device shall maintain accuracy within $\pm 5\%$ of signal

- over an airflow turndown range of no less than 16 to 1.
- e. No minimum entrance or exit duct diameters shall be required to ensure accuracy and/or pressure independence.
 - f. The airflow control device shall be constructed of one of the following three types:
 - 1) Class A—The airflow control device for non-corrosive airstreams, such as supply and general exhaust, shall be constructed of 16-gauge aluminum. The device's shaft and shaft support brackets shall be made of 316 stainless steel. The pivot arm and internal mounting link shall be made of aluminum. The pressure independent springs shall be a spring-grade stainless steel. All shaft bearing surfaces shall be made of a Teflon, polyester or PPS (polyphenylene sulfide) composite. Sound attenuating devices used in conjunction with general exhaust or supply airflow control devices shall be constructed using 24 gauge galvanized steel or other suitable material used in standard duct construction. No sound absorptive materials of any kind shall be used.
 - 2) Class B—The airflow control device for corrosive airstreams, such as fume hoods and biosafety cabinets, shall have a baked-on, corrosion-resistant phenolic coating. The device's shaft shall be made of 316 stainless steel with a Teflon coating. The shaft support brackets shall be made of 316 stainless steel. The pivot arm and internal mounting link shall be made of 316 or 303 stainless steel. The pressure independent springs shall be a spring-grade stainless steel. The internal nuts, bolts and rivets shall be stainless steel. All shaft bearing surfaces shall be made of a Teflon or PPS (polyphenylene sulfide) composite.
 - 3) Class C—The airflow control device for highly corrosive airstreams shall be constructed as defined in Paragraph E.2. In addition, these devices shall have no exposed aluminum or stainless steel components. Shaft support brackets, pivot arm, internal mounting link, and pressure independent springs shall have a baked-on, corrosion-resistant phenolic coating in addition to the materials defined in paragraph E.2. The internal nuts, bolts, and rivets shall be titanium or phenolic coated stainless steel. Only devices clearly defined as “high corrosion resistant” on project drawings will require this construction.
 - g. Actuation
 - 1) For pneumatically-actuated two-position or VAV operation, a pneumatic actuator shall be factory mounted to the valve. Loss of pneumatic main air or control power shall cause normally open valves to fail to maximum position and normally closed valves to fail to minimum position.
 - 2) For electrically actuated VAV operation, a UL 916 listed electronic actuator shall be factory mounted to the valve. Loss of main power

shall cause the valve to position itself in an appropriate failsafe state. Options for these failsafe states include: normally open-maximum position, normally closed-minimum position and last position. This position shall be maintained constantly without external influence, regardless of external conditions on the valve (within product specifications).

- 3) Constant volume valves do not require actuators.
- h. The controller for the airflow control devices shall be microprocessor based and operate using peer-to-peer control architecture. The room-level airflow control devices shall function as a standalone network.
- i. The room-level control network shall utilize a LonTalk communications protocol.
- j. There shall be no reliance on external or building-level control devices to perform room-level control functions. Each laboratory control system shall have the capability of performing fume hood control, pressurization control, temperature control, humidity control, and implement occupancy and emergency mode control schemes.
- k. The laboratory airflow control systems shall have the option of digital integration with the BMS.

l. Certification

- 1) Each airflow control device shall be factory calibrated to the job specific airflows as detailed on the plans and specifications using NIST traceable air stations and instrumentation having a combined accuracy of no more than $\pm 1\%$ of signal over the entire range of measurement. Electronic airflow control devices shall be further calibrated and their accuracy verified to $\pm 5\%$ of signal at a minimum of 48 different airflows across the full operating range of the device.
 - 2) Each airflow control devices shall be marked with device-specific factory calibration data. At a minimum, it should include the tag number, serial number, model number, eight-point characterization information (for electronic devices), and quality control inspection numbers. All information shall be stored by the manufacturer for use with as-built documentation.
- m. Airflow control devices that are not venturi valves and airflow measuring devices (e.g., pitot tube, flow cross, air bar, orifice ring, vortex shedder, etc.) shall only be acceptable, provided these meet all the performance and construction characteristics as stated throughout this specification and:
- 1) The airflow control device employs transducers manufactured by Rosemount, Bailey, Bristol, or Foxboro. Accuracy shall be no less than $\pm 0.15\%$ of span (to equal $\pm 5\%$ of signal with a 15 to one turndown) over the appropriate full-scale range, including the combined effects of nonlinearity, hysteresis, repeatability, drift over a one-year period, and temperature effect. 316L stainless steel materials shall be provided for all exhaust applications. The use of 304 stainless

- steel materials shall be provided for all make-up air applications.
- 2) Airflow sensors shall be of a multi-point averaging type, 304 stainless steel for all supply and general exhaust applications, 316L stainless steel for all fume hood, canopy, snorkel, and biosafety cabinet applications. Single point sensors are not acceptable.
 - 3) Suppliers of airflow control devices or airflow measuring devices requiring minimum duct diameters shall provide revised duct layouts showing the required straight duct runs upstream and downstream of these devices. Coordination drawings reflecting these changes shall be submitted by the supplier of the laboratory airflow control system. In addition, suppliers shall include static pressure loss calculations as part of their submittals. All costs to modify the ductwork, increase fan sizes and horsepower and all associated electrical changes shall be borne by the laboratory airflow control supplier.

D. Exhaust and Supply Airflow Device Controller

1. The airflow control device shall be a microprocessor-based design and shall use closed loop control to linearly regulate airflow based on a digital control signal. The device shall generate a digital feedback signal that represents its airflow.
2. The airflow control device shall store its control algorithms in non-volatile, re-writeable memory. The device shall be able to stand-alone or to be networked with other room-level digital airflow control devices using an industry standard protocol.
3. Room-level control functions shall be embedded in and carried out by the airflow device controller using distributed control architecture. Critical control functions shall be implemented locally; no room-level controller shall be required.
4. The airflow control device shall use industry standard 24 Vac power.
5. The airflow control device shall have provisions to connect a notebook PC commissioning tool and every node on the network shall be accessible from any point in the system.
6. The airflow control device shall have built-in integral input/output connections that address fume hood control, temperature control, humidity control occupancy control, emergency control, and non-network sensors switches and control devices. At a minimum, the airflow controller shall have:
 - a. Three universal inputs capable of accepting 0 to 10 Vdc, 4 to 20 mA, 0 to 65 K ohms, or Type 2 or Type 3 10 K ohm @ 25 degree C thermistor temperature sensors.
 - b. One digital input capable of accepting a dry contact or logic level signal input.
 - c. Two analog outputs capable of developing either a 0 to 10 Vdc or 4 to 20 mA linear control signal.
 - d. One Form C (SPDT) relay output capable of driving up to 1 A @ 24 Vac/Vdc.
7. The airflow control device shall meet FCC Part 15 Subpart J Class A and be

UL916 listed.

E. Two-position Exhaust Airflow Control Device

1. The airflow control device shall maintain a factory calibrated fixed maximum and minimum flow set point based on a switched 0 to 20 psi pneumatic signal. Two-position devices requiring feedback shall generate a 0 to 10 volt feedback signal that is linearly proportional to its airflow. All two-position devices shall be either networked or hard-wired into the room-level network so as to be considered under pressurization control.

F. Laboratory Office Airflow Control Device

1. The airflow control device shall maintain a temperature set point by controlling the airflow and the reheat valve (if required) in response to a room temperature sensor. An additional output shall be provided for supplementary cooling or heating of the office space. If the office airflow supply device is not required for make-up airflow control for fume hoods, then the one-second speed of response and fail-safe conditions required of the laboratory airflow control system shall not apply.

G. Constant Volume Airflow Control Device

1. The airflow control device shall maintain a constant airflow set point. It shall be factory calibrated and set for the desired airflow. It shall also be capable of field adjustment for future changes in desired airflow.
2. Laboratory airflow control systems suppliers not employing constant volume venturi airflow control valves shall provide pneumatic tubing or electrical wiring as required for their devices.

H. Closed Loop Variable Frequency Drive

1. The drive shall be a high-performance pulse width modulated design, which generates a sine-coded, adjustable voltage/frequency, three-phase output for complete speed control of any conventional squirrel cage induction motor.
2. The device shall not induce any voltage line notching distortion back to the utility line. The device shall maintain a displacement power factor of not less than 0.95 throughout its speed range. Synchronism between drive frequency and motor speed shall be maintained under all conditions.
3. The drive shall restart a coasting motor automatically after a power outage of any duration without tripping or shutting down. The drive shall apply rated power to accelerate the motor to the commanded speed within 0.5 second of the reapplication of drive power or the removal of a motor fault condition.
4. The drive shall accelerate the motor rapidly, limited only by the motor's rated torque and load.
5. An alarm circuit indicating low face velocity shall be included to electronically sense a loss of airflow via a drop in actual (not calculated) motor power or a difference between the actual and commanded motor speed. The alarm shall be

enunciated through audible and visual means at the fume hood monitor.

I. Local Display Unit

1. The control system shall have an optional local display option that allows control and system variables to be displayed on a user interface terminal device. The Local Display Unit shall connect to the room-level network and provide access to all room-level control data.
2. The display unit shall be powered by 24 Vac or 24 Vdc.
3. The Local Display Unit shall have the provisions of being flush mounted or surface mounted either directly to a standard electrical enclosure or DIN rail. Electrical conductors shall terminate inside the display module housing to a pluggable terminal block.
4. The display unit shall utilize an LCD display with variable contrast adjustment and backlighting to adapt the display to various lighting conditions.
5. The display unit shall provide a means of entering and displaying a unique location descriptor that may be used to identify the location and/or function of the display unit. The descriptor shall allow up to two lines of at least 13 alphanumeric characters to be entered in the description field.
6. The display unit shall allow access to pertinent flow, temperature, humidity, pressure data, as well as occupancy and emergency mode control status, and current device or system alarm status. Data shall be viewable in units of measure appropriate for users of the system.
7. The display unit shall have the ability to display up to 250 parameters, organized into display screens of up to five parameters per screen. Each screen shall have the ability to have a descriptive name of up to 16 alphanumeric characters for ease of navigation. Each parameter being displayed shall have the ability to include such information as:
 - a. Descriptive tag (up to 13 alphanumeric characters).
 - b. Present value, which may be read directly off the network, or conditioned with a fixed multiplier and/or offset to scale the value for the desired units of measure.
 - c. Units of measure, which are configurable based on local user conventions.
8. Set points and editable control parameters shall be viewable on the Local Display Unit. The user shall have the ability to enable a pass code to prevent unauthorized changes to set points and editable control parameters.

J. Control Functions

1. The airflow control devices shall utilize peer-to-peer, distributed control architecture to perform room-level control functions. Master-slave control schemes shall not be acceptable. Control functions shall include, at a minimum, pressurization, temperature, humidity control, as well as respond to occupancy and emergency control commands.
2. Pressurization Control

- a. The laboratory control system shall control supply and auxiliary exhaust airflow devices in order to maintain a volumetric offset (either positive or negative). Offset shall be maintained regardless of any change in flow or static pressure. This offset shall be field adjustable and represents the volume of air, which will enter (or exit) the room from the corridor or adjacent spaces.
- b. The pressurization control algorithm shall sum the flow values of all supply and exhaust airflow devices and command appropriate controlled devices to new set points to maintain the desired offset. The offset shall be adjustable.
- c. The pressurization control algorithm shall consider both networked devices, as well as:
 - 1) Up to three non-networked devices providing a linear analog flow signal.
 - 2) Any number of constant volume devices where the total of supply devices and the total of exhaust devices may be factored into the pressurization control algorithm.
- d. Volumetric offset shall be the only acceptable means of controlling room pressurization. Systems that rely on differential pressure as a means of control shall provide documentation to demonstrate that space pressurization can be maintained if fume hood sashes are changed at the same time a door to the space is opened.
- e. The pressurization control algorithm shall support the ability to regulate the distribution of total supply flow across multiple supply airflow control devices in order to optimize air distribution in the space.

3. Temperature Control

- a. The laboratory control system shall regulate the space temperature through a combination of volumetric thermal override and control of reheat coils and/or auxiliary temperature control devices. The laboratory control system shall support up to four separate temperature zones for each pressurization zone. Each zone shall have provisions for monitoring up to five temperature inputs and calculating a straight-line average to be used for control purposes. Separate cooling and heating set points shall be writeable from the BMS, with the option of a local offset adjustment.
- b. Temperature control shall be implemented through the use of independent primary cooling and heating control functions, as well as an auxiliary temperature control function, which may be used for either supplemental cooling or heating. Cooling shall be provided as a function of thermal override of conditioned air with both supply and exhaust airflow devices responding simultaneously so as to maintain the desired offset. Heating shall be provided through modulating control of a properly sized reheat coil.
- c. The auxiliary temperature control function shall offer the option of either heating or cooling mode and to operate as either a standalone temperature control loop, or staged to supplement the corresponding primary temperature control loop.

4. Humidity Control

- a. The laboratory control system shall have an embedded humidity control function, which allows the monitoring and control of the relative humidity level in the pressurized zone. Using peer-to-peer control, the airflow devices shall have the ability to monitor the relative humidity level of the space and, based on a BMS writeable set point, develop a control signal to drive one or the other humidification or dehumidification control circuits.
- b. The humidity control loop(s) shall share a common set point, with a configurable deadband adjustment to prevent the humidification and dehumidification control functions to operate at the same time.

5. Occupancy Control

- a. The laboratory control system shall have the ability to change the minimum ventilation and/or temperature control set points, based on the occupied state, in order to reduce energy consumption when the space is not occupied. The occupancy state may be set by either the BMS as a scheduled event or through the use of a local occupancy sensor or switch. The laboratory control system shall support a local occupancy override button that allows a user to override the occupancy mode and set the space to occupied for a predetermined interval. The override interval shall be configurable from one to 1440 minutes. The local occupancy sensor/switch or bypass button shall be given priority over a BMS command.

6. Emergency Mode Control

- a. The laboratory control system shall provide a means of overriding temperature and pressurization control in response to a command indicating an emergency condition exists, and airflow control devices are to be driven to a specific flow set point. The system shall support up to four emergency control modes. The emergency control modes may be initiated either by a local contact input or BMS command.
- b. Once an emergency mode is invoked, pressurization and temperature control are overridden for the period that the mode is active. Emergency modes shall have a priority scheme allowing a more critical mode to override a previously set condition.

7. Local Alarm Control

- a. The laboratory control system shall provide the means of summing selective alarm activity at the room-level network and generating a local alarm signal. The local alarm signal may be directed to any available output, as well as to the BMS. The alarm mask may be configured differently for each room-level system.

8. Diversity Alarm

- a. The laboratory control system shall have the ability of monitoring the airflow values for the pressurized space and generating an alarm signal in the event the total exhaust flow exceeds a predetermined threshold. The diversity alarm is intended to allow the user to take diversity in the design and generate an alarm condition in the event the diversity threshold is compromised. This function must be available in either an integrated or standalone system.

9. Fume Hood Control

- a. Airflow devices intended to control the face velocity of a fume hood shall have the ability to interface directly with the fume hood monitoring device. The airflow control device shall:
 - 1) Accept command inputs to regulate the flow accordingly and make this command value available to the BMS.
 - 2) Accept a sash position signal and make this value available to the BMS.
 - 3) Accept a Usage Based Control signal to indicate user presence and make this signal available to the BMS.
 - 4) Provide a flow feedback signal to the fume hood monitor, which may be used for calculating face velocity or to confirm the airflow device has achieved the proper flow rate and make this value available to the BMS.
 - 5) Provide alarm signals to the fume hood monitor in the event the airflow device is unable to achieve the proper flow rate, there is a loss of static pressure indicating improper fan operation, or there is a loss of power to the airflow control device, in order to provide a local alarm indication.
- b. The fume hood airflow control device shall respond to changes in sash position and user presence within one second, in order to provide a constant 100-feet-per-minute face velocity when the fume hood is in use.

10. The laboratory control system shall be segregated into subnets to isolate network communications to ensure room-level control functions and BMS communications are carried out reliably. Each laboratory space or pressurization zone shall be its own subnet. Commercially available routers shall be used to provide this isolation.
11. The laboratory airflow control system shall support at least 20 networked devices in each pressurized zone.
12. All points shall be available through the interface to the BMS for trending, archiving, graphics, alarm notification and status reports. Laboratory airflow control system performance (speed, stability and accuracy) shall be unaffected by the quantity of points being monitored, processed or controlled.
13. Refer to the BMS specification for the required input/output summary for the necessary points to be monitored and/or controlled.

K. Interface to Building Management Systems

1. The laboratory airflow control system network shall have the capability of digitally interfacing with the BMS. The required software interface drivers shall be developed and housed in a dedicated interface device furnished by the laboratory airflow control system supplier.
2. All room-level points shall be available to the BMS for monitoring or trending. The gateway shall maintain a cache of all points to be monitored by the BMS. The room-level airflow control devices shall update this cache continually.
3. The building-level network shall be a high-speed LonTalk (1.25 Mbps) communications protocol. The building-level network shall support up to 100 subnets or pressurization zones, or 6000 data points.
4. A commercially available interface card shall be provided with the Accel-Way™ gateway in order to connect to the building-level network.
5. A commercially available network interface card shall be provided with the gateway to interface with the BMS.

L. Installation

1. The automatic temperature controls (ATC) contractor shall install the sash sensors, interface boxes, presence and motion sensor, and fume hood monitor on the fume hood under initial supervision of the laboratory airflow control system supplier. Reel-type sash sensors and their stainless steel cables shall be hidden from view. Bar-type sash sensors shall be affixed to the individual sash panels. Sash interface boxes with interface cards shall be mounted in an accessible location.
2. The ATC contractor shall install all routers and repeaters in an accessible location in or around the designated laboratory room.
3. The ATC shall install an appropriately sized and fused 24 Vac transformer suitable for NEC Class II wiring.
4. The ATC contractor shall install 20 psi clean, dry pneumatic supply air to all airflow control devices, where required.
5. All cable shall be furnished and installed by the ATC contractor. The ATC contractor shall terminate and connect all cables as required. The ATC shall utilize cables specifically recommended by the laboratory airflow controls supplier.
6. The mechanical contractor shall install all airflow control devices in the ductwork and shall connect all airflow control valve linkages.
7. The mechanical contractor shall provide and install all reheat coils and transitions.
8. The mechanical contractor shall provide and install insulation as required.
9. Each pressurization zone shall have either a dedicated, single-phase primary circuit or a secondary circuit disconnect.

M. Reheat Coils: Terminal unit shall be provided with a hot water reheat coil. Refer to Division 23, Section “Heating and Air Conditioning Equipment”. The control of the reheat coil shall be in conjunction with the terminal unit control. The terminal unit controller shall be responsible for the control of the reheat coil.

N. Installation: Reel-type sash sensors and their stainless steel cables shall be hidden from view. Bar-type sash sensors shall be affixed to the individual sash panels. Sash interface boxes with interface cards shall be mounted in an accessible location.

1. The ATC contractor shall install the laboratory control unit (if panel-mounted) and wall-mounted power supply (as required) in an accessible location in the designated laboratory room.
2. The mechanical contractor shall install all airflow control devices in the ductwork and shall connect all airflow control valve linkages.
3. The mechanical contractor shall provide and install all reheat coils and transitions.
4. The mechanical contractor shall provide and install insulation as required.
5. The electrical contractor shall wire a dedicated, single phase 120 vac power circuit to the laboratory control unit or power supply.

O. System Start-Up and Training:

1. System start-up shall be provided by a factory-authorized representative of the laboratory airflow control system manufacturer. Start-up shall include calibrating the fume hood monitor and any combination sash sensing equipment as required. Start-up shall also provide electronic verification of airflow (fume hood exhaust, supply, make-up, general exhaust, or return.)
2. The balancing contractor shall be responsible for final verification and reporting of all airflows.
3. The laboratory airflow control system supplier shall furnish a minimum of eight hours of Owner training, by factory trained and certified personnel. The training will provide an overview of the job specific airflow control components, verification of initial fume hood monitor calibration, general procedures for verifying airflows of air valves, and general troubleshooting procedures.
4. Operation and Maintenance manuals, including as-built wiring diagrams and component lists shall be provided for each training attendee.

2.9 MISCELLANEOUS DEVICES

A. Local Control Panels:

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.

D. Refrigerator / Freezer Room Compressor Control:

1. Unit cooler fan(s) shall run continuously, except when turned "off" by a switch mounted on the unit cooler. This same switch shall also de-energize the liquid-line solenoid valve when the unit is in the "off" position.
2. Room thermostat for the walk-in refrigerator or freezer shall also control the liquid-line solenoid valve.
3. Compressor operation shall be controlled by the low pressure switch: high pressure cut-off switch shall prevent the compressor from operating under excessively high head pressure.
4. Flow of water through condenser shall be controlled by a water regulating valve installed in the condenser discharge line and shall modulate in response to refrigerant condensing pressure.
5. When equipment schedule indicate electric defrost, the following controls shall also be provided:
 - a. Electric defrost type unit cooler with heating elements for evaporator coil, drain pan piping within the low temperature room Defrost cycle shall be automatically controlled by an electric clock and shall include in the control circuit a safety thermostat to prevent overheating the evaporator coil.
 - b. The automatic timer for electric defrost shall also de-energize the solenoid valve in the liquid refrigerant line serving the unit cooler and shall stop the unit cooler fan(s) during the defrost cycle.

PART 3 - 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 handlers 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 26 Electrical. All wiring shall comply with the requirements of applicable portions of Division 26 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.
 - 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.
- I. Provide 120 volt, single phase, 60 hertz power to every DDC Controller panel, HVAC/Mechanical Equipment Controller, PC console, power supply, transformer, annunciator, modems, printers and to other devices as required. The power supplies are to be extended in conduit and wire from normal power circuit breakers.

3.3 PERFORMANCE

- A. Unless stated otherwise, control temperatures within plus or minus 2°F, and humidity within plus or minus 2% of the set point and static pressure within 10% of set point.

3.4 TRAINING

- A. The CCMS contractor shall provide the following training services:
1. Two 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.

3.5 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. VAV box performance verification and documentation:
1. The CCMS Contractor shall test each VAV box for operation and correct flow. At

each step, after a settling time, box air flows and damper positions will be sampled. Following the tests, a pass/fail report indicating results shall be produced and submitted to the engineer for review. Possible results are Pass, No change in flow between full open and full close, Reverse operation or Maximum flow not achieved. The report shall be submitted as documentation of the installation.

2. The CCMS Contractor shall issue a report based on a sampling of the VAV calculated loop performance metrics. The report shall indicate performance criteria, include the count of conforming and non-conforming boxes, list the non-conforming boxes along with their performance data.

- D. Promptly rectify all listed deficiencies and submit to the Engineer that this has been done.

3.6 TEMPERATURE CONTROL

- A. The sequences on the drawings describe the general intent of the control systems. Provide all devices, equipment, and wiring as required to perform the sequences described.
- B. Unless otherwise noted, size all automatic control valves for maximum ten (10) feet water pressure drop at maximum design flow rate.
- C. See plans for locations of all room thermostats, panels, dampers, valves, and equipment; where such devices are not indicated, however required by the sequences they shall be provided and located in the field by the Architect.
- D. Division 26 shall provide all detection devices (heat/smoke) as required by NFPA Standard 90A and the International Building and Mechanical Codes. The installation of detection devices and all control/power wiring for smoke detection devices and smoke dampers shall be provided under this section. Detection devices shall provide automatic shutdown of the HVAC systems in accordance with NFPA 90A.
- E. All pumps and fans shall be provided with a current sensors installed around the pump or fan. Sensors shall provide status for pump and fan operation.
- F. Adjustable freezestats shall be provided at all preheat and heating coils and shall de-energize their respective air handling system when their setting of thirty-five (35) degrees Fahrenheit is reached. Freezestats for water coils shall be installed in coil leaving air stream.
- G. All temperature, humidity, pressure, and time set points shall be fully adjustable from the BAS.
- H. Where used to control both comfort heating and cooling, zone thermostatic controls shall be capable of providing a temperature range or dead band of at least 5°F within which the supply of heating and cooling energy to the zone is shut off or reduced to a minimum. Variable air volume (VAV) terminal units shall be programmed to operate at the

minimum airflow setting without addition of reheat when the zone temperature is within the set deadband.

- I. Provide all hardware, software, devices, equipment, and wiring as required to interface with the BAS.
- J. All two (2) position dampers shall be proven open by the use of end switches.
- K. Refer to input/output summary schedule for additional control items not described in the sequences. Input/output summary are minimum requirements, provide all required points for complete operation of system.
- L. All variable frequency drives for fan shall be soft started at minimum speed and increased to operating speed by the BAS.
- M. Carbon dioxide (CO₂) monitors shall be provided for each air handling system on this project to provide continuous monitoring of CO₂ levels. Abnormal levels of CO₂ shall be detected by the monitors and alarmed on the EMCS.

3.7 SEQUENCE OF OPERATION

- A. General:
 - 1. Power - Fail Restart:
 - a. In the event of a power failure the CCMS computer will analyze the status of all controlled equipment and compare it with normal occupancy scheduling. The equipment will then be started or stopped as necessary to prevent all equipment from coming on at the same time.
 - 2. CCMS Monitoring:
 - a. Refer to the attached Input/Output schedule for a listing of all monitoring and override points and for additional software features.
 - 3. Optimal Start:
 - a. All scheduled HVAC equipment will be started based on an optimal start feature that will calculate the approximate time the unit will have to be started prior to scheduled start time in order for the space temperature to be at setpoint at schedules occupancy.
 - b. Once space temperatures reach occupied setpoint O.A. dampers will be modulated open. Whenever the unit goes in the unoccupied mode the O.A. damper will be closed.
 - 4. Night High Limit and Night Low Limit:

- a. During unoccupied periods scheduled HVAC equipment will be energized whenever space temperature drops below a night low limit setpoint of 65 degrees(adjustable) or a night high limit of 85 degrees(adj).
5. Setpoints:
 - a. All system setpoints shall be adjustable from the CCMS.
 6. Smoke dampers and smoke detectors:
 - a. Units 15,000 CFM or greater will be provided with both supply and return air smoke detectors (provided and wired by Division 26 – installed by Division 23) as well as both supply and return air smoke dampers. When the unit is to be started the supply and return air smoke dampers will be driven open. The supply fan will be started once the AHU supply and return air dampers reach 100% open as indicated by damper end switches.

END OF SECTION 230900

SECTION 233110 – AIR DISTRIBUTION

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 the air distribution systems including those devices distributing the air to the spaces, and those items which collect, filter, control, and convey air.
- B. Fans which are not an integral part of a factory fabricated air handling unit are included under this section.
- C. The requirements of Division 23, Section “Mechanical and Electrical General Provisions” shall apply to the work specified under this section.
- D. Except for duct pressure tests, all testing and balancing of the air distribution systems shall be performed under Division 23, Section “Testing and Balancing” of the Specifications.

1.3 LEED SUBMITTALS

- A. Product Data for Credit EQ 4.1: For adhesives, documentation including printed statement of VOC content and chemical components.

PART 2 - PRODUCTS

2.1 SUPPLY AIR TERMINAL UNITS (NON-LABORATORY)

- A. Provide Titus, Kreuger, Price, Metalaire or Nailor, high pressure variable/constant air volume terminal reheat units as shown on the plans and specified herein, equal to Titus Model DESV with factory installed controls furnished under Division 23, Section “Building Automation and Temperature Controls”.
- B. Terminals should be certified under the ARI Standard 880-94 Certification Program and carry the ARI Seal. Non-certified terminals may be submitted after testing at an independent testing laboratory under conditions selected by the engineering consultant in

full compliance with ARI Standard 880-94. These tests shall be witnessed by the engineering consultant with all costs to be borne by the terminal manufacturer. Testing does not ensure acceptance.

- C. The terminal casing shall be minimum twenty-two (22) gauge galvanized steel, internally lined with 1/2" thick elastomeric closed cell foam insulation. Insulation shall conform to UL 181 for erosion and NFPA 90A for fire, smoke and melting, and comply with a 25/50 Flame Spread and Smoke Developed Index per ASTM E-84 or UL 723. Additionally, insulation shall comply with Antimicrobial Performance Rating of 0, no observed growth, per ASTM G-21. Polyethylene insulation is not acceptable.
- D. The discharge connection shall be slip and drive construction for attachment to metal ductwork. The casing shall be constructed to hold leakage to the maximum values shown in the following table:

Casing Leakage CFM

<u>Inlet Size</u>	0.25 Inch <u>Diff Ps</u>	0.5 Inch <u>Diff Ps</u>	1.0 Inch <u>Diff Ps</u>
4, 5, 6	2	3	3
7, 8	3	3	5
9, 10	3	4	6
12	4	5	7
14	4	6	9
16	5	7	10

- E. The damper shall be heavy gauge steel with shaft rotating in Delrin or bronze oilite self-lubricating bearings. Nylon bearings are not acceptable. Shaft shall be clearly marked on the end to indicated damper position. Stickers or other removable markings are not acceptable. The damper shall incorporate a mechanical stop to prevent overstroking, and a synthetic seal to limit close-off leakage to the maximum values shown in the following table:

Damper Leakage CFM

<u>Inlet Size</u>	1.5 Inch <u>Diff Ps</u>	3.0 Inch <u>Diff Ps</u>	6.0 Inch <u>Diff Ps</u>
4, 5, 6	4	5	7
7, 8	4	5	7
9, 10	4	5	7
12	4	5	7
14	4	6	8
16	5	7	9

- F. Actuators shall be capable of supplying at least thirty-five (35) inch pound of torque to the damper shaft, and shall be mounted externally for service access. Terminals with internal actuator mounting or linkage connection must include gasketed access panel,

removable without disturbing ductwork. Casing with access panel shall be constructed to hold casing leakage to the maximum values previously specified. Control of terminal unit shall be provided under another section of this specification. Inlet damper and motor operator shall provide full shut-off of air volume.

- G. At an inlet velocity of 2000 feet per minute, the differential static pressure required to operate any terminal size shall not exceed
1. eighteen hundredths (0.18) inch water gauge for the basic terminal, or
 2. twenty three hundredths (0.23) inch water gauge for the terminal with integral attenuator.
- H. Sound rating for the terminal shall generally not exceed thirty (30) NC at plus 1.5 inch static pressure. Sound performance shall be ARI certified with sound ratings tested at power levels 10^{-12} watts and shall not exceed values scheduled for individual installed terminal units. The unit manufacturer shall furnish certified sound power levels for both discharge sound and casing radiated sound, tested in accordance with ASHRAE Standard 36-72. Certified sound power levels shall be for terminals actually installed on the project including effects of lining material. Sound data based on prior ASHRAE Standards will not be acceptable. The tests shall be conducted in an ADC approved sound facility. The data shall include the second through sixth octave bands for all unit sizes and inlet static pressures. All attenuation factors shall be clearly defined. Provide additional approved attenuators as required to achieve the drawing scheduled values based on the installed condition of the terminals. Many of attenuation factors commonly used in the rating of terminal units are not applicable and shall not be considered.
- I. Each terminal unit shall be field tested under Division 23, Section “Testing and Balancing” at the design air volumes. Where field tests indicate volume greater than plus or minus ten (10) percent of design value, the terminal unit shall be readjusted or recalibrated by the balancing contractor to achieve the design valves. Units which can not achieve the desired results shall be removed from the project and new units provided at no additional expense to the Owner.
- J. Control Specifications:
1. The terminals shall be equipped with pressure independent controls which can be reset to modulate airflow between zero and the maximum cataloged cubic feet per minute. Maximum airflow limiters are not acceptable.
 2. The direct digital controls shall be supplied by the control contractor and mounted by the terminal unit manufacturer. Control contractor shall provide data sheets on all components to be mounted, indicating component dimensions, mounting hardware, and methods, as well as wiring and piping diagrams for each application identified by unit tag per the schedule in the drawings, to the terminal manufacturer.
 3. Controls shall be compatible with pneumatic inlet velocity sensors supplied by the terminal manufacturer. The sensor shall be multi-point center averaging type, with

- a minimum of four measuring ports parallel to the take-off point from the sensor. Sensors with measuring ports in series are not acceptable. The sensor must provide a minimum differential pressure signal of 0.03 inch wg. at an inlet velocity of 500 fpm. The sensor must provide control signal accuracy of plus or minus five (5) percent with the same size inlet duct at any inlet condition.
4. Controls shall be field set by control contractor for the scheduled minimum and maximum flow rates. Flow measuring taps and flow curves will be supplied with each terminal for field balancing airflow. All pneumatic tubing shall be UL listed fire retardant (FR) type. Each terminal shall be equipped with labeling showing unit location, size, minimum and maximum cubic feet per minute setpoints, damper fail position, and thermostat action.
 5. The terminal manufacturer shall provide a Class II 24 VAC transformer and disconnect switch. Actuator shall be direct connection shaft mount type without linkage. All controls shall be installed in approved NEMA type sheet metal enclosure by terminal manufacturer.
 6. Box controllers in laboratory spaces with self calibration shall not interrupt flow.
- K. Hot water reheat coils shall be enclosed in a minimum twenty (20) gauge galvanized steel casing, with slip and drive construction for attachment to metal ductwork. Coils shall be factory installed on the terminal discharge. Fins shall be rippled and corrugated heavy gauge aluminum, mechanically bonded to tubes. Tubes shall be copper with minimum wall thickness of 0.016 inch with male solder header connections. Coils shall be leak tested to 300 pounds per square inch, with minimum burst pressure of 2000 pounds per square inch at ambient temperature. Number of coil rows and circuits shall be selected to provide performance as scheduled on the drawings. Coil performance data shall be based on tests run in accordance with ARI Standard 410.
- L. Provide bottom opening access door to allow cleaning and inspection of the reheat coil. Access door shall be of the same construction as the terminal unit casing and sealed airtight.

2.2 EXHAUST AIR TERMINAL UNITS (NON-LABORATORY)

- A. Provide Titus, JCI, Kreuger, Price, Metalaire or Nailor high pressure variable air volume exhaust terminal units as shown on the plans and specified herein, equal to Titus Model DECV. Construction and submittal data shall be similar to supply terminal units.
- B. Exhaust air terminal units shall meet all requirements as hereinbefore specified for supply air terminal units. Exhaust terminal units shall have a round inlet, body, and discharge connection.
- C. Exhaust air terminals installed in stainless steel ductwork shall be all stainless steel construction.

2.3 AIR DEVICES

- A. Provide air devices of the minimum sizes and quantities indicated and of the types specified. Contractor shall carefully study the drawings and the field conditions to ascertain the air device requirements as to suitability, location, air capacity, required accessories, border and finish. Devices shall be selected to provide draft-free air distribution over entire area served and sound rating shall not exceed Noise Criteria (NC) 25.
- B. Border types shall be compatible with Architectural ceiling type for the room for which the air device is located. All devices shall have plaster frames when installed in plaster or drywall construction.
- C. Margins shall be as indicated or directed to suit field conditions.
- D. Provide Titus, Kreuger, Price, Metalaire or Tuttle & Bailey air devices in accordance with the schedule below and on the drawings.
- E. Air Device Schedule:

<u>Device</u>	<u>Type</u>	<u>Finish</u>	<u>Basis of Design</u>
Ceiling Supply Diffuser	A	#26 white	Titus/PAS
Ceiling Supply Diffuser	B	#26 white	Titus/PAS-AA
Return Register	C	#26 white	Titus/PAR
Exhaust Register	D	#26 white	Titus/PAR-AA

- 1. Type A: Perforated ceiling diffusers shall be Titus Model PAS (steel, flush face) or approved equal for return. Diffusers shall have a perforated face with 3/16-inch diameter holes on ¼-inch staggered centers and no less than 51 percent free area. Perforated face shall be steel. The backpan shall be one piece stamped heavy gauge steel of the sizes and mounting types shown on the plans and outlet schedule. The diffuser neck shall have 1 1/8-inch depth for easy duct connection. Diffusers must discharge a uniform horizontal blanket of air into the room and protect ceiling against smudging. Pattern controllers in the supply models shall be mounted on the back of the perforated face and must be field adjustable to allow the discharged air to enter the room in either vertical or one-, two-, three- or four-way horizontal jets. The perforated face must be easily unlatchable from the backpan to facilitate option of the face for pattern controller adjustment.
 - a. The finish shall be #26 white. The finish shall be an anodic acrylic paint, baked at 315°F for 30 minutes. The pencil hardness must be HB to H. The paint must pass a 100-hour ASTM B117 Corrosive Environments Salt Spray Test without creepage, blistering or deterioration of film. The paint must pass a 250-hour ASTM D870 Water Immersion Test. The paint must also pass the ASTM D2794 Reverse Impact Cracking Test with a 50-inch pound force applied.
 - b. Opposed blade volume damper shall not be provided.
 - c. The manufacturer shall provide published performance data for the

perforated diffuser. The diffuser shall be tested in accordance with ANSI/ASHRAE Standard 70-1991.

2. Type B: Perforated ceiling diffusers shall be Titus Model PAS-AA (aluminum, flush face) or approved equal for exhaust. Diffusers shall have a perforated face with 3/16-inch diameter holes on ¼-inch staggered centers and no less than 51 percent free area. Perforated face shall be aluminum. The backpan shall be one piece stamped heavy gauge steel of the sizes and mounting types shown on the plans and outlet schedule. The diffuser neck shall have 1 1/8-inch depth for easy duct connection. Diffusers must discharge a uniform horizontal blanket of air into the room and protect ceiling against smudging. Pattern controllers in the supply models shall be mounted on the back of the perforated face and must be field adjustable to allow the discharged air to enter the room in either vertical or one-, two-, three- or four-way horizontal jets. The perforated face must be easily unlatchable from the backpan to facilitate option of the face for pattern controller adjustment.
 - a. The finish shall be #26 white. The finish shall be an anodic acrylic paint, baked at 315°F for 30 minutes. The pencil hardness must be HB to H. The paint must pass a 100-hour ASTM B117 Corrosive Environments Salt Spray Test without creepage, blistering or deterioration of film. The paint must pass a 250-hour ASTM D870 Water Immersion Test. The paint must also pass the ASTM D2794 Reverse Impact Cracking Test with a 50-inch pound force applied.
 - b. Opposed blade volume damper shall not be provided.
 - c. The manufacturer shall provide published performance data for the perforated diffuser. The diffuser shall be tested in accordance with ANSI/ASHRAE Standard 70-1991.
3. Type C: Perforated ceiling diffusers shall be Titus Model PAR (steel, flush face) or approved equal for return. Diffusers shall have a perforated face with 3/16-inch diameter holes on ¼-inch staggered centers and no less than 51 percent free area. Perforated face shall be steel. The backpan shall be one piece stamped heavy gauge steel of the sizes and mounting types shown on the plans and outlet schedule. The diffuser neck shall have 1 1/8-inch depth for easy duct connection. Diffusers must discharge a uniform horizontal blanket of air into the room and protect ceiling against smudging. Pattern controllers in the supply models shall be mounted on the back of the perforated face and must be field adjustable to allow the discharged air to enter the room in either vertical or one-, two-, three- or four-way horizontal jets. The perforated face must be easily unlatchable from the backpan to facilitate option of the face for pattern controller adjustment.
 - a. The finish shall be #26 white. The finish shall be an anodic acrylic paint, baked at 315°F for 30 minutes. The pencil hardness must be HB to H. The paint must pass a 100-hour ASTM B117 Corrosive Environments Salt Spray Test without creepage, blistering or deterioration of film. The paint must pass a 250-hour ASTM D870 Water Immersion Test. The paint must also pass the ASTM D2794 Reverse Impact Cracking Test with a 50-inch pound

- force applied.
 - b. Opposed blade volume damper shall not be provided.
 - c. The manufacturer shall provide published performance data for the perforated diffuser. The diffuser shall be tested in accordance with ANSI/ASHRAE Standard 70-1991.
- 4. Type D: Perforated ceiling diffusers shall be Titus Model PAR-AA (aluminum, flush face) or approved equal for exhaust. Diffusers shall have a perforated face with 3/16-inch diameter holes on ¼-inch staggered centers and no less than 51 percent free area. Perforated face shall be aluminum. The backpan shall be one piece stamped heavy gauge steel of the sizes and mounting types shown on the plans and outlet schedule. The diffuser neck shall have 1 1/8-inch depth for easy duct connection. Diffusers must discharge a uniform horizontal blanket of air into the room and protect ceiling against smudging. Pattern controllers in the supply models shall be mounted on the back of the perforated face and must be field adjustable to allow the discharged air to enter the room in either vertical or one-, two-, three- or four-way horizontal jets. The perforated face must be easily unlatchable from the backpan to facilitate option of the face for pattern controller adjustment.
 - a. The finish shall be #26 white. The finish shall be an anodic acrylic paint, baked at 315°F for 30 minutes. The pencil hardness must be HB to H. The paint must pass a 100-hour ASTM B117 Corrosive Environments Salt Spray Test without creepage, blistering or deterioration of film. The paint must pass a 250-hour ASTM D870 Water Immersion Test. The paint must also pass the ASTM D2794 Reverse Impact Cracking Test with a 50-inch pound force applied.
 - b. Opposed blade volume damper shall not be provided.
 - c. The manufacturer shall provide published performance data for the perforated diffuser. The diffuser shall be tested in accordance with ANSI/ASHRAE Standard 70-1991.
- F. Paint the ductwork behind registers with flat black enamel so that bright surface cannot be seen. Properly prime galvanized surface prior to painting.

2.4 SOUND ATTENUATORS:

A. Supply Air Stream

1. Provide Vibro-Acoustics, Semco Incorporated, Industrial Acoustics Company, Commercial Acoustics, Ruskin, Aerosonics or Kinetics Noise Control sound attenuators equal to Vibro-Acoustics Rectangular Film Lined (RFL) type as scheduled on the drawings and herein specified.
2. Outer casings of silencers shall be made of twenty-two (22) gauge galvanized steel in accordance with ASHRAE Guide recommendation for high pressured duct construction. Seams shall be lock formed and mastic filled. Interior partitions for rectangular silencers shall be made of minimum twenty-six (26) gauge galvanized

perforated steel. Filler material shall be of inorganic mineral or glass fiber of a density sufficient to obtain the specified acoustic performance and packed under not less than five (5) percent compression to eliminate voids due to vibration and settling. A Tedlar lining shall be provided to prevent fiber erosion. Material shall be inert, vermin and moisture proof. Combustion rating for the silencer acoustic fill shall be not less than the following, when tested in accordance with ASTM E84, NFPA Standard 255 or UL No. 723:

Flamespread classification	25
Smoke development rating	0
Fuel contributed	20

3. Provide airtight construction by use of a duct sealing compound on the job site the same as for medium pressure ductwork. Silencers shall not fail structurally when subjected to a differential air pressure of eight (8) inches water gauge inside to outside of casing.
4. Silencer ratings shall be determined in a duct-to-reverberant room test facility which provides for airflow in both directions through the test silencer in accordance with ASTM Specifications E 477. The test set-up and procedure shall be such that all effects due to end reflection, directivity, flanking transmission, standing waves, and test chamber sound absorption are eliminated. Acoustic ratings shall include Dynamic Insertion Loss (DIL) and Self-Noise (SN) Power Levels both for FORWARD FLOW (air and noise in same direction) and REVERSE FLOW (air and noise in opposite directions) with airflow at least 2,000 feet per minute entering face velocity. Data for rectangular and tubular type silencers shall be presented for tests conducted using silencers no smaller than the following cross-sections:

Rectangular, in. - 24 x 24, 24 x 30, or 24 x 36
Tubular, in. - 12, 24, 36, and 48

5. Static pressure loss of silencers shall not exceed those scheduled. Airflow measurements shall be made in accordance with ASTM Specification E 477 and applicable portions of ASME, AMCA, and ADC airflow test codes. Tests shall be reported on the identical units for which acoustic data is presented.
6. With submittals, the manufacturer shall supply certified test data on Dynamic Insertion Loss, Self-Noise Power Levels, and Aerodynamic Performance for Reverse and Forward Flow test conditions. Test data shall be for a standard product. All rating tests shall be conducted in the same facility, shall utilize the same silencer, and shall be open to inspection upon request from the Architect.
7. Install silencers in accordance with manufacturer's printed instructions.

B. Laboratory Exhaust Systems:

1. Provide Rectangular or Tubular Ultra-Pals Packless Silencers of the capacities and sizes shown on the plans and/or listed in the schedule. Silencers shall be as manufactured by Industrial Acoustics Company or approved equal.

2. Silencers shall be constructed entirely of stainless steel in accordance with ASHRAE guide recommendations for high pressure rectangular ductwork. Seams shall be lock formed. No sound adsorptive material of any kind shall be used in the silencers.
3. Silencers shall attenuate air/gas transmitted noise solely by virtue of controlled impedance membranes and broadly tuned resonators. Silencers shall not fail structurally when subjected to a differential air pressure of eight (8) inches water gauge inside to outside of casing.
4. Silencer ratings shall be determined in a duct-to-reverberant room test facility which provides for airflow in both directions through the test silencer in accordance with ASTM Specification E 477. The test set-up and procedure shall be such that all effects due to end reflection, directivity, flanking transmission, standing waves, and test chamber sound absorption are eliminated. Acoustic ratings shall include Dynamic Insertion Loss (DIL) and Self-Noise (SN) Power Levels both for FORWARD FLOW (air and noise traveling in same direction) and REVERSE FLOW (air and noise traveling in opposite directions).
5. Static pressure loss of silencers shall not exceed those listed in the silencer schedules at the airflow indicated. Airflow measurements shall be made in accordance with ASTM Specification E 477 and applicable portions of ASME, AMCA, and ADC airflow test codes. Test shall be reported on the identical units for which acoustic data is presented.
6. The manufacturer shall supply certified test data on Dynamic Insertion Loss, Self-Noise Power Levels, and Aerodynamic Performance for Reverse and Forward Flow test conditions. Test data shall be for a standard product. All rating tests shall be conducted in the same facility, shall utilize the same silencer, and shall be open to inspection upon request from the Architect.

2.5 AIR FILTERS

- A. Air filters shall be Camfil Farr, Cambridge, or American Air Filter equal to the filters specified herein. Air filter capacities and bank sizes shall be as scheduled on the drawings.
- B. Type "A" Filter Elements:
 1. Air filters shall be Camfil Farr 30/30 or approved equal. Air filters shall be medium efficiency ASHRAE pleated panels consisting of cotton and synthetic media, welded wire media support grid, and beverage board enclosing frame. Sizes shall be noted on drawings or other supporting materials.
 2. Filter media shall be a cotton and synthetic blend, lofted to a uniform depth of 0.15", and formed into a uniform radial pleat.
 3. A welded wire grid, spot-welded on one-inch centers and treated for corrosion resistance shall be bonded to the downstream side of the media to maintain radial pleats and prevent media oscillation.
 4. An enclosing frame of no less than 28-point high wet-strength beverage board shall provide a rigid and durable enclosure. The frame shall be bonded to the media on all sides to prevent air bypass. Integral diagonal support members on the air

entering and air exiting side shall be bonded to the apex of each pleat to maintain uniform pleat spacing in varying airflows.

5. The filter shall have a Minimum Efficiency Reporting Value of MERV 8 when evaluated under the guidelines of ASHRAE Standard 52.2-2007. It shall also have a MERV-A of 8 when tested per Appendix J of the same standard. The media shall maintain or increase in efficiency over the life of the filter.
6. Initial resistance to airflow shall not exceed 0.31” w.g. at an airflow of 500 fpm on 2” deep models.
7. The filter shall have an Energy Cost Index (ECI) value of five stars.
8. The filter shall be classified by Underwriters Laboratories as UL Class 2.
9. Manufacturer shall provide evidence of facility certification to ISO 9001:2000.
10. Manufacturer shall guarantee the integrity of the filter pack to 2.0” w.g..

C. Type "B" Filter Elements:

1. Air filters shall be Camfil Farr Riga-Flo 100 or approved equal. Air filters shall be high-efficiency ASHRAE high lofted supported media disposable type assembled in a compact and secure enclosing frame. Sizes shall be as noted on drawings or other supporting materials.
2. Filter media shall be of microfine glass laminated to a reinforced backing to form a uniform lofted media blanket.
3. The media blanket shall be formed into uniform tapered radial pleats and bonded to a stiffened backing that is bonded to the downstream side of the media to preclude media oscillation.
4. The media shall be mechanically and chemically bonded within the frame to prevent air bypass.
5. The enclosing frame shall be constructed of corrosion resistant galvanized steel. The media pleat configuration shall be maintained by bridge style plastic contour stabilizers. There shall be a minimum of four contour stabilizers on the air entering side and four on the air exiting side.
6. The filter shall have a Minimum Efficiency Reporting Value of MERV 13 per ASHRAE Standard 52.2-2007. It shall have a MERV-A of 13 when tested under Appendix J of that standard.
7. Initial resistance to airflow shall not exceed 0.50” w.g. at an airflow of 500 fpm for filters having a nominal depth of 12”. For a 6” nominal depth model initial resistance to airflow shall not exceed 0.50 w.g. at an airflow of 300 fpm.
8. The filter shall be capable of withstanding 10” w.g. without failure of the media pack.
9. Manufacturer shall provide evidence of facility certification to ISO 9001:2000.
10. Filter shall be listed by Underwriters Laboratories as UL Class 2.

D. Type "A" Filter Holding Frame:

1. Holding Frame shall be Farr Type 8 or approved equal. Air filter-holding frames shall be 16-gauge galvanized steel with filter sealing flange, centering dimples, sealing gasket and lances for appropriate air filter fasteners. Sizes shall be noted on drawings or other supporting materials.

2. Filter holding frame shall be constructed of 16-gauge galvanized steel. The frame shall be assembled from two corner sections and welded to assure a rigid and durable frame assembly.
3. The frame shall include a variety of pre-punched lances for filter fastener attachment. Fastener shall be capable of being installed without the use of tools, nuts or bolts. Lance penetrations shall be upstream of filter flange to assure leak-free integrity.
4. The frame shall include filter-centering dimples on each frame wall to facilitate ease of filter installation and assure filter centering against filter sealing flange.
5. A 3/4" filter-sealing flange shall be an integral component of the holding frame. All corners shall be flush mitered and a permanently mounted polyurethane foam gasket shall be mounted on the sealing flange to assure filter to frame sealing integrity.
6. Manufacturer shall provide evidence of facility certification to ISO 9001:2000.

E. Type "B" Filter Holding Frame:

1. Holding frames shall be Camfil Farr 3P Glide/Pack side access housing or approved equal. Filter housing shall be two-stage filter system consisting of 16-gauge galvanized steel enclosure, aluminum filter mounting track, universal filter holding frame, dual-access doors, static pressure tap, filter gaskets and seals. In-line housing depth shall not exceed 21". Sizes shall be as noted on enclosed drawings or other supporting materials.
2. The housing shall be constructed of 16-gauge galvanized steel with pre-drilled standing flanges to facilitate attachment to other system components. Corner posts of Z-channel construction shall ensure dimensional adherence. The housing shall be weatherproof and suitable for rooftop/outdoor installation.
3. The housing shall incorporate the capability of two stages of filtration without modification to the housing. A filter track, of aluminum construction shall be an integral component of housing construction. The track shall accommodate a 2" deep prefilter, a 6" or 12" deep rigid final filter, or a pocket filter with header.
4. Dual access doors, swing-open type, shall include high-memory sponge neoprene gasket to facilitate a door-to-filter seal. Each door shall be equipped with adjustable and replaceable positive sealing UV-resistant star-style knobs and replaceable door hinges.
5. A universal holding frame constructed of 18-gauge galvanized steel, equipped with centering dimples, multiple fastener lances, and polyurethane filter sealing gasket, shall be included to facilitate installation of high-efficiency filters.
6. The housing shall include a pneumatic fitting to allow the installation of a static pressure gauge to evaluate pressure drop across a single filter or any combination of installed filters.
7. Leakage at rated airflow, upstream to downstream of filter, holding frame, and slide mechanism shall be less than 1% at 3.0" w.g. Leakage in to or out of the housing shall be less than one half of 1% at 3.0" w.g.
8. Accuracy of pneumatic pressure fitting, when to evaluate a single-stage, or multiple filter stages, shall be accurate within $\pm 3\%$ at 0.6" w.g.
9. Manufacturer shall provide evidence of facility certification to ISO 9001:2000.

- F. For each filter bank, provide a Dwyer Model 2001-AF magnahelic air filter gauge complete with static pressure types, tubing, and accessories. Mount gauge on exterior of unit casing.
- G. Provide each filter assembly with a complete spare set of prefilters and final filters.

2.6 FIRE, FIRE/SMOKE, AND SMOKE DAMPERS

- A. Provide where indicated on the plans, fire dampers constructed and tested in accordance with UL Safety Standard 555. Each fire damper shall have 1-1/2 hour fire protection rating, 212 degrees Fahrenheit fusible link, and shall include a UL label in accordance with established UL labeling procedures and shall have Static Rating for HVAC systems that shut down automatically in a fire or smoke emergency or Dynamic Rating for HVAC systems that remain operational during a fire or smoke emergency. Three (3) hour dampers shall be installed where required by wall or floor rating. Damper Manufacturer's literature submitted for approval prior to installation shall include comprehensive performance data developed from testing in accordance with AMCA Standard 500 and shall illustrate pressure drops for all sizes or dampers required at all anticipated air flow rates. Fire dampers shall be equipped for vertical or horizontal installation as required by the locations indicated on the drawings. Fire dampers shall be installed in wall and floor openings utilizing steel sleeves, angles, other materials, and practices required to provide an installation equivalent to that utilized by the manufacturer when dampers were tested at UL. Fire damper installation shall also meet all requirements of the authority having jurisdiction. Installation shall be in accordance with the damper manufacturer's instructions. Fire dampers shall be Ruskin, Leader Industries, Prefco, Nailor or prior approved equal to Ruskin Type IBD, DIBD, FD of the following styles:
 - 1. Low Pressure Rectangular Ducts - Style B.
 - 2. Low Pressure Round Ducts - Style CR.
 - 3. Medium Pressure Rectangular Ducts - Style C.
 - 4. Medium Pressure Round Ducts - Style CR.
 - 5. Medium Pressure Oval Ducts - Style CO.
 - 6. Dampers for grilles, diffusers, registers, etc. - Thinline.
- B. Fire damper assembly shall include fire damper and damper enclosure wall sleeve complete with duct attachment flanges, as detailed. Provide an access door at each fire damper located so as to permit easy maintenance of damper and fusible link. All fire dampers shall be installed in accordance with NFPA Requirements and the manufacturer's printed instructions.
- C. Provide at locations shown on plans, combination fire/smoke dampers meeting or exceeding the following specifications. Each combination fire/smoke damper shall be 1-1/2 hour fire rated under UL Standard 555, and shall further be classified by Underwriters Laboratories as Leakage Rated Damper for Use in Smoke Control Systems under the latest version of UL555S, and bear a UL label attesting to same and shall have Dynamic Rating. Damper manufacturer shall have tested, and qualified with UL, a complete range

of damper sizes covering all dampers required by this specification. Testing and UL qualifying a single damper size is not acceptable. The leakage rating under UL555S shall be no higher than leakage Class I. Fire/Smoke dampers shall be Ruskin, Leader Industries, Prefco or prior approved equal to Ruskin Type FSD 37, FSD-60.

1. As part of the UL qualification, dampers shall have demonstrated a capacity to operate (to open and close) under HVAC system operating conditions, with pressures of at least four (4) inch water gauge in the closed position, and at least 2000 feet per minute air velocity in the open position. Pressures of at least six (6) inch or eight (8) inch water gauge shall have velocity levels of 3000 or 4000 feet per minute respectively.
 2. In addition to the leakage ratings already specified herein, the combination fire/smoke dampers and their operators shall be qualified under UL555S to an elevated temperature of 350 degrees Fahrenheit. Appropriate electric operators shall be installed by the damper manufacturer at time of damper fabrication; damper and operator shall be supplied as a single entity which meets all applicable UL555 and UL555S qualifications for both dampers and operators.
 3. Each combination fire/smoke damper shall be equipped with a fusible link which shall melt at 212 degrees Fahrenheit causing damper to close and lock in a closed position. Damper shall be Ruskin Model FSD 37 or FSD60.
 4. Each combination fire/smoke damper shall be furnished with factory sleeve of length and gauge required for satisfactory installation, and with damper operator factory installed on exterior of sleeve and properly linked to damper operating shaft. Smoke dampers shall be provided with a pneumatic operator and be controlled under Section 15850.
 5. Operators shall be of the spring-return fail safe type that will close damper upon power interruption or control air failure. Damper operators shall be UL listed as Fire Damper Operators, and shall bear the appropriate UL Operator label.
 6. All wiring or piping material and labor required to interconnect the combination fire/smoke dampers with detection and/or control systems shall be under Division 23.
 7. Duct smoke detectors shall be supplied by Division 26 and installed under Division 23 in accordance with NFPA and the manufacturer's recommendations.
- D. Provide at locations shown on plans smoke dampers similar to fire/smoke dampers specified hereinbefore manufactured by Ruskin, Leader Industries, Prefco or prior approved equal to Ruskin Type SD60 and having a Dynamic Rating.
- E. Submit samples for approval to the Architect of all fire, fire/smoke, and smoke damper assemblies for low pressure and medium pressure duct systems. Dampers shall not be installed prior to receiving written approval of submitted samples.
- F. Fire, smoke and/or fire/smoke dampers in stainless steel duct systems shall be of stainless steel construction.

2.7 DUCTWORK

A. General:

1. The Duct Manual as herein referenced shall mean the “HVAC Duct Construction Standards – Metal & Flexible”, 3rd Edition, 2005 as published by the Sheet Metal and Air Conditioning Contractors National Association, Inc.
2. Unless noted otherwise, ductwork shall be constructed of prime, first quality galvanized steel of gauges as called for in the Duct Manual. Reinforce all ducts to prevent buckling, breathing, vibrations, or unnecessary noise. Such reinforcing shall be as recommended in Duct Manual, plus any additional reinforcing as required to meet job conditions. Longitudinal and cross joints, elbows, transitions, etc., shall be furnished as specified in Duct Manual, including recommended duct supports to suit job conditions.
3. All uninsulated rectangular ductwork shall be crossbroken on all four (4) sides of each panel section. All vertical and horizontal sheet metal barriers, duct offsets and elbows, as well as the panels of straight sections of ducts, shall be crossbroken. Crossbreaking shall be applied between the standing seams or reinforcing angles. The center of the crossbreak shall be of the required height to assure each panel section being rigid, to prevent vibrations and "breathing".
4. Ductwork and ductwork fittings for acid/perchloric fume hood exhaust system shall be acid resistant fiberglass reinforced plastic ductwork.
5. Ductwork and ductwork fittings for laboratory fume hood and laboratory general exhaust systems shall be fully welded type 304 stainless steel of gauges as called for in the Duct Manual.
6. Supply air ductwork from air handling units to the air terminal units shall be "medium pressure" ductwork. Supply ductwork from air terminal units to air devices shall be “low pressure” ductwork.
7. Laboratory exhaust air ductwork shall be "medium pressure" ductwork.
8. Outdoor air, return air, relief air and non-laboratory exhaust air ductwork shall be low pressure ductwork.
9. Exposed circular low pressure supply ductwork shall be provided with grip finish and painted. Refer to Division 9 specifications. Color shall be by Architect.
10. Duct cleaning and acceptable level of contaminants allowed in the HVAC system, otherwise known as the Duct Cleanliness Level, shall be equal to Level C - Advanced in accordance with SMACNA Duct Cleanliness for New Construction, 2000 Edition.
11. Support and restrain all ducts in accordance with the Duct Manual and IBC 2009.

B. Low Pressure Ductwork (0" to 2" Water Gauge):

1. Ductwork shall conform to requirements and details, unless specified or indicated otherwise in the SMACNA “HVAC Duct Construction Standards – Metal & Flexible”, 3rd Edition, 2005. A copy of the duct manual shall be secured by the Contractor and shall be kept at the project for convenient reference.
2. Concealed circular low pressure supply and exhaust ductwork shall be United McGill low pressure spiral ductwork and fittings, equal to United Uni-seal spiral lockseam duct.
3. Exposed circular low pressure supply ductwork shall be acoustically insulated

double-wall spiral ductwork and fittings. Double wall duct shall be constructed of a paintable outer shell, a 1" thick layer of fiberglass insulation and an inner metal liner. Insulation shall have a thermal conductivity "K" factor of .27 BTU/hr/sq. ft./°F or less. Double-wall spiral ductwork shall be United ACOUSTI-k27 spiral lockseam duct, Semco Industries SL95P, Lindab Safe, United Sheet Metal spiral pipe, or approved equal.

4. Flexible duct connections where indicated shall be "Ventglass" duct fabric as manufactured by Ventfabrics, Inc.
5. Low pressure ductwork shall conform to the requirements and details contained in the Duct Manual and shall be constructed to the requirements for two (2) inches water gauge. Construction shall conform to the following:
 - a. Material gauges (galvanized steel) & general construction - Tables 1-5, 1-10 thru 1-13 Seal Class B
 - b. Longitudinal seams - Fig. #1-5, Types L-1, L-3 & L-4
 - c. Corner Closures - Fig. #1-13 & # 1-14
 - d. Hangers - Fig. #4-1 & 4-4 & Tables 4-1 & 4-2
 - e. Radius Elbows - Fig. #2-2, Type RE-1 and RE-3
 - f. Vaned Elbows (Applied to Square elbows) - Fig. #2-2 Type Re-2 & Figs. #2-3 & #2-4, double thickness vanes only
 - g. Transitions & Offsets - Fig #2-9
 - h. Branch connections - Fig. #2-8, 45° only
 - i. Volume dampers, up to 12" deep - Fig. #2-14, Figs. A&B w/Ventlok #555 quadrant
 - j. Volume dampers, over 12" deep - Fig. #2-15, Fig. A w/Ventlok #555 quadrant
 - k. Access doors - Cesco #HADDF-10 hinged one (1) side w/Ventlok #100 latch, insulated, one (1) inch thick
6. Duct sizes indicated on the drawings are air side sizes. Where duct lining is indicated, increase sheet metal sizes accordingly to compensate for thickness of lining.
7. Seal all transverse joints in all low pressure supply ductwork with mineral impregnated woven fiber tape as manufactured by Hardcast, Inc.

8. Provide stand-offs on volume dampers installed in all insulated ductwork.
9. Flexible ductwork for connection to air devices shall be Casco Silent Flex II or FlexMaster Type 6B. Flexible duct shall have a minimum R-6 insulation, comply with NFPA Standard 90A and shall be U.L. listed as Class 1 Air Duct & Connector, Standard 181.

C. Medium Pressure Ductwork (Over 2" and up to 6" Water Gauge):

1. Medium pressure ductwork consists of rectangular, flat-oval, and circular types as indicated on the drawings.
2. Submit samples of medium pressure ductwork for approval as directed. Samples shall include longitudinal seams, transverse joints and reinforcement and others as requested. No ductwork shall be fabricated until duct construction samples are approved in writing by the Architect.
3. All medium pressure duct systems shall be leak tested in strict conformance with "HVAC Air Duct Leakage Test Manual", 1985. Tests shall be witnessed by the balance subcontractor as hereinafter specified.
4. Medium pressure ductwork shall conform to the requirements and details contained in the Duct Manual and shall be constructed to the requirements for six (6) inches water gauge. Construction shall conform to the following:
 - a. Reinforcement & Gauge - Tables #1-7, 1-10 thru 1-13
 - b. Transverse Joints - Figs. #1-4 Type T-21, #1-10, #1-12, #1-14, #1-15, Type T-21, and T-22, #1-16, #3-2 Type RT-1 and 2
 - c. Longitudinal Joints - Fig. #1-5 Type L-1 and L-3
 - d. Vanes and Vane Runners - Fig. #2-3
 - e. Branch Connections - Figs. #2-7 and 2-8
 - f. Transitions - Figs #2-9
 - g. Offsets - Figs. #2-9 Type 3
 - h. Supporting Systems - Figs. #4-16, #4-17, #6-4, and Tables #4-1, #4-2 and #4-3
 - i. Riser Supports - Fig. #4-6
 - j. Volume and Floor - High Velocity Air Foil Type, Ultra-Low Leakage

when closed, Ruskin CD-50 suitable for electronic operator provided under Section 230900.

- k. Supply and Exhaust Fan Isolation Dampers - High Velocity Air Foil Isolation Dampers Type, Ruskin OD102 fan outlet damper with silicone rubber blade seals, stainless steel jamb seals and bearings with integral shaft seals. Damper shall be suitable for electronic operator provided under Section 230900.
- l. Duct Sealants - See Section 1 Basic Duct Construction Duct Sealing Commentary
- m. Access Doors - CESCO #HADP-10 with cam latches, neoprene gasketing and insulated, one (1) inch thick.
- n. Acoustical Liner - In conformance w/SMACNA Standard
- o. Welded Galvanized - Coated with two (2) coats of corrosion Resistant aluminum paint.

5. Circular Medium Pressure Ductwork shall be as manufactured by United Sheet Metal, Eastern or Semco, and shall consist of spiral pipe and welded fittings.

- a. Circular duct shall have locked seams so made as to eliminate any leakage under the pressures for which this system has been designed. Longitudinal seam duct shall have fusion welded butt seam. Circular duct shall be manufactured of galvanized steel meeting ASTM A653/A924 by the spiral lockseam method and in the minimum gauges listed:

<u>Diameter</u>	<u>Minimum Gauge</u>
3" thru 8"	26 Ga.
9" thru 14"	26 Ga.
15" thru 26"	24 Ga.
27" thru 36"	22 Ga.
37" thru 50"	20 Ga.

- b. All fittings are to have continuous welds along all seams. All divided flow fittings are to be manufactured as separate fittings, not as tap collars welded into spiral duct sections. Fittings and couplings shall be of the following minimum gauges:

<u>Diameter</u>	<u>Minimum Gauge</u>
3" thru 14"	24 Ga.
15" thru 26"	22 Ga.
27" thru 50"	20 Ga.

- c. All ninety (90) degree tees and forty-five (45) degree laterals, either full size or reducing, shall be conical pattern produced by machine or press forming. The entrance shall be free of weld build-up, burrs or irregularities. Provide tangential tees where indicated and required.
- d. Elbows in diameters three (3) inches through eight (8) inches shall be two (2) section die-stamped elbows. All other elbows shall be gored construction with all seams continuous-welded. Elbows shall be fabricated to a centerline radius of 1.5 times the cross section diameter. All elbows not die-stamped shall be fabricated according to the following schedule:

<u>Elbow Angle</u>	<u>Number of Gores</u>
Less than 30°	2
30° thru 60°	3
Over 60°	5

- e. The reduction of divided flow fittings shall be conical spun section in the thirty-six (36) reductions in sizes four (4) inches through twenty-two (22) inches.
- f. Spun bellmouth connections shall be used at each round take-off from the high pressure plenum.
- g. Offset fittings shall be constructed so that length of offset is not less than two (2) duct diameters.
- h. Galvanized areas that have been damaged by welding shall be coated with corrosion resistant aluminum paint, minimum two (2) coats.
- i. Supports and sealants shall conform with applicable portions of the medium pressure Duct Manual.
- j. Flexible ductwork shall be as previously specified for low pressure duct systems.

D. Fiberglass Reinforced Plastic (FRP)

1. Design Standards

- a. Fiberglass reinforced plastic ductwork and accessories shall be constructed and inspected according to the following standards.
 - 1) NBS PS 15-69: Standard for Contact-Molded Reinforced Polyester Chemical Resistant Process Equipment.
 - 2) ASTM E 84-89: Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 3) ASTM C 582-87: Standard Specification for Contact-Molded Reinforced Thermosetting Plastic Laminates for Corrosion Resistant Equipment.
 - 4) ASTM D 2563-70: Standard Practice for Classifying Visual Defects in Glass-Reinforced Plastic Laminate Parts.
 - 5) ASTM D 2996-88: Standard Specification for Filament Wound

“Fiberglass” (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe.

- 6) ASTM D 4097-88: Standard Specification for Contact-Molded Glass-Fiber-Reinforced Thermoset Resin Chemical Resistant Tanks.
- 7) SMACNA Thermoset FRP Duct Construction Manual: First Edition, June 1997.

- b. In the event of conflict between these references, the most appropriate and stringent source shall be followed.

2. Design Criteria

- a. Designed for min 8" WC pressure and 8" WC vacuum.
- b. Minimum designed structural safety factor of 5.
- c. All rectangular duct sections shall be constructed with integral stiffeners which limit maximum deflection to ½ inch across any span when subjected to –5.0 inches W. C. static pressure.

3. Quality Assurance

- a. All FRP duct components shall be fabricated by qualified, experienced personnel with a minimum of 5 years experience with the lay-up, fabrication and joining of FRP materials.
- b. Beside meeting the requirements of this section, resins used in the fabrication of the FRP ductwork shall be approved and applied in accordance with the resin vendor's published technical criteria.
- c. A visual quality inspection of laminate shall be performed on each duct section in accordance with ASTM D 2563. Acceptable ductwork shall have no visual surface defects greater than Level III, smooth with no glass fibers exposed. There shall be no foreign inclusions, dry spots, air bubbles, cracks, crazing, pinholes, or delamination. Inspections shall be done and recorded by the manufacturer and the installing contractor.

4. Ductwork Construction

- a. Internal Corrosion-Resistant Surface:
 - 1) The interior liner in contact with the contaminated exhaust airstream shall be a minimum of 100 mil thick and constructed of materials resistant to the chemicals listed in the attached data sheets. The corrosion liner shall be layed-up as a separate corrosion barrier from the intermediate structural layers.
 - 2) The internal liner shall be formed with a 10 mil C-glass veil for superior corrosion resistance. Two layers of 1.5 ounce per square foot chopped strand mat and spray-up chopped borosilicate glass shall make up the balance of the internal liner to achieve 100 mil total thickness.
 - 3) The corrosion liner shall gel completely prior to continuing with the structural layer.

- 4) Resin used for the internal corrosion-resistant liner shall be Reichhold Dion Ver 9300 FR or equal. Resin-to-glass ratios shall be 90% resin, 10% glass.
 - 5) The resin shall carry a flame spread rating of 25 or less, and smoke contribution rating of Unrated (in excess of 1000) with the addition of 3% antimony trioxide.
- b. Intermediate Structural Layer:
- 1) The intermediate layer of duct wall thickness shall be fabricated by either filament wound or hand lay-up techniques to the dimensional thickness and strength as required by NBS PS 15-69 standards.
 - 2) Resin for the intermediate structural layer shall be Reichhold VER 9300 FR or equal. Resin to glass ratios shall be 66% resin, 33% glass.
 - 3) The resin shall carry a flame spread rating of 25 or less, and smoke contribution rating of Unrated (in excess of 1000) with the addition of 3% antimony trioxide.
 - 4) The outer surface shall be relatively smooth with no exposed glass fiber ends.
- c. External Layer:
- 1) The exposed external surface of all FRP ductwork installed whether indoors on grade or on the roof, shall provide protection against ultraviolet degradation and weather erosion. The duct shall carry a flame spread rating of 25 or less and a smoke contribution rating of Unrated (in excess of 1000).
 - 2) All ductwork shall be identified by a finished appearance in the gray color spectrum. Gel coat color shall be Viron BM 1606 medium gray.
 - 3) External duct protection shall be provided by an ultraviolet stabilizer added to the final coat of resin that also incorporates paraffinated wax curing elements and color pigment.

5. Dampers

- a. Equipment isolation dampers, header separation manifold dampers, and exhaust branch duct balancing shall be manufactured using the same materials as the ductwork. Round dampers shall be single butterfly blade type, rectangular dampers shall be parallel blade type. Blade shaft shall be fiberglass with Teflon shaft seals. All dampers shall be suitable for 13 inches WC pressure differential. Blade shaft shall be designed to provide a 10:1 safety factor for operating torque requirements. The shaft shall be glassed into the damper blade, such that the center portion of the blade is significantly thicker than the outer perimeter with a smooth, even taper from the center to perimeter. Dampers shall be by Viron. Manual dampers to be equipped with manual stainless steel adjustable locking handles or worm

gear operators. Automatically controlled dampers to be equipped with automatic electric or pneumatic actuators supplied by the controls contractor and installed by mechanical contractor.

6. Fabrication

- a. All ductwork to be supplied as butt and wrap joints except as necessary for connection to equipment and dampers. All butt and wrap joints shall be constructed to ensure the bottoms of adjacent duct sections are relative to each other such that no pockets or low spots are created where condensed liquid can collect.
- b. Butt joints over 24" diameter shall be internally, as well as externally wrapped. Internal wraps shall include a minimum 20 mil synthetic veil in contact with the airstream. External wraps shall include a gelcoat finish as specified above.
- c. Strength of the butt joint shall be at least equal to that of the duct. Total minimum width of the joint shall be 3" for 1/8" thickness, 4" for 3/16" thickness and 6" for 1/4" thickness.
- d. Where flanges are necessary, they shall be made by hand lay-up. The face of the flange shall be smooth with no projections or depressions greater than 1/32" and shall be perpendicular to the duct centerline within 1/2 degree. Machine facing of the back of the flanges is not acceptable. Flange thickness shall be in accordance with ASTM D 4097-88. Flange height shall be a minimum of 2 inches. The duct wall at the hub of the flange shall be a minimum of 1.5 times the nominal duct thickness and taper to the normal thickness over a distance of at least one flange width. Fillet radius shall be a minimum of 3/8" at the point where the hub meets the back of the flange.
- e. Flange drilling, nuts, bolts, washers, and gaskets shall be provided by the installing contractor.
- f. Where required, drains shall be installed at locations indicated on the drawings. Drains shall be 1" diameter FRP 1/2 threaded couplings glassed into the bottom of the duct. The fitting shall be trimmed flush with the interior surface of the duct and the duct shall be recoated at the connection.
- g. Access openings shall be provided where located on the drawings and shall be rigidly framed and fitted with airtight covers which can easily be removed and installed. Cover plate and end caps shall be flanged as previously described, a minimum thickness of 1/4", and shall be reinforced as necessary to comply with design pressure criteria of the system. Access doors will be complete with Type 304 stainless steel hardware and full-face type gaskets. Gaskets shall be chemically resistant to the contaminants listed in attached data sheets.
- h. Flexible connections, expansion joints, revent connections, and fire sprinklers shall be provided by the installing contractor where shown on the drawings.

2.8 VISUAL PRESSURE MONITORS

- A. Visual pressure monitors shall be Airflow Direction, Inc model ADI-69-V-N/P manually switchable negative/positive room application. Unit shall be ball in tube device providing visual indication of room pressure. Unit shall be capable of responding to pressure differences of 0.001” wg and shall be self calibrating and self checking.

2.9 DUCT LINING

- A. Duct lining shall be provided where indicated and as herein specified. Duct lining shall be Solcoustic or Armacell AP Coilflex flexible polyimide foam coated duct liner, thickness at 1-inch unless otherwise indicated. Adhere liner, with coated side toward air stream, to all interior sides of duct with 100 percent coverage of manufacture approved fire-resistant insulation binding adhesive meeting ASTM C 916. Adhesive shall completely cover the sheet metal at each end of each section of ductwork. Where duct width exceeds twelve (12) inches, or height exceeds sixteen (16) inches further secure the liner to these surfaces with welded pin type mechanical fasteners as shown in the SMACNA duct manual. Pin length should be such as to limit compression of liner to 1/8 inch. Additionally, point all joints in liner and butter the edges of the liner where sections of ductwork will be jointed with adhesive meeting ASTM C 916. Provide leading edge protection as indicated in Duct Manual. Take every precaution to protect surface of liner as damaged liner will be rejected.
- B. Duct lining shall have air surface coated with acrylic coating formulated with immobilized EPA registered anti-microbial agent and been tested to Industry Standards, UL 181 mold growth and humidity test, ASTM C1071 fungi resistance test, and ASTM G21 and G22 and have proven not to support microbial growth. When tested at two and one-half times (12,500 feet per minute) the maximum recommended service velocity, the duct liner shall meet the erosion requirements of UL 181. Approval labels shall be supplied with all liner material. All raw edges and tears shall be repaired in an EPA registered anti-microbial coating such as Johns-Manville Superseal or approved equal.
- C. Solcoustic duct liner shall have temperature limit up to 250 degrees Fahrenheit and have fire hazard classification 25/50 per ASTM E84 and UL 723. Thermal conductance of insulation material shall be 0.30 BTU/HR Sq. Ft. Degrees Fahrenheit at seventy-five (75) degrees Fahrenheit mean temperature and one (1) inch thickness. Acoustical performance shall be tested in accordance with ASTM C423-90a and ASTM E795-83 and meet or exceed the following sound absorption coefficients:

Thickness (Inches)	Frequency (Hz)						
	<u>125</u>	<u>250</u>	<u>500</u>	<u>1000</u>	<u>2000</u>	<u>4000</u>	<u>NC</u>
1.00	0.11	0.30	0.73	1.02	0.73	0.66	0.70

2.10 AIR MEASURING DEVICES

- A. Airflow/Temperature Measurement – General

1. The airflow/temperature measurement station (ASTMS) indicated on the plans shall be capable of monitoring airflow and temperature rates at each measurement location. Sensors shall use thermal dispersion technology with two “bead in glass,” hermetically sealed thermistor probes at each measurement point. The system shall be factory tested prior to shipment and not require calibration or adjustment over the life of the equipment when installed according to the manufacturer’s guidelines. Each sensor probe shall be provided with a UL plenum-rated connecting cable with circular terminal connectors and gold plates contacts. Connecting cable shall be a minimum of 20 feet in length for each probe. Sensor probes shall be “plug and play” design and do not have to be matched to a specific transmitter. All sensor calibration data shall be stored in the sensor probe. No additional devices or transducers shall be required to interface with the host controls.
2. Sensors shall be factory-calibrated at 16 airflow rates and 3 temperatures to NIST-traceable standards for both airflow and temperature. Each sensing point shall independently measure airflow and temperature prior to averaging. Installed accuracy shall be percent of reading and demonstrated at both maximum and minimum airflow rates for each measurement location.

B. Transmitter and Electronics Enclosure:

1. The transmitter shall be microprocessor-based and capable of processing up to 16 independent sensing points per location. All connectors and interconnects shall have gold plated contacts. The transmitter shall operate on 24 VAC and be internally fused and protected. The transmitter shall have a 16 character alphanumeric LCD display for airflow, temperature, and system diagnostics. Analog output signals shall be field selectable (0-10 VDC or 4-20 mA.) When required on the plans, a serial RS-485 interface will be made available with field selectable network protocols (N2 or ModBus RTU.) All inputs and outputs shall be fused, protected, and internally isolated from the 24 VAC power supply. The transmitter shall have a digital adjustment for output signal offset/gain and an adjustable digital filter for airflow output. The transmitter shall be capable of being field configured to display either I.P. or S.I. units. The transmitter shall accept a user-defined area for CFM or LPS display. The transmitter shall be capable of continuously performing sensor and transmitter diagnostics and perform a full system check on power-up. A sensor detection system shall ignore any malfunctioning sensors and set a visual alarm on the LCD display. The transmitter shall be capable of indicating individual airflow and temperature readings on the LCD display.
2. The enclosure shall be aluminum alloy for indoor use and capable of operating over a temperature range of +30 deg. F to +120 deg. F. The electronics shall be installed inside and protected from the weather.

C. Duct and Plenum Mounted Sensor Probes:

1. Sensor probes shall be constructed of gold anodized aluminum alloy tube with 303 stainless steel mounting brackets. Probes shall be constructed as insertion,

internal, or standoff mounting, depending on the installation requirements.

a. Probe Performance Requirements

- 1) The sensor accuracy for airflow shall be at least $\pm 2\%$ of Reading over the sensor probe operating ranges. The installed total accuracy for airflow shall be better than $\pm 3\%$ of Reading over the sensor probe operating ranges when installed in accordance with manufacturer's guidelines. The sensor accuracy for temperature shall be better than ± 0.15 deg. F over the entire operating range.

b. Probe Sensor Density

- 1) The number of independent sensing points shall be as indicated below.

<u>Area (ft²)</u>	<u>Sensors</u>
≤ 1	2
> 1 to < 4	4
4 to < 8	6
8 to < 12	8
12 to < 16	12
≥ 16	16

c. Probe operating ranges:

- 1) Airflow: 0 to 5,000 FPM
- 2) Temperature: -20 deg. F to 160 deg. F.
- 3) Relative Humidity: 0 to 99% (non-condensing.)

D. Fan Inlet Velocity Sensors:

1. Sensors shall be conducted with stainless steel sensor bodies, stainless steel mounting brackets, and with adjustable cadmium-plated mounting rods.

a. Fan Inlet Performance Requirements:

- 1) The individual sensor accuracy for airflow shall be better than $\pm 3\%$ of Reading over the sensor probe operating ranges when installed in accordance with the manufacturer's guidelines. The installed accuracy for temperature shall be better than ± 0.15 deg. F over the entire operating range.

b. Fan Inlet Sensor Density:

- 1) Probes shall be provided with an adjustable mounting, and two sensors per inlet, for single and dual inlet fans.
- c. Fan Inlet Sensor Operating Ranges:
- 1) Airflow: 0 to 10,000 FPM.
 - 2) Temperature: -20 deg. F to 160 deg. F.
 - 3) Relative Humidity: 0 to 99% (non-condensing.)
- E. Dynamic Pressure “Bleed Airflow” Sensors:
1. Each sensing point shall independently measure bleed airflow rates and direction, or dynamic differential pressure, plus temperature. Sensor housing shall be constructed of an engineered thermoplastic with ½ NPT female threads on the inlet and outlet of the housing.
 - a. DP Sensor Performance Requirements:
 - 1) The installed total accuracy of airflow shall be better than +/-2% of Reading, and +/-4% of Reading for pressure, over the sensor operating range when installed in accordance with the manufacturer’s guidelines. The sensor accuracy for temperature shall be better than +/-0.15 deg. F over the entire operating ranges.
 - b. DP Sensor Operating Ranges:
 - 1) Bleed Airflow: -2,000 FPM to 2,000 FPM, or
 - 2) Differential Pressure: -0.25” wg to +0.25” wg and
 - 3) Temperature: -20 deg. F to 160 deg. F.
 - 4) Relative Humidity: 0 to 99% (non-condensing)

2.11 FANS

A. General:

1. Provide fans having a certified rating based on tests performed in accordance with AMCA Bulletins Number 210, 211A and 300. See AMCA Standard 99 "Standard Handbook" for definitions of fan terminology. Arrangement, size and capacity of fans are scheduled on the drawings.
2. All fans shall be statically and dynamically balanced by the manufacturer and shall be provided with field mounted vibration isolation units as hereinbefore specified.
3. Diffuser cones and inlet bells are not permitted in rating a fan unless they are an integral part of the fan design.
4. Provide inlets and outlets of fans not duct connected, including fans in plenum

- chamber or open to the weather, with heavy guard screens to protect personnel. Construct guard screens in a manner that will not impair fan performance, and when bolted to equipment will permit their removal for fan service and cleaning.
5. Provide lubrication facilities, such as oil reservoirs, sight glasses, grease and relief fittings, fill and drain plugs, pipe connections, etc. Place in a readily and safely accessible location so that after installation they will perform required function without requiring the dismantling of any parts or stopping equipment.
 6. All parts of fans shall be protected against corrosion prior to operation of the fan.
 7. Certified performance data including acoustical data shall be submitted for each fan at design conditions. Data shall include published sound power levels based on actual test on the fan sizes being furnished, and conducted in accordance with current AMCA standards. Such data is to define Sound Power Levels (PWL), re: 10^{-12} watts for each of the eight (8) frequency bands. Sound Power Levels shall not exceed those scheduled. Should additional attenuation be required to achieve the levels specified, it shall be included by the fan manufacturer. Any cost of field modifications necessitated by additional attenuation shall also be included by the fan manufacturer. Fan curves shall be submitted which will depict static pressure, total pressure, brake horsepower, and mechanical efficiency plotted against air volume. Data submitted in tabular form is not acceptable.
 8. Motors, drives, curbs, and bases shall be furnished by the fan manufacturer in accordance with the requirements of Division 23, Sections “Mechanical and Electrical General Provisions” and “Motors”. Motors and drives exposed to the weather shall be suitably protected as specified herein.

B. Type "A" Fan:

1. Fan shall be Twin City, Trane, Greenheck, Buffalo, or Loren Cook, equal to Twin City EPQN quiet efficient plenum, direct drive, centrifugal fan. Each fan shall be direct drive in AMCA arrangement 4.
2. Fans shall have a sharply rising pressure characteristic extending through the operating range and continuing to rise beyond the peak efficiency to ensure quiet and stable operation. Fans shall have a non-overloading design with self-limiting horsepower characteristics and shall reach a peak in the normal selection area. All fans shall be capable of operating over the minimum pressure class limits as specified in AMCA's Standard 2408-69.
3. Fans shall be designed without a scroll type housing and shall incorporate a non-overloading type backward inclined airfoil blade wheel, heavy-gauge reinforced steel inlet plate, structural steel frame, and shaft and bearings.
4. Inlet panels shall be of heavy-gauge reinforced steel construction. The inlet panel incorporates a removable spun inlet cone designed for smooth airflow into the accompanying inlet retaining ring of the fan wheel. A square, formed lip suitable for attachment of a boot connector shall surround the unit.
5. Wheels shall have a spun non-tapered style blade retaining ring on the inlet side to allow higher efficiencies over the performance range of the fan. All wheels on direct drive arrangement 4 fans shall have airfoil-shaped extruded aluminum blades. All hollow blade wheels shall be continuously welded around all edges. Wheels shall have twelve blades for better sound quality. All wheels shall be

statically and dynamically balanced on precision electronic balancers to a Balance Quality Grade G6.3 per ANSI/AMCA 204 or better.

6. Shafts shall be AISI 1040 or 1045 hot rolled steel, accurately turned, ground, polished, and ring gauged for verification. Shafts shall be sized for the first critical speed of at least 1.43 times the maximum speed.
7. All shafts must be dial indicated for straightness after the keyways are cut and straightened as required. Structural steel bases to be designed and manufactured by the fan supplier to ensure proper alignment of the fan and motor and structural integrity of the base to prevent vibration
8. Bearings shall be heavy duty, grease lubricated, spherical roller or adapter mounted antifriction ball, self-aligning, pillow block type and selected for a minimum bearing life (AFBMA L-10) in excess of 80,000 hours at the maximum fan RPM. All bearings shall be equipped with greasable zerkl fittings and, where necessary, extended lube lines for easy access for lubrication.
9. The entire fan assembly, excluding the shaft, shall be thoroughly degreased and deburred before application of a rust-preventative primer. After the fan is completely assembled, a finish coat of paint shall be applied to the entire assembly. The fan shaft shall be coated with a petroleum-based rust protectant. Aluminum components shall be unpainted.
10. All fans prior to shipment shall be completely assembled and test run as a unit at the specified operating speed or maximum RPM allowed for the particular construction type. Maximum vibration shall be within the limits of ANSI/AMCA 204 Fan Application Category BV-3. Balance readings shall be taken by electronic type equipment in the axial, vertical, and horizontal directions on each of the bearings. Records shall be maintained and a written copy shall be available upon request.
11. The manufacturer shall guarantee the workmanship and materials for at least one (1) year from startup or eighteen (18) months from shipment, whichever occurs first.

C. Type "B" Fan:

1. Mixed-flow induced dilution exhaust fan shall be roof mounted, laboratory exhaust type manufactured by Loren Cook, Greenheck, Strobic, Twin City or MKPlastics equal to MKPlastics, model AXIJETS-S. Fan shall be direct drive upblast centrifugal airfoil blower with coupling drive as indicated on the plans and specifications.
2. Acceptable manufacturers whose equipment is not licensed to bear the AMCA Certified Ratings Seal for Sound and Air Performance for Induced Flow Fans shall submit sound and air performance data obtained and calculated in accordance with AMCA Standards 210, 260, and 300. These tests shall be performed by a laboratory that is accredited by AMCA and certified by a corporate officer of the company. Additionally, at the owner's and/or engineer's option, and manufacturer's expense, performance witness testing of fan(s) shall be provided per paragraph 1.04 F for any units which are not licensed to bear the AMCA Certified Ratings Seal for Induced Flow Fan Air and Sound Performance.
3. Fans shall be manufactured at an ISO 9001 Certified facility.

4. Units shall conform to AMCA Standard 99-0401-86, “Classifications for Spark Resistant Construction.”
5. Fan impeller shall be statically and dynamically balanced in accordance with ANSI/AMCA Standard 204-05, “Balance Quality and Vibration Levels for Fans.” Vibration tests shall be conducted and recorded on each assembled fan before shipment at the specified fan RPM. These readings shall conform to the ANSI/AMCA 204-05 Standard.
6. Fan entrainment design shall have been verified by computational fluid dynamics (CFD). Computational fluid dynamics (CFD) evaluation of fan discharge and entrainment airflow may also be provided as requested by the owner and/or engineer.
7. Fan manufacturer shall provide at the owner and/or engineer’s expense and option, witness testing of the fan in an AMCA Accredited Laboratory during the submittal stage of the project. These tests shall be performed in accordance with ANSI/AMCA Standard 210-07, “Laboratory Methods of Testing Fans for Aerodynamic Performance Rating,” AMCA Standard 260-07, “Laboratory Methods of Testing Induced Flow Fans for Rating,” and ANSI/AMCA Standard 300-08, “Reverberant Room Method for Sound Testing of Fans.”
8. Provide lubrication facilities, such as oil reservoirs, sight glasses, grease and relief fittings, fill and drain plugs, pipe connections, etc. Place in a readily and safely accessible location so that after installation they will perform required function without requiring the dismantling of any parts or stopping equipment.
9. All parts of fans shall be protected against corrosion prior to operation of the fan.
10. Motors, drives, curbs, and bases shall be furnished by the fan manufacturer in accordance with the requirements of Division 15. Motors and drives exposed to the weather shall be suitably protected as specified herein.
11. Certified performance data including acoustical data shall be submitted for each fan at design conditions. Data shall include published sound power levels based on actual test on the fan sizes being furnished, and conducted in accordance with current AMCA standards. Such data is to define Sound Power Levels (PWL), re: 10-12 watts for each of the eight (8) frequency bands. Sound Power Levels shall not exceed those scheduled. Should additional attenuation be required to achieve the levels specified, it shall be included by the fan manufacturer. Any cost of field modifications necessitated by additional attenuation shall also be included by the fan manufacturer. Fan curves shall be submitted which will depict static pressure, total pressure, brake horsepower, and mechanical efficiency plotted against air volume. Data submitted in tabular form is not acceptable.
12. All fans shall be provided with field mounted seismic vibration isolation units as hereinbefore specified.
13. Primary airflow from laboratory exhaust system, bypass airflow through mixing box, overall airflow through fan, and discharge nozzle airflow shall be submitted. Outlet nozzle velocity and plume rise calculated per ASHRAE Applications Handbook shall also be provided for the specified fan performance and wind velocity.
14. Fans selected shall allow for +/- 15% variation of scheduled static pressure and airflow.
15. Fan Housing and Construction (unless otherwise noted):

- a. Fan housing shall be a minimum 14 gauge steel construction.
- b. Fan shall be constructed with an integral housing drain to alleviate rainwater.
- c. Fan shall include a bolted and gasketed access door.
- d. Unit fasteners exposed to the airstream shall be of stainless steel construction.
- e. EF-L-3
 - 1) General laboratory exhaust fans shall have an electrostatically applied, high performance, heresite-plastic 3055 baked phenolic, five (5) to seven (7) mil thick coating on all internal surfaces and corrosion resistant enamel coating on all exterior surfaces.
 - 2) Fans shall be spark-resistant.
- f. Coatings shall be salt spray tested per ASTM B117 for in excess of 1000 hours without failure, humidity resistance tested per ASTM D2247 for in excess of 1000 hours without failure, and impact resistance tested per ASTM D2794 and shall pass a minimum of 100 in-lbs.
- g. Finish color shall be light gray.
- h. Unit shall bear an engraved aluminum nameplate. Nameplate shall indicate design CFM, static pressure, and maximum fan RPM.
- i. Units specified as Spark Resistant Construction shall be constructed to the AMCA Spark Resistant Construction level as dictated on the plans and specifications.
- j. Unit shall be shipped in ISTA Certified Transit Tested Packaging.

16. Dilution Nozzle:

- a. Fans shall incorporate a double concentric accelerator fiberglass reinforced plastic (FRP) induction nozzle selected for optimal performance per the plans and specifications. Nozzle shall be constructed and designed to avoid extreme variations in velocity flows across the outlet, even against wind loading. Where required, CFD shall be provided demonstrating this on submitted nozzle. Bifurcated designs shall not be allowed.
- b. Induction nozzle shall be constructed and designed to efficiently handle up to 7000 feet per minute outlet velocity and shall have a optimally matched accelerator for the specified design conditions.

17. Centrifugal Fan Impeller:

- a. Fan impeller shall be steel, non-overloading, centrifugal backward inclined, airfoil type. Blades shall be continuously welded to the backplate and inlet shroud.
- b. Fan impeller hub shall be keyed and securely attached to the fan shaft. Fan shaft shall be AISI C-1045 hot rolled or stainless steel and accurately turned, ground, and polished. Shafting shall be sized for a critical speed of at least 125% of maximum fan RPM.
- c. Fan impeller shall be statically and dynamically balanced in accordance

with AMCA Standard 204-96, “Balance Quality and Vibration Levels for Fans.”

- d. Fan impeller shall be coated with finish to match the fan housing.
- e. Pillow block bearings shall utilize concentric mounting locking collars for attachment to fan shaft.

18. Fan Motors and Drives:

- a. Fan motors shall be premium efficiency, NEMA frame, nominal 1800 or 3600 RPM Totally Enclosed Fan Cooled (TEFC) with a 1.15 service factor.

D. Type "C" Fan:

- 1. Factory fabricated fiberglass reinforced plastic (FRP) induced-flow perchloric acid fume exhaust system shall be manufactured by M.K. Plastics Corporation or equal to M.K. Plastics Corporation Model MV.

2. References

- a. AMCA -99 Standards Handbook
- b. AMCA 210 - Laboratory Methods of Testing Fans for Rating Purposes.
- c. AMCA 211 - Certified Ratings Procedure - Air Performance.
- d. AMCA 300 - Test Code for Sound Rating Air Moving Devices.
- e. AMCA 311 - Certified Sound Ratings Program for Air Moving Devices.
- f. AFMBA - Method of Evaluating Load Ratings of Bearings (ASA - B3.1 1).
- g. AMCA 204 - Balance Quality and Vibration Levels for Fans.
- h. CRC Handbook of Laboratory Safety.
- i. Industrial Ventilation, ACGIH.
- j. ANSI Z9.5, American National Standard, Laboratory Ventilation.

3. Quality Assurance

- a. Performance Ratings: Conform to AMCA 211 and AMCA 311.
- b. Classification for Spark Resistant Construction; Conform to AMCA 99.
- c. Each fan shall be tested before shipping. Motors to be tested for amperage drawn.
- d. A certificate to be supplied with each fan as to quality control before shipping and compliance to specifications.

4. General

- a. Base fan performance at standard conditions (density 0.075 Lb/ft³)
- b. Fans selected shall be capable of accommodating static pressure and airflow of scheduled values.
- c. Each fan shall be belt drive in arrangement #10 according to drawings.

5. Venturi Stack

- a. Induced draft venturi to be manufactured in a single piece. Material shall be

- corrosion resistant fiberglass reinforced polymer (FRP) construction. Resin to be polyester or vinyl ester, properly cured containing no fillers. Material flame spread rating of 25 or less shall be provided when specified. Venturi interior surface shall be smooth without crevices, minimizing the deposit of unstable and volatile perchlorates.
- b. Discharge velocity of venturi stack shall be 3000 fpm or greater in accordance with ANSI Z9.5.
 - c. Venturi stack to be provided with integral curb cap when shown on the drawings
 - d. Venturi stack and wash ring water line to be fabricated with a 2” double wall insulation system for exterior installations. Insulation shall be R-12, 2” thick.
 - e. Venturi stack discharge to be provided with integral FRP wash ring for water cleaning of perchlorate deposits on the venturi interior.
6. Fan Housing
- a. Fan housing to be aerodynamically designed with high-efficiency inlet, engineered to reduce incoming air turbulence.
 - b. Fan housing shall be manufactured in specifically formulated resins and reinforced with fiberglass for structural strength, or heavy duty epoxy coated cast aluminum.
 - c. Fan outlet to be flanged. Fan inlet to be provided with either a PVC mesh screen, or spiral wire type with an electrostatic zinc finish.
 - d. A manual control damper fabricated of UV inhibited PVC shall be provided on the fan discharge for flow control.
 - e. A flexible connector fabricated of UV inhibited flexible PVC shall connect the induction blower discharge and the venturi stack using 304 stainless steel clamps.
 - f. Standard finish color to be light gray.
7. Fan Impeller
- a. Impellers shall either be of flat radial blade design in solid molded FRP or epoxy coated cast aluminum construction. The impeller shall be electronically balanced both statically and dynamically Grade GS.3 per AMCA 204-96 Standard.
8. Fan Base Support
- a. Arr. #10 or #9 support to be manufactured in formed steel and to be baked polyester coated.
 - b. An access panel to be standard to provide accessibility to the motor junction box.
 - c. An OSHA belt guard shall be provided to cover the sheaves and belts.
9. Fan Motors and Drives

- a. Motors to be TEFC and premium-efficiency with a 1.15 service factor.
- b. Belts and pulleys are to be accessible for service and maintenance.
- c. Shafts to be AISI -1045 carbon steel. The shaft shall not be in the corrosive air stream.
- d. Bearings shall be regreaseable spherical pillow block and have a minimum L-10 life of 200,000 hours life.
- e. Drive guard to be supplied and manufactured according to OSHA standards.
- f. Fans up to 5 HP motor to have variable pitch.

10. Wash System Controls

- a. The manufacturer shall provide a NEMA 3R control panel complete with washdown/exhaust fan control switches, indicator lights, manual/automatic toggle switch (mounted on the enclosure door), and PLC display per fan, (mounted inside the enclosure), control circuitry, interface terminal strip and three way water solenoid valves (shipped loose).
- b. Venturi exhaust system shall be de-energized during wash cycle.
- c. Wash cycle time shall be determined by the Facility Safety Manager.
- d. Washdown shall be either manually operated or automatically set.
- e. Provide optional battery back-up, (UPS), which will protect against possible power surges and provide full timer operation during a power failure.

11. Auxiliary Wash Rings

- a. Venturi exhaust system manufacturer shall provide auxiliary FRP wash rings to be installed every 10 to 12 feet of vertical duct work, spray nozzles to be in horizontal duct at every 4 to 5 feet, and duct elbow spray nozzles.

PART 3 - EXECUTION

3.1 AIR DEVICES

- A. Install air devices in accordance with the manufacturer's latest published installation instruction to insure against incorrect air pattern, drafts, and dirt smudging.
- B. Construct, and install sheet metal duct or plenum connections to air devices in accordance with terminal manufacturer's recommendations.
- C. Make modifications to the duct systems as required to accommodate actual sizes of air devices furnished, e.g., transformations and collar sizes without additional cost.
- D. Make joints between each devices and its components, connecting duct, or the mounting surface airtight, using gasket or its equivalent.
- E. Align exposed butt edges of linear diffusers using slots and keys strips or with other concealed means.

3.2 AIR TERMINAL UNITS

- A. Install units such that access panels, volume regulators and damper motors are readily accessible for maintenance and adjustment.
- B. Rigidly support units so they remain stationary. Provide cross-bracing or other means of stiffening as necessary. Use method of support such that distortion and maloperation of units cannot occur.

3.3 FILTERS

- A. Protect filter elements and media against contamination from dirt during construction. Thoroughly clean system prior to placing filters in operation.
- B. After all adjustments and tests are completed and immediately before the filters are accepted for regular operation, restore filter media to "new" condition status.
- C. Install static pressure pitot tips in duct upstream and downstream of the filter and connect to the draft gauge with tubing. Provide suitable cocks in tubing in a manner that will permit calibrating the draft gauge. Carefully level and adjust gauges.

3.4 DUCTWORK

- A. Install hangers, supports, and their attachments, generally in conformance with SMACNA standard referred to in this section of the specifications and applicable portions of article "Piping, Conduit and Supports", of Division 23, Section "Mechanical and Electrical General Provisions".
- B. Furnish hangers in accordance with SMACNA standards.
- C. Neatly erect ducts and plenums of sizes and arrangements shown and detailed and as required to carry out intent of specifications and drawings. Work must meet approval of the Architect in all its parts and details.
- D. Sizes shown are air side sizes. Where ducts are shown as lined, dimensions shall be increased to reflect that thickness of the lining.
- E. Install ductwork in such a manner as to meet the recommendations of NFPA Standard 90A.
- F. Provide each air outlet with a collar adequately stiffened, fastened, and made suitable for securing air device thereto. Make field changes in ductwork, such as those required to accommodate the sizes of factory fabricated equipment actually furnished, i.e., coils, air filters, fans, damper and air terminal units and similar items, without additional cost. Provide duct flanges to match those of connecting factory fabricated equipment. When

necessary, relocate and modify ductwork to avoid obstructions such as structural members, piping and conduit, in a manner acceptable to the Architect.

- G. Construct and install all ductwork in accordance with the SMACNA Standards specified. Coordinate the installation of all duct systems with all other trades including plumbing, electrical, sprinkler, ceiling systems, etc.
- H. All open end return air ducts and open end transfer ducts shall be provided with 1/2" galvanized wire mesh screen.
- I. Leak Testing of Ductwork:
 - 1. When deemed necessary by the Architect, test low pressure ductwork for leaks by sealing openings and pressurizing system to that static pressure which the system will operate. Use test methods approved by SMACNA and Architect. Seal all joints. Leakage shall not exceed three (3) percent of air flow specified at the system's nominal static pressure.
 - 2. Medium pressure ductwork shall be pressure tested as hereinbefore defined.
- J. Duct smoke detectors shall be installed where indicated on the mechanical and electrical drawings. Duct smoke detectors shall be installed upstream of the associated smoke damper and within 6'-0" of the damper in as straight a section of ductwork as possible.

END OF SECTION 233110

SECTION 237300 – OUTDOOR CENTRAL STATION AIR HANDLING UNIT

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 WORK INCLUDED

- A. The work under this Section shall include furnishing all materials, equipment and performing all operations necessary for the complete production, packaging, delivery, factory testing and assembling the factory fabricated outdoor air handling units.
- B. The units shall consist of base, enclosures, access doors, insulation, piping, wiring systems, electrical components, and all components specified to be installed by the air handling unit manufacturer within the enclosures.
- C. The unit(s) shall be factory fabricated to completion as an assembled unit and then separated into individual shipping sections only after the unit(s) are complete, tested and have been inspected by the Owner's representatives.
- D. Motors and variable frequency drives, as shown on product drawings and described in performance specifications.
- E. Factory packaged controls, as shown on drawings and described in performance specifications.
- F. The requirements of Division 23, Section “Mechanical and Electrical General Provisions” shall apply to the work specified under this section.

1.3 QUALITY ASSURANCE

- A. All building heating and air conditioning systems shall meet the mandatory provisions for HVAC performance as documented in ASHRAE 90.1-2007 Section 6.4. The minimum system component efficiency requirements listed in ASHRAE 90.1-2007 Tables 6.8.1A-G must be met.
- B. Fabrication: Conform to AMCA 99.

- C. Air handling units: Product of manufacturer regularly engaged in production of air handling units.
- D. Ductwork and equipment installation shall be in accordance with the current editions of NFPA Air Conditioning and Ventilating System Code 90-A and B.
- E. Sound power level ratings: Comply with AMCA Standard 301 "Method of Calculating Fan Sound Power Ratings from Laboratory Test Data." Test fans in accordance with AMCA Standard 300 "Test Code for Sound Rating" Fans shall be licensed to bear the AMCA Seal for Air and Sound.
- F. UL Compliance: Electrical components shall be UL listed and labeled.
- G. NFPA Compliance: Provide air handling unit insulating materials having flame spread ratings not over 25 and smoke developed ratings no higher than 50; and complying with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems" Manufacturer shall provide a copy of NFPA 90 test certificate as part of the submittal to indicate compliance.
- H. NEMA Compliance: Motors and electrical accessories shall comply with NEMA Standards.
- I. Electrical Component Standard: Components and installation shall comply with NFPA 70"National Electric Code".
- J. The air handling unit(s) shall be run tested as specified herein at the manufacturer's facility. A certified run test report shall be furnished prior to shipment.
- K. Performance data of filters shall be based on ASHRAE 52.1-1992 and ASHRAE 52.2-1999.
- L. Coil performance data shall be certified in accordance with ARI Standard 410 Coil Certification Program.
- M. Qualify welding procedures and welding operators in accordance with American Welding Society (AWS) - Structural Welding Code.
- N. Metal nameplates shall be provided on the units. All information contained on the nameplate shall be etched or burned into the surface to prevent fading. Information shall include:
 - 1. Job name, sales order number, unit tagging, and service model number.
 - 2. MCA, MOP, and maximum fuse/HACR circuit breaker size.
 - 3. Voltage, frequency, phase, Hp, FLA, and inverter input current for all motors

- O. Labels shall be provided on the units for unit rigging and coil piping and connection instructions. Labels shall be provided on fans indicating direction of rotation. Warning labels shall be provided on appropriate components indicating hazardous voltage. For each section which must be assembled to another, matching steel identification tags shall be welded at each mating joint to ensure correct assembly order.
- P. Factory installed components shall be installed by the unit manufacturer in full accordance with the component manufacturer's installation procedures.

1.4 DEFINITIONS

- A. Full thermal break shall be defined as a thermal break that ensures no member on the exterior of the unit, including fasteners, has through metal contact with any member on the interior of the unit. Unit walls, roof, base and supporting frame work shall have a thermal break with an R-Value not less than 2.6 BTU/hr-ft²-°F. Caulk is not an acceptable thermal barrier.
- B. Wall assemblies shall include all unit wall panels inside and around the air tunnel perimeter and service corridor, including all channels, fasteners, structural members and seams exposed to both the interior and exterior of the unit, and all removable wall access panels.
- C. Door assemblies shall include interior and exterior unit door panels, door frames, and door channels, fasteners, exposed to both the interior and exterior of the unit.
- D. Roof assemblies shall include exterior unit roof panels, interior unit ceiling panels, and all roof channels, fasteners, structural members and seams, exposed to both the interior and exterior of the unit.

1.5 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.

1.6 SUBMITTALS

- A. Shop Drawings: Indicate assembly, unit dimensions, weight loading, required clearances, construction details, field connection details, and electrical characteristics and connection requirements. Computer generated fan curves for each air handling unit shall be submitted with specific design operating point noted. A computer generated psychometric chart shall be submitted for each cooling coil with design points and final operating point clearly noted. Sound data for discharge, radiated and return positions shall be submitted by octave band for each unit. Calculations for required baserail heights to satisfy condensate trapping requirements of cooling coil shall be included.
- B. Product Data:
 - 1. Provide literature that indicates dimensions, weights, capacities, ratings, fan performance, finishes of materials, electrical characteristics, and connection requirements.
 - 2. Provide data of filter media, filter performance data, filter assembly, and filter frames.
 - 3. Provide manufacturer's installation instructions.

1.7 SAFETY AGENCY LISTED & CERTIFICATION

- A. Air Handling units shall be cETLus safety listed to conform with UL Standard 1995 and CAN/CSA Standard C22.2 No. 236. Units shall be accepted for use in New York City by the Department of Building, MEA 342-99-E.
- B. Air handler furnished with double width, double inlet (DWDI) fans and/or plenum fans where applicable, shall be certified in accordance with the central station air handling units certification program, which is based on AHRI Standard 430.
- C. Air handling unit water heating & cooling coils shall be certified in accordance with the forced circulation air cooling and air heating coils certification program, which is based on AHRI Standard 410.

1.8 DELIVERY

- A. Deliver the unit(s) as a factory assembled unit to the extent allowable by shipping limitations.
- B. Shipping sections with exposed openings shall be properly covered by the unit manufacturer, prior to shipment, to protect the unit and components during transportation.
- C. Handle carefully to avoid damage to components, enclosures, and finish. Do not install damaged components; remove and replace damaged components as required or directed.

- D. Deliver the unit with factory installed shipping skids and lifting lugs; pack components in factory-fabricated protective containers, suitably marked to indicate the contents within.
- E. All components shall be properly braced as necessary to prevent damage during transportation and rigging.
- F. During temporary storage, the installing contractor shall provide suitable protection and perform the necessary preventative maintenance to provide the unit in "like new" condition.
- G. Furnish written instructions needed to complete the field assembly of the unit. Provide all sealing and fastening hardware required.
- H. Painted units shall be tarped for protection during shipment.
- I. Rain hoods shall ship loose.

1.9 WARRANTY

- A. Provide two (2) year parts and labor warranty for the whole unit, including VFDs and motors. This warrants that all products are free from defects in material and workmanship.
- B. Warranty covers all parts except consumable items (belts, filters, fuses) for the warranty period. It does not cover any labor to troubleshoot machinery or normal maintenance and re-calibration labor after initial field start-up.
- C. All start up, warranty, and inspections shall be performed by a local factory authorized service representative. All work, as described herein, shall be performed by OEM certified technicians, employed by the manufacturer. Provide documentation that service technicians have updated certifications to perform start up/maintenance/warranty on the equipment.
- D. Warranty period shall begin on date of Substantial Completion.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. The following manufacturers are approved for use. No substitutions shall be permitted.
 - 1. McQuay 'Skyline' Air Handler
 - 2. Buffalo
 - 3. Temtrol
 - 4. Trane

5. JCI York Solutions

2.2 GENERAL

- A. Air-handling units shall be designed and built to meet performance detailed in this specification.
- B. Unit shall be complete with fans, motors, motor controls, coils, dampers, controls, access doors and other components/options, as shown on product drawings, wiring diagrams, and as described in performance specifications.
- C. Fans and drives shall be balanced to limit vibration at operating speeds.
- D. Unit shall ship in one (1) piece whenever possible. Shipping splits shall be provided when necessary. Lifting lugs shall be provided where required for proper lifting.
- E. Unit casing and frame shall be factory insulated.
- F. Units shall be ETL labeled.

2.3 PERFORMANCE REQUIREMENTS

- A. AHUs shall meet the specified requirements indicated hereinafter for casing deflection, leakage, acoustics, and thermal performance.
- B. Refer to the equipment schedules for the performance characteristics of all fans, coils, filters and related components required in the units.
- C. Design data on the equipment schedules refer to conditions at job site elevation.
- D. Design fan total static pressures to include all losses, internal and external to the unit, including allowances for filter loading.

2.4 UNIT CASING

- A. Unit shall be specifically designed for outdoor applications.
- B. Unit casing shall consist of a structural frame with insulated roof, wall, and floor panels.
- C. Removal of wall panels shall not affect structural integrity of units.
- D. Unit casing shall be insulated with spray injected foam to achieve thermal resistance of R13 hr-ft²-°F/BTU. Insulation application shall meet the requirements of NFPA 90A.

- E. Unit shall conform to ASHRAE Standard 111 Class 6 for casing leakage no more than 1% of design airflow at 1.25 times design static pressure up to a maximum of +8 inches w.g. in positive pressure sections and -8 inches w.g. in negative pressure sections..
- F. Wall panels and access doors shall deflect no more than L/240 when subjected to 1.5 times design static pressure up to a maximum of +8 inches w.g. in positive pressure sections and -8 inches w.g. in negative pressure sections. 'L' is the panel-span length and 'L/240' is the deflection at panel midpoint.
- G. Unit shall have double wall, 2" insulated panels for walls, roof, and floor. Exterior skin shall be galvanized and painted sheet steel. Individual segments shall have galvanized sheet steel, stainless sheet steel, or perforated galvanized interior liner, as described in performance specifications.
 - 1. Panels with perforated liner shall have 1" of 3 lb/ft.3 fiberglass board insulation, faced to prevent fiber erosion, and 1" of foam insulation. Exterior skin shall be galvanized and painted sheet steel. Interior liner shall be perforated galvanized. Minimum perforated panel thermal resistance shall be R11 hr-ft²-°F/BTU.
- H. Unit roof shall be double-sloped with a longitudinal peak and a minimum pitch of 1/4" per foot.
 - 1. Roof snow-loads capacity shall be at least 50 lb/ft².
 - 2. Roof overhangs unit perimeter by 1-1/2".
- I. Floor panels shall be double wall construction, designed to provide at most L/240 deflection when subjected to a 300 lb. load at mid-span.
- J. Double wall access doors shall be provided on sections as shown on product drawings.
 - 1. Stainless steel hinges permit a 180° door swing.
 - 2. Access door shall be of the same material type as exterior/interior casing.
 - 3. Access door latches shall use a roller cam latching mechanism.
- K. View ports shall be double-pane tempered glass.
- L. Primary and auxiliary drain pans shall comply with the guidelines of ASHRAE 62.
 - 1. Drain pans shall be double sloped at least 1/8" per foot, and have no horizontal surfaces.
 - 2. Drain connection material shall be the same as drain pan.
 - 3. Drain pans shall drain to one point.
 - 4. Drain connections shall be welded to drain pans
 - 5. Drain pans shall have at least 1" clearance between pan and coil supports.

2.5 FANS

- A. Refer to Division 15, Section “Air Distribution” for additional information.
- B. Fans shall provide CFM and static pressure, as shown in performance specifications.
- C. Fans shall be Class I, II, or III, as required to meet selected RPM and horsepower shown in performance specifications.
- D. Fans shall be SWSI (plenum), as shown on product drawings.
- E. Fans shall have airfoil blades, as shown in performance specifications.
- F. Airfoil fans shall bear the AMCA Seal. Airfoil fan performance shall be based on tests in accordance with AMCA standard 210 and shall comply with the requirements of AMCA certified ratings programs for air and sound. Airfoil wheels shall comply with AMCA standards 99 2408 69 and 99 2401 82.
- G. Fans shafts shall be polished steel and sized such that the first critical speed shall be at least 125% of the maximum operating speed for the fan pressure class. Shaft shall be coated with an anti-corrosion coating.
- H. Fan and motor assembly shall be internally mounted on a common base. Fan and motor base shall be spring isolated on a full width isolator support channel.
 - 1. Fan motor shall be on an adjustable base.
 - 2. Fan discharge shall be connected to cabinet via a flexible connection.
 - 3. Access doors shall be provided as shown on product drawing.

2.6 BEARINGS AND DRIVES

- A. Fan bearings will have average life (L50) of at least 200,000 hours. Bearing fatigue life ratings will comply with ANSI/AFBMA 9.
- B. DWDI fans will be belt-driven. SWSI fans will be belt driven or direct driven, as shown on product drawings.
- C. Forward curved fans smaller than 18” will have permanently lubricated bearings. Re-greaseable fan bearings will be factory lubricated and equipped with standard hydraulic grease fittings.
- D. Fan drives will be selected for a 1.5 service factor and will be furnished with anti-static belts.
 - 1. Drives 15 hp or smaller on constant volume fans will be adjustable pitch.

2. Drives 20 hp or larger or drives on fans with VFDs will be fixed pitch.
3. Sheaves will be machined from close grain cast iron and statically balanced.
4. Drive belts will be V type, precision molded, raw edge construction, anti-static, oil and heat resistant.

2.7 ELECTRICAL MOTORS

- A. Refer to Division 15, Section “Motors” for additional information
- B. Fan motors will be built in accordance with the latest NEMA and IEEE standards.
- C. Fan motors comply with ASHRAE Standard 90.1.
- D. Fan motors will be furnished in sizes, electrical power and starting characteristics as shown in performance specifications.
 1. Fan motors will be rated for continuous, full load duty at 104°F (40°C) ambient temperature and 1.15 service factor.
 2. Fan motors will be NEMA design ball bearing type.
 - a. Direct drive plenum fans will be coupled with motors that closely match required fan RPM.
 3. Fan motors will be open drip proof (ODP).
 4. Premium Efficiency Inverter ready per NEMA STD MG1 PART 31.4.4.2
 5. Motors will be suitable for use with variable frequency drives, per NEMA MG-1 Part 30.

2.8 VARIABLE FREQUENCY DRIVES

- A. VFDs with bypass shall be provided, mounted, and wired by the AHU manufacturer for all air handling units. Refer to Division 23, Section “Variable Frequency Drives (VFD)” for requirements.
- B. VFDs will be UL or ETL listed and comply with applicable provisions of the National Electric Code.
- C. VFDs will be housed in a dedicated, weather resistant compartment.
 1. VFDs provided on units without single point power will be housed in a NEMA 3R enclosure.
 2. Weatherproof compartments will be provided on units with single point power.
- D. VFDs furnished or provided with units will be programmed and started by a manufacturer’s trained and employed technician.
- E. VFD will include harmonic distortion feedback protection:

1. Swinging DC Line Choke (equivalent to 5% input line reactor)
2. Integral RFI/EMI filtering to meet EMC EN61800-3 for First Environment.

2.9 HEATING AND COOLING COILS

- A. Water coil capacity and pressure drop performance will be certified in accordance with AHRI Standard 410, when selected within fluid velocity, inlet fluid temperature, and entering air temperature ranges specified by AHRI 410.
- B. Cooling coil segments will have a full-width IAQ drain pan that extends at least 6” downstream of the last coil in the section.
- C. Coils will be removable from the side of unit, via removable AHU panels. No more than one panel must be removed to remove a coil.
- D. Coils will have frames constructed of galvanized steel. Casing channels will be free-draining and do not block fin area.
- E. Cooling coils with finned height greater than 48” will have an intermediate drain pan with downspout to drain condensate to main drain pan. Intermediate drain pan material will match coil frame material.
- F. Coil segment door clearances will allow for at least 2-inches of field installed piping insulation.
- G. Coil bulkheads and blank-offs will prevent air from bypassing coils.
- H. Coil segment casing to accommodate full-face or reduced-face coils will be provided. Provide face and bypass coil segments with factory installed bypass damper
- I. Coil connections will be extended through unit casing.
- J. Water coils will have a 1/4" FPT plugged vent or drain tap on each connection that is accessible from outside the unit.
- K. Spool shaped coil grommets will be provided to insulate and seal coil penetrations.
- L. Water coils will be designed to operate at 250 psig and up to 300° F and will be factory tested with 325 psig compressed air under water.
- M. Water coils tubes will be mandrel expanded to form fin bond and burnished, work-hardened interior surface.
- N. Coil fins will be die-formed, continuous aluminum, and have fully drawn collars to accurately space fins, and form a protective sheath for tubes.

2.10 FILTERS AND FILTER FRAMES

- A. Filter elements and cartridges shall be as scheduled on the drawings and of the type specified in Division 23 Section “Air Distribution”.
- B. Filter holding frames shall be of heavy duty construction designed for industrial applications equal to those specified in Division 23 Section “Air Distribution”. Holding frames applied in both low efficiency pre-filter applications and high efficiency final filter applications shall be upstream accessible only. Holding frames shall be constructed from no less than eighteen (18) gauge galvanized steel. Filter racks over forty-eight (48) inches in height and seventy-two (72) inches in width shall require steel reinforcement at the midpoint. The filter racks with dirty filters shall have maximum deflection not to exceed 1/200th of rack dimension in either direction.
- C. Racks shall be equipped with polyurethane foam gaskets, fasteners, and filter centering dimples. The in-line depth shall not be less than 2.75 inches in order to effect adequate bearing surface for built-up filter banks. Filter fasteners shall be capable of being installed without the requirement of tools, nuts or bolts. The holding frame shall be designed to accommodate standard size filters with the application of the appropriate type fastener. Holding frame assemblies shall be sized to accommodate the filters scheduled on the drawings.
- D. Air Filter Gauges
 - 1. Air filter gauges shall be provided for each bank of filters and mounted flush with unit casing.
 - 2. Each gauge shall be a diaphragm actuated, dial type gauge with zero adjustment, 3-way vent valves, static pressure taps, integral compression fittings on both valves and taps, and aluminum surface mounting bracket with screws. Gauge shall be Dwyer Instruments, Inc., Series 2000 Magnehelic differential pressure gauge.
 - 3. Gauges shall have a range of 0 to 1.0" for pre-filter banks, 0 to 2.0" for ASHRAE cartridge filter banks, 0 to 3.0" for two stage banks and 0 to 3.0" for HEPA filter banks.
- E. Manufacturer shall provide one set of startup filters.

2.11 DAMPERS

- A. Dampers will be factory installed.
- B. Dampers will have airfoil blades with extruded vinyl edge seals and flexible metal compressible jamb seals.
- C. Dampers will have a maximum leakage rate of 4 CFM/square foot at 1" w.g. and comply with ASHRAE 90.1.

- D. Maximum damper torque requirement will be 7 in. lbs./ft².
- E. Damper blades will be parallel acting unless submitted otherwise.
- F. Damper blades will be galvanized steel or aluminum.

2.12 APPURTENANCES

- A. Safety grates capable of supporting a 300 lb. center load will be provided over bottom openings, as shown in performance specifications.
- B. Formed steel base rails suitable for rigging and lifting will be provided, as shown on product drawings.
- C. Lifting lugs will be provided where required for proper lifting.
- D. Air intake hoods
 - 1. Outside air weather hoods shall be fabricated from the same material as the unit exterior.
 - 2. The leading edge and sides of the hood shall extend 6" below the bottom edge of the damper section covered.
 - 3. Hood assembly shall be provided with drain gutters and wire mesh bird-screen.
 - 4. Inlet hoods shall be provided with a moisture eliminator that ensures no entrainment of water into the unit for the velocity at which the hood is selected.
 - 5. The hood to unit sheet metal joint shall be caulked to prevent water leakage into intake dampers. If hood is shipped as a sub-assembly, the installing contractor shall install and seal with caulking provided by the unit manufacturer.
- E. Access sections shall be provided for access between components. Floor options shall include 0.125-inch aluminum treadplate or drainpan as shown on project schedule.
- F. Plenum sections shall be provided and properly sized for inlet and/or discharge air flow (between 600 and 1500 feet per minute). The plenum shall provide single or multiple openings as shown on drawings and project schedule.
- G. Economizer section shall be provided with right side outside air opening and end return air opening and left side exhaust air opening with or without parallel low leak airfoil damper blades. Dampers shall be hollow core galvanized steel airfoil blades, fully gasketed and have continuous vinyl seals between damper blades in a galvanized steel frame. Dampers shall have stainless steel jamb seals along end of dampers. Linkage and ABS plastic end caps shall be provided when return and outside air dampers sized for full airflow. Return and outside air dampers of different sizes or very large dampers and exhaust dampers must be driven separately.

2.13 ELECTRICAL

- A. Wiring Termination: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclosed terminal lugs in terminal box sized to NFPA 70.
- B. Installing contractor shall provide GFI receptacle within 25 feet of unit to satisfy National Electrical Code requirements.
- C. All electrical connection components shall be field provided and mounted as shown on project schedule.

2.14 FINISHES

- A. External unit surfaces will be factory cleaned prior to finishing or shipping.
- B. Unit will be painted, as shown in performance specifications.
 - 1. Painted units will be prime-coated prior to painting.
 - 2. Paint will be acrylic polyurethane.
 - 3. Painted unit will exceed 500-hour salt spray test, with (5%) solution, without any sign of red rust when tested in accordance with ASTM B-117.

2.15 TESTS AND INSPECTIONS

- A. Fan skid will be run-balanced at specified speed to insure smooth, operation.
 - 1. Variable volume fan assemblies will be balanced from 10% to 100% of design RPM.
 - 2. Filter-in measurements will be taken in horizontal and vertical axes on drive and opposite-drive sides of fan shafts.
 - 3. Variable speed fan vibration limits: filter -in measurements will not exceed 7 mils.
- B. Unit wiring with voltage greater than 30VAC will be hipot tested prior to shipping.

PART 3 - EXECUTION

3.1 SUPERVISION OF INSTALLATION

- A. After the mechanical contractor has received the units on site, the AHU manufacturer's authorized technician shall inspect the units for proper storage, check for damage, and complete initial inspection report to be submitted to the engineer. The installing contractor shall coordinate this site visit with the AHU manufacturer.
- B. The manufacturer's factory trained and authorized technician shall supervise the work performed by the installing contractor during the rigging and assembly of the unit (s). All

tools and labor, shall be provided by the installing contractor.

- C. Once the contractor has set the units in place, the AHU authorized technician shall provide onsite installation specific instructions to the contractor regarding piping, electrical, ductwork, and field control wiring connections to the unit. The AHU authorized technician shall approve any and all field penetrations to the units, if required. Upon completion of this inspection, the AHU manufacturer representative shall complete an inspection report to be submitted to the engineer. The mechanical contractor shall coordinate this site visit with the AHU service company.
- D. The Mechanical Contractor shall verify that the following items have been completed prior to scheduling the AHU Manufacturer's final inspection and start up. In addition to items listed below, please complete manufacturer's AHU Pre Start-Up Checklist and submit a copy to engineer a minimum of two weeks prior to scheduled start-up:
1. All spring-isolated components have had their shipping restraints removed and the components have been leveled.
 2. All water piping connections have been completed and hydrostatically tested and all waterflow rates have been set in accordance with the capacities scheduled on the Drawings.
 3. All ductwork connections have been completed and all ductwork has been pressure tested for its intended service.
 4. All power wiring, including motor starters and disconnects, serving the unit has been completed.
 5. Power is available to the unit and within unit manufacturers tolerances.
 6. All automatic temperature and safety controls have been completed.
 7. All dampers are fully operational.
 8. All shipping materials have been removed.
 9. All (clean) filter media has been installed in the units.
 10. Remove all foreign loose material in ductwork leading to and from the unit and in the unit itself.
 11. Condensate drains have been connected and trapped properly.
 12. All internal demount wiring has been completed.
 13. There is free movement of rotating components and this has been confirmed by hand rotation.
 14. Individual Fan hub screws have been checked for tightness.
 15. Bearing set screws have been checked for tightness.

3.2 INSTALLATION

A. General

1. Contractor to install air handling units where indicated on the drawings in full accordance with equipment manufacturer's installation instructions and as follows:
2. Access: Provide access space around units for service as indicated on the drawings, but in no case less than recommended by the equipment manufacturer.

3. Electrical: Install electrical devices furnished by unit manufacturer but not specified to be factory-mounted. Verify that electrical wiring installation is complete and in accordance with manufacturer's submittal and installation requirements of Division 26 sections.
4. Piping: Provide piping, valves, accessories, gauges, and supports as indicated on the drawings. Trap unit drain pans according to manufacturer's recommendations and extend condensate line to nearest drain. For indoor units, provide a concrete pad of adequate height (minimum 6") to allow for proper installation of condensate drain trap above the finished floor.
5. Duct Connections: Provide ductwork, accessories, and flexible connections as required.

3.3 USER TRAINING

- A. The manufacturer shall provide a minimum of 8 hours of training on the proper operation and maintenance of the units. The operator training shall be videotaped by the manufacturer's agent, and a copy provided to the Owner's representative as a training reference.

3.4 FINAL CLEANING

- A. Prior to acceptance by the owner, the contractor shall thoroughly clean the outside and particularly the inside of each air handling unit. Industrial grade cleaners can be used to remove construction dust. Any sheet metal mil finish or grease can be removed with Freon TF solvent fluorocarbon. All proposed cleaning materials shall have contents identified and approved prior to use.

3.5 ENVIRONMENTAL REQUIREMENTS

- A. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

3.6 EXTRA MATERIALS

- A. Provide four extra set(s) of fan belts, filters, etc. for each unit as shown on project schedule.

END OF SECTION 237300

SECTION 238120 – 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 23, Section “Mechanical and Electrical General Provisions” shall apply to the work specified under this section.
- C. As part of the contract, TMI, the manufacturer of the existing Discovery One vivarium air handling unit (AHU-V-1) and laboratory air handling unit (AHU-L-3), shall verify proper installation of the existing Air Handling Units and perform factory system check test and start up.

1.3 QUALITY ASSURANCE

- A. All building heating and air conditioning systems shall meet the mandatory provisions for HVAC performance as documented in ASHRAE 90.1-2007 Section 6.4. The minimum system component efficiency requirements listed in ASHRAE 90.1-2007 Tables 6.8.1A-G must be met.

1.4 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.

PART 2 - PRODUCTS

2.1 FAN COIL UNIT FCU-1

- A. The precision fan coil units shall be a self-contained chilled water unit with a high sensible cooling system, factory assembled, piped, wired, and run tested prior to shipment. The system shall be specifically designed for ceiling-mounted installation and have a total cooling capacity as scheduled on the contract documents. Net capacities shall include losses due to fan motor heat. Standard 60 Hz units shall be CSA (NRTL-C) certified. The system shall be designed for draw through air arrangement to insure even air distribution to the entire face of the coil, and be ETL listed.
- B. The precision fan coil units shall be Liebert MinMate2, Data Aire or equal.
- C. Quality Assurance
 1. Submittals shall be provided with the proposal and shall include: Single-Line Diagrams; Dimensional, Electrical and Capacity data; Piping and Electrical Connection Drawings.
 2. The specified system shall be factory tested before shipment. Testing shall include, but shall not be limited to Quality Control Checks, “HiPot” Test (two times rated voltage plus 1000 volts, per NRTL agency requirements) and Metering Calibration Tests. The manufacturer shall be ISO 9001 certified.
- D. Evaporator Cabinet Construction
 1. The cabinet and chassis shall be constructed of heavy gauge galvanized steel, and shall be serviceable from one side. Mounting brackets shall be factory-attached to the cabinet. Internal cabinet insulation shall meet ASHRAE 62.1 requirements for Mold Growth, Humidity & Erosion, tested per UL 181 and ASTM 1338 standards.
- E. Air Distribution
 1. The air distribution system shall be constructed with a quiet, direct-drive fan assembly equipped with double-inlet blower, self-aligning ball bearings and lifetime lubrication. Fan motor shall be permanent-split capacitor, high-efficiency type, equipped with two speeds for airflow modulation. Dehumidification shall utilize the lower fan speed. System shall be suitable for plenum or ducted air distribution.
- F. Microprocessor Control

1. The control system shall be microprocessor-based, factory-wired into the system and tested prior to shipment. The wall-mounted control enclosure shall include a 2-line by 16-character LCD providing continuous display of operating status and alarm condition. An 8-key membrane keypad for setpoint/program control, fan speed selection and unit On/Off shall be located below the display. The control display shall be field-wired to the control board using 4-conductor field-supplied thermostat wire. Temperature and humidity sensors shall be located in the wall box, which shall be capable of being located up to 300 ft from the evaporator unit.
2. Monitoring
 - a. The LCD shall provide On/Off indication, operating mode indication (cooling, heating, humidifying, dehumidifying), fan speed indication and current day, time, temperature and humidity (if applicable) indication. The monitoring system shall be capable of relaying unit operating parameters and alarms to the Liebert SiteScan monitoring system.
 - b. Control Setpoint Parameters
 - 1) Temp. Setpoint 65-85°F (18-29°C)
 - 2) Temp. Sensitivity 1-9.9°F (1-5°C)
 - 3) Humidity Setpoint 20-80% RH
 - 4) Humidity Sensitivity 1-30% RH
3. Unit Controls
 - a. Compressor Short-Cycle Control
 - 1) The control system shall prevent compressor short-cycling by a 3-minute timer from compressor stop to the next start.
 - b. Common Alarm and Remote On/Off
 - 1) A common alarm relay shall provide a contact closure to a remote alarm device. Two (2) terminals shall also be provided for remote On/Off control. Individual alarms shall be “enabled” or “disabled” from reporting to the common alarm.
 - c. Setback Control
 - 1) The control shall be user-configurable to use a manual setpoint control or a programmable, time-based setback control. The setback control will be based on a 5 day/2 day programmed weekly schedule with capability of accepting 2 events per program day.
 - d. Temperature Calibration
 - 1) The control shall include the capabilities to calibrate the temperature and humidity sensors and adjust the sensor response delay time from 0 to 90 seconds. The control shall be capable of displaying temperature

values in °F or °C.

e. System Auto Restart

- 1) For startup after power failure, the system shall provide automatic restart with a programmable (up to 9.9 minutes in 6-second increments) time delay. Programming can be performed either at the wall-mounted controller or from the central, site-monitoring system.

G. Alarms

1. Unit Alarm

- a. The control system shall monitor unit operation and activate an audible and visual alarm in the event of the following factory preset alarm conditions:

- 1) High Temperature
- 2) Low Temperature
- 3) High Humidity
- 4) Low Humidity
- 5) High Water Alarm - Lockout Unit Operation
- 6) High Head Pressure
- 7) Loss of Power
- 8) Compressor Short Cycle

b. Custom Alarms (2x)

- 1) Humidifier Problem
- 2) Filter Clog
- 3) Water Detected
- 4) Smoke Detected
- 5) Custom Alarm (1)
- 6) Custom Alarm (2)
- 7) User-customized text shall be able to be entered for the two (2) custom alarms.

2. Alarm Controls

- a. Each alarm (unit and custom) shall be separately enabled or disabled, selected to activate the common alarm (except for high head pressure).

3. Audible Alarm

- a. The audible alarm shall annunciate any alarm that is enabled by the operator.

4. Common Alarm

- a. A programmable common alarm shall be provided to interface user selected alarms with a remote alarm device.
5. Remote Monitoring
 - a. All alarms shall be communicated to the Liebert site monitoring system with the following information: date and time of occurrence, unit number, and present temperature and humidity.
- H. Chilled Water Control Valve
 1. The control valve shall be a motorized, slow-close on/off type to reduce water hammer. Design pressure shall be 300 psig static pressure, with a maximum close-off pressure of 60 psig. Valve shall be non-spring return.
- I. Chilled Water Coil
 1. The cooling coil shall have a minimum of 3.1 sq.ft. face area, 3 rows deep. It shall be constructed of copper tubes and aluminum fins and have a maximum face velocity of 390 fpm at 1250 CFM. The coil shall be supplied with 42°F entering water temperature, with a 14°F temperature rise. The coil assembly shall be mounted in a stainless steel condensate drain pan.
- J. Disconnect Switch, Non-Locking
 1. The non-automatic, non-locking, molded case circuit interrupter shall be factory mounted in the high-voltage section of the electrical panel. The switch handle shall be accessible from the front of the indoor unit.
- K. High-Temperature Sensor
 1. The high-temperature sensor shall immediately shut down the system when high temperatures are detected. The high-temperature sensor shall be mounted with the sensing element in the return air.
- L. Smoke Sensor
 1. The smoke detector shall immediately shut down the environmental control system and activate the alarm system when activated. The sensing element shall be located in the return air compartment. This smoke sensor shall not function or replace any room smoke detection system that may be required by local or national codes.
- M. Filter Clog Switch
 1. The filter clog switch senses pressure drop across the filters and shall annunciate the wall box display upon exceeding the adjustable setpoint.

N. Condensate Pump

1. The condensate pump shall have the capacity of 3 GPH at 5 ft. head. It shall be complete with integral float switch, pump, motor assembly and reservoir.

O. Liebert SiteScan® Site Monitoring System

1. A Liebert SiteScan Site Monitoring System shall be provided for remote monitoring of the Liebert DataMate unit and monitoring of other Liebert support equipment. The Liebert SiteScan shall have the capability to monitor and change (at the user direction) the temperature and humidity setpoints and sensitivities of each unit. The printer shall provide the user with chronological alarm information. It shall also be capable of being programmed to print out environmental conditions or operating modes at each unit.

P. Warranty

1. All product parts shall be warranted to be free of defects in material and workmanship for a period of two (2) years from the date of Substantial Completion..

2.2 HOT WATER REHEAT COILS

- A. Coils shall be Aerofin Type "MP" or approved equal, of the capacity and size scheduled.
- B. Tubes shall be 5/8 inch outside diameter copper tubing with helically wound, permanently bonded, aluminum fins. Casing shall be galvanized steel with punched flanges for duct connections. Water connections shall be brass with female threads. All joints shall be high temperature brazed. Provide air vent and drain tapping.
- C. Coils shall be air tested under water at 250 pounds per square inch gauge and shall be guaranteed for 200 pounds per square inch gauge working pressure. Coils shall be certified in accordance with ARI Standard 410-91.
- D. Coils shall be same end connection and shall be circuited to achieve to pressure drops scheduled.

PART 3 - EXECUTION

3.1 GENERAL

- A. General: The Contractor shall provide and install equipment, including components and controls required for operation, in accordance with manufacturer's written instructions and recommendations. Floor mounted equipment shall be installed on a concrete equipment housekeeping pad with vibration isolators as specified. The Contractor shall coordinate concrete pad requirements with the selected equipment.

- B. Location: Equipment shall be installed in general position indicated on the drawings. Provide shop drawings indicating requirements for the proper positioning of the equipment with sufficient clearance for normal service and maintenance (as suggested by the equipment manufacturer).

3.2 TESTING

- A. Verification: The Contractor shall perform manufacturer's recommended field verification tests for the equipment. Refer to Division 23 Section "Testing and Balancing". The purpose of the test is to demonstrate compliance with the submitted performance data and the factory test. Report all field test data reports to the Owner and Architect.

END OF SECTION 238120

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. IISCO; a branch of Barden 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 Crawlspace: 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 Crawlspace: 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 torque-tightening 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. Conductor Terminations and Connections:
 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 2. 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. 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.
- 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 slotted support 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.

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.

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. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
 - 6. 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 surface raceways only where indicated on Drawings.
- F. 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 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. Warning labels and signs.
 - 5. Instruction signs.
 - 6. Equipment identification labels.
 - 7. 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.

2.5 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."

2.6 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.

2.7 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.

2.8 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.

2.9 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.

PART 3 - EXECUTION

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 trench exceeds 16 inches overall.

3.2 IDENTIFICATION SCHEDULE

- A. 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.

- B. 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.
- C. Power-Circuit Conductor Identification, More than 600 V: For conductors in vaults, pull and junction boxes, manholes, and handholes, use write-on tags.
- D. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.
- E. 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.
- F. Control-Circuit Conductor Termination Identification: For identification at terminations provide self-adhesive vinyl labels with the conductor designation.
- G. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source.
- H. 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.

- I. 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.

- J. 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.

- K. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive 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.

- L. 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 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.
 - 3. Electronic Grade 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.
7. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories for surge protection devices.

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. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- G. 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. [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, 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 ELECTRONIC GRADE PANELBOARDS

- A. Electronic grade panelboards shall have all the features and requirements of sections 2.1, 2.2 and 2.3 above.
- B. Electrical Requirements:
 1. Unit operating voltage. The nominal unit operating voltage and configuration shall be as indicated on the drawings.

2. Maximum continuous operating voltage (MCOV). The maximum continuous operating voltage (MCOV) of all suppression components utilized in the unit shall not be less than 125 percent of the facility's nominal operating voltage for 120 volt nominal systems.
3. Operating frequency. The operating frequency range of the unit shall be 47 to 63 hertz.
4. Protection modes. The unit's primary mode of protection shall be line-to-neutral (wye-configured systems). The secondary modes of protection shall be line-to-ground and neutral-to-ground.
5. Maximum repetitive surge current capacity. Based on ANSI/IEEE-C62.41 standard 8 x 20 microsecond current waveform, the maximum repetitive surge current capacity, in amps, of the unit shall be no less than as follows.

<u>Mode of Protection</u>	<u>L-N</u>	<u>L-G</u>	<u>N-G</u>
Maximum Repetitive Surge Current Capacity per Phase	50,000	50,000	50,000

6. Performance ratings. The unit's published performance ratings shall be the UL-1449 listed suppression rating. The UL-1449 suppression ratings shall be, for each mode of protection, as follows:

<u>UL-1449 Suppression Rating</u>			
<u>Voltage</u>	<u>L-N</u>	<u>L-G</u>	<u>N-G</u>
120/208	400	400	400

7. Life expectancy testing. The unit shall be capable of protecting against and surviving at least 1,250 ANSI/IEEE-C62.41 Category-C surges without failing or degrading the UL-1449 Surge Suppression Rating by more than 10 percent.

C. The surge suppressor shall be factory mounted in the panelboard by the manufacturer.

2.5 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.

PART 3 - EXECUTION

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-inch empty 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. Twist-locking receptacles.
 - 3. Snap switches.
 - 4. Floor service outlets.
 - 5. Multi-outlet assemblies.

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' packing-label 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. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; CWL520R.
 - b. Hubbell; HBL2310.
 - c. Leviton; 2310.
 - d. Pass & Seymour; L520-R.

2.6 POKE-THROUGH ASSEMBLIES

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Hubbell Incorporated; Wiring Device-Kellems.
2. Pass & Seymour/Legrand.
3. Square D/Schneider Electric.
4. Thomas & Betts Corporation.
5. Wiremold/Legrand.

B. Description:

1. Factory-fabricated and -wired assembly of below-floor junction box with multichanneled, through-floor raceway/firestop unit and detachable matching floor service-outlet assembly.

2. Comply with UL 514 scrub water exclusion requirements.
3. Service-Outlet Assembly: Flush type with two duplex receptacles and space for two RJ-45 jacks complying with requirements of USC standard Hubbell, HXJ6GN, Xceleraor, Category 6 jack. Quantities unless otherwise noted on drawings.
4. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.

C. See drawings for specific catalog numbers.

2.7 PREFABRICATED MULTIOUTLET ASSEMBLIES

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. [Hubbell Incorporated; Wiring Device-Kellems.](#)
2. [Wiremold/Legrand.](#)

B. Description:

1. Two-piece surface metal raceway.
2. Components shall be products from single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.

C. Raceway Material: Metal, with manufacturer's standard grey finish.

D. Multioutlet raceway:

1. Receptacles: 15-A, 125-V, NEMA WD 6 Configuration 5-15R receptacles complying with NEMA WD 1, UL 498, and FS W-C-596.
2. Receptacle Spacing: **12 inches (300 mm)**.

2.8 TOGGLE SWITCHES

A. Comply with NEMA WD 1, UL 20, and FS W-S-896.

B. Switches, 120/277 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:

- 1) [Single Pole:](#)
 - a) [Cooper; AH1221.](#)
 - b) [Hubbell; HBL1221.](#)
 - c) [Leviton; 1221-2.](#)
 - d) [Pass & Seymour; CSB20AC1.](#)

- 2) [Three Way:](#)
 - a) [Cooper; AH1223.](#)

- b) [Hubbell; HBL1223.](#)
 - c) [Leviton; 1223-2.](#)
 - d) [Pass & Seymour; CSB20AC3.](#)
- 3) [Four Way:](#)
- a) [Cooper; AH1224.](#)
 - b) [Hubbell; HBL1224.](#)
 - c) [Leviton; 1224-2.](#)
 - d) [Pass & Seymour; CSB20AC4.](#)

2.9 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).

2.10 FINISHES

- A. Device Color:
 - 1. Wiring Devices Connected to Normal Power System: grey unless otherwise indicated or required by NFPA 70 or device listing.
 - 2. Wiring Devices Connected to Emergency Power System: red 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper Bussmann, Inc.
 - 2. Edison Fuse, Inc.
 - 3. Ferraz Shawmut, Inc.
 - 4. Littelfuse, Inc.

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.

END OF SECTION 262813

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. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 3. Siemens Energy & Automation, Inc.
 4. Square D; a brand of Schneider Electric.
- 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. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

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. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

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 262913 - ENCLOSED CONTROLLERS

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 the following enclosed controllers rated 600 V and less:
 - 1. Full-voltage manual.
 - 2. Full-voltage magnetic.
- B. Related Section:
 - 1. Section 230550 "Variable-Frequency Motor Controllers" for general-purpose, ac, adjustable-frequency, pulse-width-modulated controllers for use on variable torque loads in ranges up to 200 hp.

1.3 DEFINITIONS

- A. CPT: Control power transformer.
- B. MCCB: Molded-case circuit breaker.
- C. MCP: Motor circuit protector.
- D. N.C.: Normally closed.
- E. N.O.: Normally open.
- F. OCPD: Overcurrent protective device.
- G. SCR: Silicon-controlled rectifier.

1.4 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Enclosed controllers 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 controller. Include manufacturer's technical data on features, performance, electrical characteristics, ratings, and enclosure types and finishes.
- B. Shop Drawings: For each enclosed controller. Include dimensioned plans, elevations, sections, details, and required clearances and service spaces around controller enclosures.
 1. Show tabulations of the following:
 - a. Each installed unit's type and details.
 - b. Factory-installed devices.
 - c. Nameplate legends.
 - d. Short-circuit current rating of integrated unit.
 - e. Listed and labeled for integrated short-circuit current (withstand) rating of OCPDs in combination controllers by an NRTL acceptable to authorities having jurisdiction.
 - f. Features, characteristics, ratings, and factory settings of individual OCPDs in combination controllers.
 2. 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 controllers, 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.
- D. Load-Current and Overload-Relay Heater List: Compile after motors have been installed, and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.

- E. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed, and arrange to demonstrate that switch settings for motor running overload protection suit actual motors to be protected.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For enclosed controllers 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 enclosed controllers and installed components.
 - 2. Manufacturer's written instructions for testing and adjusting circuit breaker and MCP trip settings.
 - 3. Manufacturer's written instructions for setting field-adjustable overload relays.
 - 4. Manufacturer's written instructions for testing, adjusting, and reprogramming reduced-voltage solid-state controllers.

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. 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 NFPA 70.
- D. IEEE Compliance: Fabricate and test enclosed controllers according to IEEE 344 to withstand seismic forces defined in Section 260548 "Vibration and Seismic Controls for Electrical Systems."

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Store enclosed controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect enclosed controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.

1.10 COORDINATION

- A. Coordinate layout and installation of enclosed controllers with other construction including conduit, piping, equipment, 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 anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.
- C. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

PART 2 - PRODUCTS

2.1 FULL-VOLTAGE CONTROLLERS

- A. General Requirements for Full-Voltage Controllers: Comply with NEMA ICS 2, general purpose, Class A.
- B. Motor-Starting Switches: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off or on.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [Eaton Electrical Inc.; Cutler-Hammer Business Unit.](#)
 - b. [General Electric Company; GE Consumer & Industrial - Electrical Distribution.](#)
 - c. [Rockwell Automation, Inc.; Allen-Bradley brand.](#)
 - d. [Siemens Energy & Automation, Inc.](#)
 - e. [Square D; a brand of Schneider Electric.](#)
 - 2. Configuration: Nonreversing.
 - 3. Surface mounting.
 - 4. Red pilot light.
- C. Fractional Horsepower Manual Controllers: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off, on, or tripped.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [Eaton Electrical Inc.; Cutler-Hammer Business Unit.](#)
 - b. [General Electric Company; GE Consumer & Industrial - Electrical Distribution.](#)
 - c. [Rockwell Automation, Inc.; Allen-Bradley brand.](#)
 - d. [Siemens Energy & Automation, Inc.](#)
 - e. [Square D; a brand of Schneider Electric.](#)
 - 2. Configuration: Nonreversing.
 - 3. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, Class 10 tripping characteristics; heaters matched to nameplate full-load current of actual protected motor; external reset push button; bimetallic type.
 - 4. Surface mounting.

5. Red pilot light.
- D. Combination Magnetic Controller: Factory-assembled combination of magnetic controller, OCPD, and disconnecting means.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [Eaton Electrical Inc.; Cutler-Hammer Business Unit.](#)
 - b. [General Electric Company; GE Consumer & Industrial - Electrical Distribution.](#)
 - c. [Rockwell Automation, Inc.; Allen-Bradley brand.](#)
 - d. [Siemens Energy & Automation, Inc.](#)
 - e. [Square D; a brand of Schneider Electric.](#)
 2. Fusible Disconnecting Means:
 - a. NEMA KS 1, heavy-duty, horsepower-rated, fusible switch with clips or bolt pads to accommodate indicated fuses.
 - b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
 3. Auxiliary Contacts: N.O./N.C., arranged to activate before switch blades open.

2.2 ENCLOSURES

- A. Enclosed Controllers: NEMA ICS 6, to comply with environmental conditions at installed location.
1. Dry and Clean Indoor Locations: Type 1.
 2. Outdoor Locations: Type 3R.

2.3 ACCESSORIES

- A. General Requirements for Control Circuit and Pilot Devices: NEMA ICS 5; factory installed in controller enclosure cover unless otherwise indicated.
1. Push Buttons, Pilot Lights, and Selector Switches: Heavy-duty type.
 - a. Push Buttons: Shielded types; maintained as indicated.
 - b. Pilot Lights: LED types; colors as indicated; push to test.
 - c. Selector Switches: Rotary type.
- B. N.C. or N.O. auxiliary contact(s) as required for building automation system.
- C. Control Relays: Auxiliary and adjustable solid-state time-delay relays.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and surfaces to receive enclosed controllers, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
- B. Examine enclosed controllers before installation. Reject enclosed controllers that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Wall-Mounted Controllers: Install enclosed controllers on walls with tops at uniform height unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Section 260529 "Hangers and Supports for Electrical Systems."
- B. Seismic Bracing: Comply with requirements specified in Section 260548 "Vibration and Seismic Controls for Electrical Systems."
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- D. Install fuses in each fusible-switch enclosed controller.
- E. Install fuses in control circuits if not factory installed. Comply with requirements in Section 262813 "Fuses."
- F. Comply with NECA 1.

3.3 IDENTIFICATION

- A. Identify enclosed controllers, components, and control wiring. Comply with requirements for identification specified 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 nameplate.
 - 3. Label each enclosure-mounted control and pilot device.

3.4 CONTROL WIRING INSTALLATION

- A. Install wiring between enclosed controllers and remote devices and facility's central control system.
- B. Bundle, train, and support wiring in enclosures.
- C. Connect selector switches and other automatic-control selection devices where applicable.
 - 1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switch is in manual-control position.
 - 2. Connect selector switches with enclosed-controller circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.5 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 enclosed controller, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- D. Tests and Inspections:
 - 1. Inspect controllers, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
 - 2. Test insulation resistance for each enclosed-controller element, component, connecting motor supply, feeder, and control circuits.
 - 3. Test continuity of each circuit.
 - 4. Verify that voltages at controller locations are within plus or minus 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Construction Manager before starting the motor(s).
 - 5. Test each motor for proper phase rotation.
 - 6. Perform each electrical test and visual and mechanical inspection stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

8. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

E. Enclosed controllers will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports including a certified report that identifies enclosed controllers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 ADJUSTING

A. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.

B. Adjust overload-relay heaters or settings if power factor correction capacitors are connected to the load side of the overload relays.

3.7 PROTECTION

A. Replace controllers whose interiors have been exposed to water or other liquids prior to Substantial Completion.

END OF SECTION 262913

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. Indoor occupancy sensors.
 - 5. Emergency Shunt Relays.
 - 6. Building Lighting Control Panel

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 INDOOR OCCUPANCY SENSORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. [Cooper Industries, Inc.](#)
2. [Hubbell Building Automation, Inc.](#)
3. [Leviton Mfg. Company Inc.](#)
4. [Lightolier Controls.](#)
5. [Lithonia Lighting; Acuity Lighting Group, Inc.](#)
6. [Lutron Electronics Co., Inc.](#)
7. [NSi Industries LLC; TORK Products.](#)
8. [Sensor Switch, Inc.](#)
9. [Square D; a brand of Schneider Electric.](#)
10. [Watt Stopper.](#)

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.

2.11 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. [Watt Stopper.](#)
- 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.

2.12 BUILDING LIGHTING CONTROL PANEL

- A. The building lighting control panels are existing to remain by Watt Stopper.
- B. Contractor to provide programming necessary to accommodate the renovations.
- C. Engage a factory-authorized service representative to re-train Owner's maintenance personnel to adjust, operate, and maintain the existing panels.

PART 3 - EXECUTION

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 nonpower-limited 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 including the existing Watt Stopper panels.

END OF SECTION 265100

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.
 - 2. J-Hook cable support systems.

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. [Allied Tube & Conduit; a Tyco International Ltd. Co.](#)
 2. [Cablofil/Legrande.](#)
 3. [Chalfant Manufacturing Company.](#)
 4. [Cooper B-Line, Inc.](#)
 5. [Enduro Systems, Inc.](#)
 6. [Mono-Systems, Inc.](#)
 7. [MP Husky.](#)
 8. [Niedax-Kleinhuis USA, Inc.](#)

9. [Snake tray.](#)
10. [Wiremaid Products Division; Vutec Corporation.](#)

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-inch usable 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 J-HOOK CABLE SUPPORT SYSTEM

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 1. [Allied Tube & Conduit; a Tyco International Ltd. Co.](#)
 2. [Cablofil/Legrande.](#)
 3. [Chalfant Manufacturing Company.](#)
 4. [Cooper B-Line, Inc.](#)
 5. [Enduro Systems, Inc.](#)
 6. ERICO Caddy
 7. [Mono-Systems, Inc.](#)
 8. [MP Husky.](#)
 9. [Niedax-Kleinhuis USA, Inc.](#)

10. [Snaketray.](#)
11. [Wiremaid Products Division; Vutec Corporation.](#)

B. Description

1. Configuration: 2” wall mounted.
2. Materials: J-hooks shall be galvanized steel. Provide wall mounting bracket of same material.

2.6 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."

2.7 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 J-HOOK CABLE SUPPORT SYSTEM

- A. Follow manufacturer's recommendation for wall mounting.

3.4 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.

3.5 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 retorqued 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. Manual fire-alarm boxes.
 - 2. System smoke detectors.
 - 3. Heat detectors.
 - 4. Notification appliances.
 - 5. Addressable interface device.

1.3 DEFINITIONS

- A. LED: Light-emitting diode.
- B. NICET: National Institute for Certification in Engineering Technologies.

1.4 SYSTEM DESCRIPTION

- A. Provide an extension of the existing moncoded, UL-certified addressable system, with multiplexed signal transmission, dedicated to fire-alarm service only.

1.5 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.

1.6 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.

1.7 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.

1.8 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.

1.9 PROJECT CONDITIONS

- A. Interruption of Existing Fire-Alarm Service: Do not interrupt fire-alarm service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary guard service according to requirements indicated:
 1. Notify Construction Manager and Owner no fewer than seven days in advance of proposed interruption of fire-alarm service.
 2. Do not proceed with interruption of fire-alarm service without Construction Manager's and Owner's written permission.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. SimplexGrinnell LP; a Tyco International 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. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
 7. Close smoke dampers in air ducts of designated air-conditioning duct systems.
 8. Recall elevators to primary or alternate recall floors.
 9. 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. The control unit is existing to remain and shall continue to function as it currently functions.

B. 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.

- C. All fire alarm circuits shall be installed in raceway. See Section 260533 "Raceways and Boxes for Electrical Systems" for installation details.

- D. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.

1. Batteries: Existing to remain, verify that additional devices will comply with NFPA 72 requirement.

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 power-on 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 single-mounting assembly, equipped for mounting as indicated and with screw terminals for system connections.

- B. Chimes, Low-Level Output: Vibrating type, 75-dBA minimum rated output.
- 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.

2.8 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.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

- A. Comply with NFPA 72 for installation of fire-alarm equipment.
- B. Connecting to Existing Equipment: Verify that existing fire-alarm system is operational before making changes or connections.
 - 1. Connect new equipment to existing control panel in existing part of the building.
 - 2. Connect new equipment to existing monitoring equipment at the supervising station.
 - 3. Expand, modify, and supplement existing control and monitoring equipment as necessary to extend existing control and monitoring functions to the new points. New components shall be capable of merging with existing configuration without degrading the performance of either system.
- 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 A in NFPA 72.
 5. HVAC: Locate detectors not closer than **3 feet (1 m)** from air-supply diffuser or return-air 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. Remote Status and Alarm Indicators: Install near each smoke detector and each sprinkler water-flow switch and valve-tamper switch that is not readily visible from normal viewing position.
- F. 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.
- G. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least **6 inches (150 mm)** below the ceiling.
- H. Device Location-Indicating Lights: Locate in public space near the device they monitor.

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