

Project Manual

for

2017 SET Laboratory Renovation - Garni

for

St. Mary's University

Volume 1 – Divisions 00 – 33

March 17, 2017

PBK Project No.: 1760

ISSUE FOR CONSTRUCTION



Architecture
Engineering
Planning
Technology
Facility Consulting

601 NW Loop 410, Suite 400
San Antonio, Texas 78216
(210) 829-0123
FAX (210) 829-0578

Board of Trustees

Thomas Mengler, J.D.	President
Aaron Tyler, PhD	Provost and V.P. for Academic Affairs
Rebeckah Day	V.P. for Administration and Finance
Rev. Timothy Eden, S.M., EdD	V.P. for Mission
Richard Kimbrough	V.P. for University Advancement
Curtis White	V.P. for Information Services (CIO)
Tylor Behrens, EdD	Assoc. V.P. for Career Services
Leona Pallansch, PhD	V.P. for Academic Affairs
Rosalind Alderman, PhD	V.P. for Enrollment Management
Tim Bessler, EdD	V.P. for Student Development and Dean of Students
Bill Buhrman, PhD	Assistant Provost for Academic Operations

OWNER

St. Mary's University
One Camino Santa Maria
San Antonio, TX 78228

<u>ARCHITECT</u> PBK Architects 601 NW Loop 410, Suite 400 San Antonio, TX 78216 p: 210-829-0123	<u>STRUCTURAL</u> Intelligent Engineering Services Union Square II 10001 Reunion Place, Ste. 200 San Antonio, TX 78216 p: 210-349-9098	<u>MEP ENGINEER</u> PBK Architects 601 NW Loop 410, Suite 400 San Antonio, TX 78216 p: 210-829-0123
---	--	--



PROJECT MANUAL TABLE OF CONTENTS

TABLE OF CONTENTS

Project Manual Table of Contents A

PROJECT MANUAL SEALS

Project Manual Seals Page

DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS

00 73 00 Supplementary Conditions A

DIVISION 01 – GENERAL REQUIREMENTS

01 11 00 Summary of Work A
01 25 13 Product Substitution Procedures A
01 26 00 Contract Modification Procedures A
01 29 00 Payment Procedures A
01 29 73 Schedule of Values A
01 31 13 Project Coordination A
01 31 19 Project Meetings A
01 32 16 Construction Progress Schedule A
01 33 00 Submittal Procedures A
01 35 16 Alteration Project Procedures A
01 40 00 Quality Requirements A
01 41 00 Regulatory Requirements A
01 45 00 Quality Control A
01 45 23 Testing and Inspecting Service A
01 50 00 Temporary Facilities and Controls A
01 60 00 Product Requirements A
01 71 23 Field Engineering A
01 73 00 Execution A
01 73 29 Cutting and Patching A
01 74 19 Construction Waste Management and Disposal A
01 77 00 Closeout Procedures A
01 78 39 Project Record Documents A
01 81 13 Sustainable Design Requirements A

DIVISION 02 – EXISTING CONDITIONS

02 41 00 Demolition A

DIVISION 03 – CONCRETE

03 54 00 Cast Underlayment A

DIVISION 04 – MASONRY *(Not Used)*

DIVISION 05 – METALS

05 77 00 Decorative Extruded Metal A

DIVISION 06 – WOOD PLASTICS, AND COMPOSITES

06 10 00 Rough Carpentry A

06 20 00 Finish Carpentry A

DIVISION 07 – THERMAL AND MOISTURE PROTECTION

07 52 19 Modified Bitumen Membrane Roofing System A

07 62 00 Roof Related Sheet Metal A

07 72 00 Roof Accessories A

07 81 23 Intumescent Fireproofing A

07 84 00 Firestopping A

DIVISION 08 – OPENINGS *(Not Used)*

08 80 00 Glazing A

DIVISION 09 – FINISHES

09 21 16 Gypsum Board Assemblies A

09 51 00 Acoustical Ceilings A

09 65 13 Resilient Base and Accessories A

09 65 16 Resilient Sheet Flooring A

09 65 19.23 Vinyl Tile Flooring A

09 90 00 Painting and Coating A

DIVISION 10 – SPECIALTIES

10 11 00 Visual Display Units A

10 44 00 Fire Protection Specialties A

DIVISION 11 – EQUIPMENT

11 53 13 Laboratory Fume Hoods A

DIVISION 12 – FURNISHINGS

12 24 13	Roller Window Shades	A
12 35 53	Laboratory Casework	A

DIVISION 13 – SPECIAL CONSTRUCTION *(Not Used)*

DIVISION 14 – CONVEYING EQUIPMENT *(Not Used)*

DIVISION 21 – FIRE SUPPRESSION *(Not Used)*

DIVISION 22 – PLUMBING

22 05 00	Common Work Results for Plumbing	P
22 05 16	Expansion Fittings and Loops for Plumbing Piping	P
22 05 29	Plumbing Hangers and Supports	P
22 11 16	Domestic Water Piping	P
22 11 23	Gas Piping	P
22 13 16	Sanitary Waste and Vent Piping	P
22 13 21	Acid Waste Vent Systems	P
22 40 00	Plumbing Fixtures	P
22 66 59	Laboratory Safety Device System	P

DIVISION 23 – HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)

23 01 30.51	HVAC Air Duct Cleaning	M
23 05 00	Common Work Results for HVAC	M
23 05 13	Common Motor Requirements for HVAC Equipment	M
23 05 14	Variable Frequency Drives	M
23 05 29	Hangers and Supports for HVAC Piping and Equipment	M
23 05 48	Vibration and Seismic Controls for HVAC Piping and Equipment	M
23 05 53	Identification for HVAC Piping and Equipment	M
23 05 93	Testing, Adjusting, and Balancing for HVAC	M
23 07 13	Duct Insulation	M
23 09 23	Direct Digital Controls	M
23 22 00	Condensate Piping	M
23 31 13	Metal Ducts	M
23 33 00	Air Duct Accessories	M
23 34 00	HVAC Fans	M
23 37 13	Diffusers, Registers, and Grilles	M
23 37 23	HVAC Gravity Ventilators	M

23 74 13	Packaged, Outdoor, Central-Station Air Handling Units	M
----------	---	---

DIVISION 26 – ELECTRICAL

26 05 00	Common Work Results for Electrical	E
26 05 19	Low-Voltage Electrical Power Conductors and Cables	E
26 05 26	Grounding and Bonding for Electrical Systems	E
26 05 29	Hangers and Support for Electrical Systems	E
26 05 33	Raceways and Boxes for Electrical Systems	E
26 05 53	Identification for Electrical Systems	E
26 09 23	Digital Lighting Control Devices	E
26 24 16	Electrical Panelboards	E
26 27 26	Wiring Devices	E
26 50 00	Interior Lighting	E

DIVISION 27 – COMMUNICATIONS *(Not Used)*

DIVISION 28 – ELECTRONIC SAFETY AND SECURITY *(Not Used)*



DIVISION 31 – EARTHWORK *(Not Used)*

DIVISION 32 – EXTERIOR IMPROVEMENTS *(Not Used)*

DIVISION 41 – MATERIAL PROCESSING AND HANDLING EQUIPMENT *(Not Used)*

END OF PROJECT MANUAL TABLE OF CONTENTS

Each specification section included herein is listed in the Project Manual Table of Contents with a letter code, indicated below, designating the Designer of Record responsible for its preparation, under whose seal and/or authority it is issued for the purpose(s) stated above. Seals and signatures do not apply to documents not included herein, nor (except as otherwise indicated) to documents prepared by the Owner or others ("O"), including but not necessarily limited to documents in Division 00, geotechnical and other reports, etc.

<p>Architect of Record ("A"): Cliff Whittingstall R.A. #18585</p>	<p>PBK Architects, Inc. 601 NW Loop 410, Suite 400 San Antonio, Texas 78216 p. 210-829-0123</p>	
<p>Engineer of Record, Mechanical, Electrical, & Plumbing ("M, E, P"): Mark Stehney P. E. #110329</p>	<p>PBK Architects 601 NW Loop 410, Suite 400 San Antonio, TX 78216 p: 210-829-0123</p>	

**SECTION 00 73 00
SUPPLEMENTARY CONDITIONS**

Supplement AIA Document A201, 2007 Edition as follows:

ARTICLE 1 - GENERAL CONDITIONS

1.1 BASIC DEFINITIONS

Revise the first sentence in Subparagraph 1.1.1 as follows:

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, the Conditions of the Contract (General, Supplementary, and other Conditions), Performance Bond, Labor and Material Payment Bond, the Drawings, the Specifications, all Addenda issued prior to execution of the Agreement and all Modifications issued after the execution of the Contract.

Add the following text to Subparagraph 1.1.3, THE WORK:

1.1.3 It also includes all supplies, skill, supervision, transportation services and other facilities and things necessary, proper or incidental to the carrying out and completion of the terms of the contract and all other items of cost or value needed to produce, construct and fully complete the public work identified by the Contract Documents.

Add the following Subparagraphs:

1.1.9 DESCRIPTION OF PARTIES

The following definitions apply to parties named in the Contract Documents.

1. Owner: St. Mary's University
Phone: _____ Fax: _____
2. Architect: PBK Architects
601 NW Loop 410, Suite 400
San Antonio, Texas 78216
Phone: (210) 829-0123
5. MEP Engineer: PBK
601 NW Loop 410, Suite 400
San Antonio, Texas 78216
Phone: (210) 829-0123
3. Structural Engineer: Intelligent Engineering Solutions
Union Square II
10001 Reunion Place, Ste. 200
San Antonio, TX 78216
Phone: (210) 349-9098

1.1.10 ADDENDA

Addenda are written or graphic instruments issued prior to the execution of the Contract, which modify or interpret the proposal documents, including Drawings and Specifications, by additions, deletions, clarifications or corrections. Addenda will become part of the Contract Documents when the Construction Agreement is executed.

1.1.11 APPROVED, APPROVED EQUAL, APPROVED EQUIVALENT, OR EQUAL

The terms Approved and Approved Equal relate to the substitution of materials, equipment or procedure approved in writing by the Architect prior to receipt of proposals.

1.1.12 ABBREVIATIONS

N.I.C. By Others; By Owner; Existing	Not in contract. Indicating work not to be done by this Contractor under this Agreement.
AIA	American Institute of Architects
ACI	American Concrete Institute
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
ASA	American Standards Association
ASTM	ASTM International
AWSC	American Welding Society Code
FS	Federal Specification
NEC	National Electrical Code
SPR	Simplified Practice Recommendation
UL	Underwriters Laboratories, Inc.

1.1.13 PROPOSAL DOCUMENTS

Proposal Documents consist of all documents bound into or referenced in the Project Manual, the Drawings, and Addenda related thereto. The Project Manual contains the Proposed Requirements, Sample Forms, Conditions of the Contract, the Specifications, and a list of Drawings, and Schedules, some of which are bound into the Project Manual (Other Drawings and Schedules are bound separately).

1.1.14 MISCELLANEOUS OTHER WORDS

Provide: Whenever the word "provide" is used in these documents, it shall mean the same as "furnish and install".

1.2 CORRELATION AND INTENT OF THE CONTRACT DOCUMENTS

Add the following Subparagraphs:

1.2.4 PRECEDENCE OF THE CONTRACT DOCUMENTS

The most recent issued Document takes precedence over previous issued forms of the same Document. The order of precedence is as follows with the highest authority listed first.

- .1 The Agreement
- .2 The Addenda

.3 Conditions of the Contract, Drawings, and Specifications shall have equal authority and are complementary documents. Should these documents disagree in themselves; the Architect will select the appropriate method for performing the work at no additional increase in the Contract Cost.

1.2.5 RELATION OF SPECIFICATIONS AND DRAWINGS

The Drawings and Specifications are correlative and have equal authority and priority. Should they disagree in themselves, or with each other, base the proposals on the most expensive combination of quality and quantity of work indicated. The appropriate method of performing the Work, in the event of the above mentioned disagreements, will be made by the Architect.

1.2.6 OPTIONAL MATERIALS, BRANDS AND PROCESSES

When more than one is specified for a particular item of Work, the choice shall be the Contractor's. The final selection of color and pattern will be made from the range available within the option selected by the Contractor, unless the item is specified to match a specific color or sample furnished. Where particular items are specified only products of those named manufacturers are acceptable. Certain specified construction and equipment details may not be regularly included as part of the named manufacturer's standard catalog equipment but shall be provided by the manufacturer as required for the proper functioning of the equipment. Reasonable minor variations in equipment are expected and will be acceptable; however, indicated and specified performance and material requirements are minimum, and will be required in addition to standard accessories. The Architect reserves the right to determine the equality of equipment and materials that deviate from any of the indicated and specified requirements.

Add Paragraph 1.7 and following Subparagraphs:

1.7 MISCELLANEOUS OTHER DEFINITIONS

1.7.1 ADDENDA, ADDENDUM

Documents issued by the Architect prior to execution of the Owner Contractor Agreement that modify or clarify the Proposal Documents. The addenda become a part of the Contract Documents

1.7.2 ALTERNATE PROPOSAL(S)

A separate amount stated on the Proposal Form which, if accepted by the Owner, will be added to or deducted from the Base Proposal. If accepted, the work that corresponds to the alternate proposal will become part of the Agreement between Owner and Contractor. Alternative proposals shall remain valid for a period of 30 days after receipt of proposals, regardless if an Owner Contractor Agreement has been executed, unless indicated otherwise herein.

1.7.3 BASE PROPOSAL

The Contractor's proposal for the Work, not including any Alternatives.

1.7.4 CONTRACT TIME

The period of time which is established in the Contract Documents for Substantial Completion of the Work.

1.7.5 DATE OF AGREEMENT

The date the Owner formally awards a Contract for Construction of the Work. This date will be inserted on the first page of the Agreement Between Owner and Contractor and shall be referenced in Performance Bond and Payment Bond forms. See also Date of Commencement of the Work.

1.7.6 DATE OF COMMENCEMENT OF THE WORK

The date that either (1) the fully executed Agreement Between Owner and contractor, or (2) a written Notice to Proceed is delivered to the Contractor. This date constitutes day zero ("0") of the stated Contract Time.

1.7.7 DATE OF FINAL COMPLETION

The end of construction. Refer Paragraph 9.10.

1.7.8 DATE OF SUBSTANTIAL COMPLETION

Refer Subparagraph 8.1.3 and Paragraph 9.8. Contractor shall be Substantially Complete by date stated in the Agreement.

1.7.9 DAY

The following days are referenced in the documents:

- .1 Calendar Days: The days of the Gregorian Calendar. The Contract Time is established in Calendar Days and extensions of time granted for Regular Work Days lost, if any, will be converted to Calendar Days.
- .2 Holidays: The days officially recognized by the construction industry in this area as a holiday; normally limited to the observance days of New Year's Day, Memorial Day, Fourth of July, Labor Day, Thanksgiving Day and the day after, and Christmas Day.
- .3 Regular Work Days: All calendar days except holidays, Saturdays, and Sundays. Requests for extensions of time shall be requested on the basis of Regular Work Days, and those days, if approved; will be converted to calendar days by multiplying by a factor of one and four-tenths (1.4).
- .4 Anticipated Weather Days: An allowance of Regular Work Days, established as probable days lost due to weather delays; said allowance to be included in the Contractor's proposed Completion Time on his Proposal Form.

San Antonio, Texas

Average Days of Precipitation, 0.01 Inches or More											
Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
11	8	9	7	9	9	9	9	9	7	8	9

Normal Monthly Precipitation, Inches											
Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
3.29	2.96	2.92	3.21	5.24	4.96	3.60	3.49	4.89	4.27	3.79	3.45

- .5 Weather Days: Regular Work Days when rain, flooding, snow, unusually high winds, excessively wet grounds, or similar circumstances prevent progress on major portions of the Work. The Contractor will be entitled to an extension of the Contract Time for the net additional time, if any, which results from deducting the amount of Anticipated Weather Days from the total amount of Weather Days.
- .6 Net Weather Days: The difference in working days between Anticipated Weather Days and Weather Days.

1.7.10 NOTICE TO PROCEED

A notice that may be given by the Owner to the Contractor that directs the Contractor to start the Work. It may also establish the Date of Commencement of the Work.

1.7.11 PUNCH LIST

A comprehensive list prepared by the Contractor prior to Substantial Completion to establish all items to be completed or corrected; this list may be supplemented by the Architect or Owner. Refer to Subparagraph 9.8.2.

ARTICLE 2 - OWNER

2.2 INFORMATION AND SERVICES REQUIRED OF THE OWNER

Delete the text of Subparagraph 2.2.5 in its entirety and substitute the following:

2.2.5 The Contractor will be furnished free of charge, eight (8) copies of the Drawings and Specifications for the execution of the work. The Contractor shall pay actual reproduction costs of any additional copies required.

2.4 OWNER'S RIGHT TO CARRY OUT THE WORK

Delete text of Subparagraph 2.4.1 in its entirety and substitute the following:

2.4.1 If the Contractor defaults or neglects to carry out the work in accordance with the Contract Documents and fails, 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 cost of correcting such deficiencies, including compensation for the Architect's additional services and expenses 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.

2.5 OWNER'S RIGHT TO OCCUPY THE PROJECT

Add the following Subparagraphs:

2.5.1 The Owner shall have the right to occupy or use without prejudice to the right of either party, any completed or largely completed portions of the project, notwithstanding the time for completing the entire work or such portions may not have expired. Such occupancy and use shall not constitute acceptance of any work not in accordance with the Contract Documents.

2.5.2 If such prior use delays the completion of the project, the Contractor shall be entitled to extension of time, which claim shall be in writing with supporting data attached.

2.5.3 Refer to Article 11 - Insurance and Bonds regarding property insurance requirements in the event of such occupancy.

ARTICLE 3 - CONTRACTOR

3.2 REVIEW OF CONTRACT DOCUMENTS AND FIELD CONDITIONS BY CONTRACTOR

Delete text of Subparagraph 3.2.1 and substitute the following:

3.2.2 The Contractor shall carefully study and compare the Agreement, Conditions of the Contract, Drawings, Specifications, Addenda, and Modifications and shall at once report to the Architect any error, inconsistency, or omission he may discover. Contractor shall be liable for any damage to Owner for failure

to report any error, inconsistency or omission he may discover or should have discovered, but he shall not be liable to Owner or Architect for any damage resulting from such error, inconsistency or omission which he should not have discovered or which he did discover and at once so reported. Contractor shall do no work without approved Drawings and Specifications.

Add the following Subparagraphs:

3.2.5 The Contractor shall not be entitled to additional compensation for the "rework portion" of any additional work caused by his failure to carefully study and compare the contract documents prior to execution of the Work.

3.2.6 The Contractor shall make a reasonable attempt to interpret the Contract Documents before asking the Architect for assistance in interpretation. The Contractor shall not ask the Architect for observation of work prior to the Contractor's field superintendent's personal inspection of the work and his determination that the work complies with the Contract Documents. The Contractor shall arrange meetings prior to commencement of the work of all major subcontractors to allow the subcontractor to demonstrate his understanding of the documents to the Architect and to allow the subcontractor to ask for any interpretation he may require.

3.2.7 If, in the opinion of the Architect, the Contractor does not make a reasonable effort to comply with the above requirements of the Contract Documents and this causes the Architect or his Consultants to expend an unreasonable amount of time in the discharge of the duties imposed on him by the contract Documents, then the Contractor shall bear the cost of compensation for the Architect's additional services made necessary by such failure. The Architect will give the Contractor prior notice of intent to bill for additional services related to above requirements before additional services are performed.

3.2.8 If the Contractor has knowledge that any of the products or systems specified will perform in a manner that will limit the Contractor's ability to satisfactorily perform the work or to honor his Warranty, he shall promptly notify the Architect in writing, providing substantiation for his position. Any necessary changes, including substitution of materials, shall be accomplished by appropriate Modification.

3.3 SUPERVISION AND CONSTRUCTION PROCEDURES

Add the following Subparagraph:

3.3.4 The Contractor is especially cautioned to coordinate the routing of mechanical and electrical items prior to commencing these operations.

3.5 WARRANTY

Add the following Subparagraphs:

3.5.2 In the event of failure of materials, products, or workmanship, either during construction or the Correctional Period (which shall be one (1) year from the Date of Substantial Completion, except where a longer period is specified), the Contractor shall take appropriate measures to assure correction or replacement of the defective items, whether notified by the Owner or Architect. Items of work first performed after Substantial Completion shall have their warranties extended by the period of time between Substantial Completion and the actual performance of the Work.

3.5.3 Refer to warranty forms included under Section 01710 Guarantees, Certificates and Close-Out, which will be required prior to final payment.

3.5.4 Appropriately 11 months after Substantial Completion, the Contractor shall accompany the Owner and Architect on a complete walk-thru of the Project and be responsible for correcting of any additional deficiencies observed or reported.

3.6 TAXES

Delete text of Subparagraph 3.6.1, and substitute the following.

3.6.1 The Owner is exempt from the Texas Sales Tax on any purchase of tangible personal property and will issue Certificates of Exemption from the Texas Sales Tax on materials furnished by Contractors on School Construction projects. The Contractor shall give a written statement to the Owner (with a copy to the Architect) as to the proration of costs of skilled crafts, labor and materials for the project prior to awarding of a Construction Contract. The contractors shall obtain Certificates of Resale from their suppliers in order to avoid payment of the State Sales Tax on materials incorporated in School jobs. Failure of the Contractor to obtain Certificates of Resale from their suppliers shall make the Contractor responsible for absorbing the tax.

3.7 PERMITS, FEES, NOTICES AND COMPLIANCE WITH LAWS

3.7.1 Supplement Subparagraph 3.7.1, as follows:

3.7.1.1 The Owner will pay directly to the governing authority, the cost of all permanent property utility assessments and similar connection charges.

3.7.1.2 The Contractor shall pay directly all temporary utility charges, tap charges, and water meter charges. The Contractor shall secure and pay for all governing authorities' permit fees.

Delete text of Subparagraph 3.7.3 in its entirety and substitute the following:

3.7.3 It is not the Contractor's responsibility to ascertain that the contract Documents are in accordance with Applicable laws, statutes ordinances, building codes, and rules and regulations. However, if the Contractor observes, or should have observed, that portions of the Contract Documents are to variance therewith, the Contractor shall promptly notify the Architect and Owner in writing and necessary changes shall be accomplished by appropriate Modification.

3.7.3.1 If the Contractor performs Work which he knew or should have known to be contrary to applicable laws, statues, ordinances, building codes, local rules or regulations, without such notice to the Architect and Owner, the Contractor shall assume full responsibility for such Work and shall bear there attributable costs.

3.8 ALLOWANCES

Delete text of Subparagraph 3.8.1, and substitute the following:

3.8.1 The General Contractor shall include in his proposal the allowances stated in the Specifications. These stated allowances represent the cost estimate of the materials and equipment delivered and unloaded at the site. The Contractor's handling costs on site, overhead, profit, and other expenses contemplated for the allowance material and equipment shall be included in allowance only where called for in the various sections of these specifications.

The Contractor shall purchase the allowance materials and equipment as directed by the Architect on the basis of the lowest responsible proposal of at least three (3) competitive proposals. If the actual cost of the materials and equipment delivered and unloaded at the site is more or less than all the allowance estimates, the Contract Sum will be adjusted accordingly by Change Order.

3.9 SUPERINTENDENT

Delete Subparagraph 3.9.1, in its entirety and substitute the following:

3.9.1 Prime Contractor shall employ competent superintendent and necessary assistants who shall be in attendance at the Project site during the progress of the work. The Superintendent shall be satisfactory to the Owner and shall not be changed except with the consent of the Architect, unless the Superintendent leaves the employment of the Contractor. No increase in Contract Time or Contract Sum shall be allowed in the event the Owner or Architects objects to any nominated superintendent.

3.10 CONTRACTOR'S CONSTRUCTION SCHEDULES

Add the following Subparagraph:

3.10.4 The Contractor shall submit to the Architect with each monthly Application for Payment, a copy of the progress schedule showing all modifications required to have the schedule reflect appropriate revisions and shall take whatever action is necessary to assure that the project completion schedule is met.

3.12 SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

Add the following Subparagraphs:

3.12.11 The Contractor shall submit complete drawings, data and samples to the Architect at least 30 days prior to the date the Contractor needs the reviewed submittals returned. The Contractor shall be prepared to submit color samples on any key items (such as quarry tile, vinyl wall covering, etc.) within 30 days of the award of Contract. Once samples of all key items are received, the Architect will finalize color selections.

3.12.12 The Contractor shall submit the number of copies of product data and samples which the Contractor and his subcontractors need for their use PLUS two (2) additional sets for the Architect, one (1) additional set for the Owner and one (1) additional set for each of the Architect's consultants involved with the particular Section of Work. Where shop drawings are involved, submit one (1) high quality reproducible transparency and one (1) opaque print of the shop drawing for the Architect plus one (1) additional opaque print for each of the Architect's consultants involved with the particular Section of Work. The reproducible transparency will be marked by the Architect and/or his consultants. After final review and correction of the submittal, the Contractor shall send one (1) corrected set to the Architect and one (1) to each of the Architect's consultants involved with the particular Section of Work.

3.12.13 The Contractor shall provide composite drawings within three (3) months of contract signing showing how all piping, ductwork, lights, conduit, equipment, etc. will fit into the ceiling space allotted, including clearances required by the manufacturer, by Code, or in keeping with good construction practice. Space for all trade elements must be considered on the same drawing. Drawings shall be at 1/4 inch per foot minimum scale and shall include invert elevations and sections required to meet intended purpose.

3.15 CLEANING UP

Add the following Subparagraph:

3.15.3 Prior to the Architect's review for Substantial Completion, the Contractor shall clean exterior and interior surfaces exposed to view; remove temporary labels, stains, and foreign substances; polish transparent and glossy surfaces; clean equipment and fixtures to a sanitary condition; clean roofs; clean site; sweep paved areas and rake clean other surfaces; remove trash and surplus materials from the site.

Add following Paragraphs in their entirety:

3.19 REPRODUCIBLE RECORD DRAWINGS

3.19.1 At the completion of the Project, the contractor shall submit one (1) complete set of drawings with all changes made during construction, including concealed mechanical, electrical, and plumbing items. Drafting shall be compatible and the Contractor shall submit these as Mylar sepia. The record drawings

shall exclude the seal of the Architect and/or Engineer and shall have a statement added to indicate the purpose of the drawings (i.e., "AS BUILT" or "RECORD DRAWING").

3.20 PREVAILING WAGE RATES

3.20.1 No employee used in this construction may be paid less than the minimum wage rate provided herein in Article 16.

3.21 ANTITRUST VIOLATIONS

3.21.1 To permit the Owner to recover damages suffered; in antitrust violations, the Owner/Contractor Agreement shall include the following, "Contractor hereby assigns to Owner any and all claims for overcharges associated with this contract which are under the antitrust laws of the United States, 15 U.S.C.A., Sec. 1 et.seq. (1973)". The Contractor shall include this provision in his agreements with each subcontractor and supplier. Each subcontractor shall include such provisions in agreements with sub-subcontractors and suppliers.

ARTICLE 4 - ARCHITECT

4.2 ADMINISTRATION OF THE CONTRACT

Add the following text to Subparagraph 4.2.3:

4.2.3 The Architect shall endeavor to guard the Owner against defects and deficiencies in the Work.

Delete text of following Subparagraphs and substitute the following:

4.2.6 The Architect will have authority to reject Work which does not conform to the Contract Documents. Whenever the Architect considers it necessary or advisable for implementation of the intent of the Contract Documents, the Architect will have authority to require additional inspection or testing of the Work in accordance with Subparagraphs 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 reasonably and 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 an equipment suppliers, their agents or employees, or other persons performing portions of the Work.

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 so rendered reasonably and in good faith.

ARTICLE 5 - SUBCONTRACTORS

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

Delete text of Subparagraphs 5.2.1, 5.2.2, 5.2.3, and 5.2.4 in their entirety and substitute the following:

5.2.1 As soon as practicable after Award of the Contract but no later than ten (10) days prior to the submittal date for the Contractor's first Application for Payment, Contractor shall furnish to the Owner and Architect in writing the names of the persons or entities (including those who are to furnish materials or equipment fabricated to a special design) proposed for each of the principal portions of the Work. Where Subcontractors or Sub-subcontractors have been listed in the Specifications or in an Addendum as a Listed Subcontractor the proposed entity shall be one of those firms listed, unless agreement has been reached to

accept a proposed Substitute Subcontractor as listed on the Proposal Form. Regarding proposed persons or entities to perform portions of the Work where no Listed Subcontractors have been listed or approved by Addendum, the Architect will promptly reply to the Contractor in writing stating whether or not the Owner or the Architect, after due investigation, has objection to any such proposed person or entity. Failure of the Owner or Architect to reply promptly shall constitute notice of no objection. Failure of the Contractor to submit the subject names in a timely manner will delay processing of the Contractor's Application for Payment.

5.2.2 The Contractor shall not contract with a proposed person or entity to whom the Owner or Architect has made a timely objection. The Contractor shall not be required to contract with anyone to whom the Contractor has made an objection under the provisions of Subparagraph 5.2.1.

5.2.3 If the Owner or Architect has objection to a person or entity proposed by the Contractor, the Contractor shall propose another to whom the Owner or Architect has no objection. The Contract Sum shall be increased or decreased by the difference in cost occasioned by such change and an appropriate Change Order shall be issued. However, no increase in the Contract Sum shall be allowed for such change unless the Contractor has acted promptly and responsively in submitting names as required in Subparagraph 5.2.1.

5.2.4 Prior to such substitution the Contractor shall notify the Architect of his intent and reasons for such proposed substitutions. The Contractor shall not change a Subcontractor, person or entity previously selected if the Owner or Architect makes objection to such change.

Add Subparagraphs 5.2.5 and 5.2.6 as follows:

5.2.5 The Contractor shall submit the list of proposed Subcontractors on Document 00 40 00 AF. The Contractor may obtain blank copies from the Architect.

5.2.6 The Contractor is required to visit the site and completely familiarize himself with the existing conditions prior to the proposal. No additional increase in the Contract amount will be provided when existing or known conditions require a certain amount of work to comply with the intent of the Contract Documents.

ARTICLE 7 - CHANGES IN THE WORK

7.2 CHANGE ORDERS

Add Subparagraph 7.2.2 as follows:

7.2.2 The cost or credit to the Owner resulting from a change in the work shall be determined in one or more of the ways listed below. The first method listed shall be used unless the Architect determines that the method is inappropriate, in which case another method shall be selected:

- A. By mutual acceptance of a lump sum properly itemized and supported by sufficient substantiating data to permit evaluation. Where additional work is involved, the lump sum shall represent the estimated cost of labor and materials plus markups to cover overhead and profit:
 1. To compensate the contractor or subcontractor actually performing a part of the work for the combined cost of overhead and profit, the performing party shall be entitled to a single markup not to exceed 10% of the estimated cost of that part of the work.
 2. To compensate the contractor for the combined cost of overhead and profit on work performed by subcontractors, the Contractor shall be entitled to a single markup not to exceed 10% of the subcontract amount.
 3. When a subcontractor performs the work of a change, the 10% markup for combined overhead and profit shall be used only by the sub-subcontractor. The Contractor and

Subcontractor would each be entitled to a single markup not to exceed 10% of the cost to them for the Subcontractor and sub-subcontractor, respectively.

- B. By unit prices stated in the Contract Documents or subsequently agreed upon. Additional markups for overhead and profit will not be allowed in Unit Price work.
- C. By cost to be determined in a manner agreed upon by the parties and a mutually acceptable fixed or percentage fee.

7.3 CONSTRUCTION CHANGE DIRECTIVES

Delete text of Subparagraph 7.3.3 in its entirety and substitute the following:

7.3.3 The cost or credit to the Owner resulting from a change in the Work shall be determined in one or more ways listed below. The first method listed shall be used unless the Architect determines that the method is inappropriate, in which case another method shall be selected.

- .1 By mutual acceptance of a lump sum properly itemized and supported by sufficient substantiating data to permit evaluation. Where additional Work is involved, the lump sum shall represent the estimated cost of labor and materials plus markups to cover overhead and profit:

To compensate the Contractor or Subcontractor actually performing a part of the Work for the combined cost of overhead and profit, the performing party shall be entitled to a single markup not to exceed 10% of the estimated cost of that part of the Work.

To compensate the Contractor for the combined cost of overhead and profit on work performed by Subcontractors, the Contractor shall be entitled to a single markup not to exceed 10% of the subcontract amount.

When a Sub-subcontract performs the Work of a change, the 10% markup for combined overhead and profit shall be used only by the Sub-subcontractor. The Contractor and Subcontractor would each be entitled to a single markup not to exceed 10% of the cost to them from the Subcontractor and Sub-subcontractor respectively.

- .2 By unit prices stated in the Contract Documents or subsequently agreed upon. Additional markups for overhead and profit will not be allowed in Unit Price Work.
- .3 By cost to be determined in a manner agreed upon by the parties and a mutually acceptable fixed or percentage fee.

Add the following Subparagraph:

7.5 CHANGES FUNDED BY ALLOWANCES

7.5.1 Allowances balances may be used to fund changes in the work.

The Contractor will not be allowed an overhead and profit mark-up when changes in the work are funded by one of the Allowances. For Subcontractor and Sub-Subcontractor overhead and profit mark-up when changes in the work are funded by one of the Allowances, refer to Paragraph 7.2.2.

ARTICLE 8 - TIME

8.1 DEFINITIONS

Delete Subparagraph 8.1.2 in its entirety and substitute the following:

8.1.2 Unless agreed otherwise, the date inserted on the Agreement form and the Date of Commencement of the Work shall be as follows:

- .1 The date inserted on the first page of the Agreement form will be the date the Owner formally awards the Contract. As soon as feasible after receipt of Proposals, the Architect will present Agreement forms to the Contractor for his review and signature; the Contractor will be allowed a maximum of five (5) days from the date the prepared Agreements are presented to him to 1) obtain the required bond forms and insurance certificates and 2) return the executed Agreement and supporting documents to the Architect for transmittal to the Owner for his final review and execution.
- .2 The Date of Commencement of the Work is the date that either (1) the fully executed Agreement or (2) a written Notice to Proceed is delivered to the Contractor and constitutes day "0" (zero) of the stated Completion Time.

8.3 DELAYS AND EXTENSIONS OF TIME

Add the following Subparagraph:

8.3.4 The following is a requirement of the Contract and will be included in the Agreement Between Owner and Contractor under Time of Completion and the blank spaces will be completed indicating the completion date as stated on the Proposal Form.

The Work to be performed under this Contract shall be commenced and substantially completed by the date as stated on the Proposal Form, or by such dates thereafter as may be established in any written extensions granted under Article 8 of the General Conditions. The parties hereto agree that time is of the essence of this contract and that the pecuniary damages which would be suffered by the Owner, if the Contractor does not complete all work called for in the contract documents by the specified date, are in their very nature difficult of ascertainment.

It is therefore expressly agreed as a part of the consideration inducing the Owner to execute this contract that the Owner may deduct from the final payment made to the Contractor a sum equal to \$1,000.00 per calendar day for each and every calendar day beyond the agreed date which the Contractor shall require for Substantial Completion of the work included in this contract. It is expressly understood that the said sum per day is agreed upon as a fair estimate of the pecuniary damages which will be sustained by the Owner in the event that the work is not completed within the agreed time, or within the legally extended time, if any, otherwise provided for herein. Said sum shall be considered as liquidated damages only and in no sense shall be considered a penalty, said damage being caused by additional compensation to personnel, for loss of interest on money and other miscellaneous increased costs, all of which are difficult of exact ascertainment.

Any disruption, all or in part, of Owner's use of the existing facilities or newly completed facilities, unless as agreed to beforehand or as terms of this contract, will also be subject to a sum equal to \$500.00 per calendar day for liquidated damages until the said disruption is rectified and use of the facility is returned to the Owner in its previous condition.

Failure to complete and close-out project 60 days after Substantial Completion will result in liquidated damages being assessed in the amount of \$500.00 per calendar day until close-out occurs.

ARTICLE 9 - PAYMENTS AND COMPLETION

9.2 SCHEDULE OF VALUES

Add Subparagraph 9.2.2 as follows:

9.2.2 In order to facilitate the review of Applications for Payment, the Schedule of Values shall be submitted on AIA Documents G702 and G703 or other similar forms approved by the Owner, and shall include the following:

- .1 General Contractor's costs for Contractor's fee, bonds and mobilization, etc., shall be listed as individual line items.
- .2 Contractor's costs for various construction items shall be detailed. For example, concrete Work shall be subdivided into footings, grade beams, floor slabs, paving, etc. These subdivisions shall appear as individual line items.
- .3 On major subcontracts, such as mechanical, electrical and plumbing, the schedule shall indicate line items and amounts in detail (for example; underground, major equipment, fixtures, installation of fixtures, start up, etc.)
- .4 Costs for subcontract Work shall be listed without any additional of General Contractor's costs for overhead, profit or supervisions.
- .5 Where payment for stored materials may be requested prior to installation, material and labor shall be listed as separate line items.
- .6 Sample pages from an approved schedule of values are included following this document.

9.3 APPLICATIONS FOR PAYMENT

Delete Subparagraph 9.3.1 in its entirety and substitute the following:

- 9.3.1 At least ten (10) days before the date established for each progress payment, the Contractor shall submit to the Architect an itemized Application for Payment for operations completed in accordance with the schedule of values. Prior to this submittal, the Contractor shall contact the Architect's Field Department for on-site review of the proposed application. Upon approval by the Architect's Field Department, the Application for Payment shall be notarized and submitted to the Architect.

Included shall be data required to support the Contractor's right to payment as may be required by the Owner or Architect, such as copies of requisitions from subcontractors and material suppliers, and reflecting retainage, if provided for elsewhere in the contract documents.

Delete Subparagraph 9.3.2 in its entirety and substitute the following:

- 9.3.2 Payments will be made on account of materials or equipment 1) incorporated in the Work and 2) Suitably stored at the site or 3) suitably stored at some off-site location provided the following conditions are met for off-site storage:
- .1 The location must be agreed to, in writing, by the Owner and Surety.
 - .2 The location must be a bonded warehouse.
 - .3 Surety must agree, in writing, to each request for payment.
 - .4 The Contractor must bear the cost of the Owner's and Architect's expenses related to visiting the off-site storage area.

Payments for materials or equipment stored on or off the site shall be conditioned upon submission by the Contractor of bills of sale or such other procedures satisfactory to the Owner to establish the Owner's title to such materials or equipment or otherwise protect the Owner's interest, including applicable insurance (naming the Owner as insured) and transportation to the site for those materials and equipment stored off the site. Under no circumstances will the Owner reimburse the Contractor for down payments, deposits, or other advance payments for materials or equipment.

The Contractor acknowledges that the review of materials stored off site is an additional service of the Architect and shall be charged for that service. The cost for that service will be established by the Architect and is not subject to appeal.

Add the following Subparagraph:

- 9.3.4 Contractors shall submit application in quadruplicate using AIA Document G702 and G703, Application and Certificate for Payment, 1992 Edition. All blanks in the form must be completed and signatures of Contractor and Notary Public must be original on each form.

9.4 CERTIFICATES FOR PAYMENT

Add the following Subparagraph:

- 9.4.3 The Architect will affix his signature to the same form described in Paragraph 9.3.4 to signify his certification of payment provided the application is otherwise satisfactory.

9.6 PROGRESS PAYMENTS

Add the following Subparagraph:

- 9.6.8 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 in the conditions of the Contract as follows:

On or about the 15th day of each month 95% of the proportion of the Contract Sum properly allocable to labor, materials and equipment incorporated in the Work and 95% of the portion of the Contract Sum properly allocable to materials and equipment suitably stored at the site or at some other location agreed upon in writing by the parties, up to the first (1st) day of that month; less the aggregate of previous payments in each case; and upon Substantial Completion of the entire work, a sum sufficient to increase the total payments to 95% of the Contract Sum less such retainages as the Architect shall determine for all incomplete work and unsettled claims.

9.7 FAILURE OF PAYMENT

Delete the phrase "or awarded by binding dispute resolution".

9.8 SUBSTANTIAL COMPLETION

- 9.8.1 Add the following:

The following items are a partial list of requirements, as applicable to the Project, that must be completed prior to the established Substantial Completion:

1. All fire alarm system components must be completed and demonstrated to the Owner.
2. Local fire marshal approval certificate must be delivered to the Owner.
3. All exterior clean-up and landscaping must be complete.
4. All final interior clean-up must be complete.
5. All HVAC air and water balancing must be complete.
6. All Energy Management Systems must be complete and fully operational and demonstrated to the Owner.
7. All communications equipment, telephone system, and P.A. systems must be complete and demonstrated to the Owner.
8. All final lockset cores must be installed and all final Owner directed keying completed.
9. All room plaques and exterior signage must be completed.
10. All Owner demonstrations must be completed including kitchen equipment, HVAC equipment, plumbing equipment, and electrical equipment.
11. A final certificate of occupancy must be signed by the Contractor and delivered to the Owner.
12. All operation and maintenance manuals are delivered and approved ("D-slant" ring binders in triplicate).

9.10 FINAL COMPLETION AND FINAL PAYMENT

At Subparagraph 9.10.2, modify as follows:

- .1 On line 8, delete the phrase "if any".

.2 On line 8, delete the phrase "If required by the Owner".

Add the following to Subparagraph 9.10.2:

Prior to final payment, the Contractor shall submit in triplicate to the Architect the following completed forms:

1. Contractor's Affidavit of Payment of Debts and Claims, AIA Document G706.
2. Contractor's Affidavit of Release of Liens, AIA Document G706A.
3. Consent of Surety to Final Payment, AIA Document G707.
4. General Contractor's Guarantee - notarized
5. Subcontractor's Guarantee - notarized
6. Subcontractor's Lien Releases - signed and notarized on a same piece of paper.
7. Each Bidder (and subcontractor and supplier submitting a bid to a Bidder) shall submit a notarized affidavit stating that no asbestos, PCB, or lead, except for flashing in roofing, containing building materials were used.
8. Maintenance and inspection manuals. Three (3) sets of each bound in a 3 inch "D-slant" ring binder.
9. Record drawings. Reproducible Mylar sepias.
10. Final list of subcontractors.

Documents identified as affidavit must be notarized. Manuals shall contain an index listing the information submitted. The index sections will be divided and identified by tabbing each section as listed in the index.

Upon request, the Architect will furnish the Contractor with blank copies of the forms listed above. Final payment, constituting the entire unpaid balance of the Contract Sum shall be paid by the Owner to the Contractor 31 days after substantial completion of the work unless otherwise stipulated in the Certificate of Completion, the contract fully performed, and Final Certificate of Payment has been issued by the Architect.

The Owner may accept certain portions of the work as being complete prior to the acceptance of the entire project. If certain areas are accepted by the Owner as being complete, and if the Contractor has completed all of the requirements for final payment of that portion of work, then the Owner may release retainage for that area/portion of work. Amounts of retainage shall be agreed upon by both Owner and Contractor prior to final acceptance of these areas.

Refer to Section 01 77 00 Closeout Procedures for warranties, certificates, and close-out for additional requirements.

ARTICLE 10 - PROTECTION OF PERSONS AND PROPERTY

10.3 HAZARDOUS MATERIALS

Delete text of Subparagraph 10.3.2 in its entirety and substitute the following:

10.3.2 If requested in writing by the Contractor, the Owner shall obtain the services of a licensed laboratory to verify a 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 verify that it has been rendered harmless. If requested in writing by the Contractor or Architect, 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.

Add the following Subparagraphs:

10.7 ASBESTOS, LEAD OR PCBs CONTAINING MATERIALS

10.7.1 The contractor and each subcontractor, prior to final payment, shall submit a notarized statement on their letterhead certifying "to the best of their information, knowledge, and belief asbestos, asbestos containing materials, and PCBs have not been used or incorporated into the Work and lead or lead bearing materials have not been incorporated into potable water systems." For the purpose of definition as used in this statement, the term "potable water systems" includes, but is not limited to, those water systems for drinking fountains, all sinks, showers, bath tubs, residential and commercial kitchen equipment, ice machines, and hose bibbs, as applicable to the project. The Contractor shall also obtain such statements from Subcontractors and all such statements shall be notarized.

ARTICLE 11 - INSURANCE AND BONDS

11.1 CONTRACTOR'S LIABILITY INSURANCE

Add the following to Paragraph 11.1.3:

11.1.3.1 Proof of insurance shall be evidenced on 1) an original ACORD Certificate of Insurance 25-N (1/95) and 2) an original Supplemental Attachment for ACORD Certificate of Insurance 25-S (1/95), AIA Document G715-1991, indicating the minimum Contractor's Insurance required. The Contractor is urged to carry such additional insurance as he may deem appropriate to provide protection from risks assumed under this contract. The Contractor shall fill in the blank spaces on this form and submit one (1) copy each of the completed Certificate of Insurance forms to the Owner and Owner prior to commencement of the Work. The required insurance must be written by a Company licensed to do business in the State of Texas and be acceptable to the Owner.

Contractor's Liability Insurance: Insurance described in Paragraph 11.1 of AIA Document A201, 1997 Edition, shall be for the following minimum limits:

A. Worker's Compensation Insurance Coverage

Definitions:

Certificate of coverage ("Certificate") - A copy of a certificate of insurance, a certificate of authority to self-insure issued by the commission, or a coverage agreement (TWCC-81, TWCC-82, TWCC-83, or TWCC-84), showing statutory workers' compensation insurance coverage for the person's or entity's employees providing services on a project, for the duration of the project.

Duration of the project - includes the time from the beginning of the work on the project until the contractor's/person's work on the project has been completed and accepted by the governmental entity.

Persons providing services on the project ("subcontractor" in Texas Labor Code 406.096) - includes all persons or entities performing all or part of the services the contractor has undertaken to perform on the project, regardless of whether that person has employees. This includes, without limitation, independent contractors, subcontractors, leasing companies, motor carriers, owner-operators, employees of any such entity, or employees of any entity that furnishes persons to provide services on the project. "Services" shall include, without limitation, providing, hauling, or delivering equipment or materials, or providing labor, transportation, or other service related to a project. "Services" does not include activities unrelated to the project, such as food/beverage vendors, office supply deliveries, and delivery of portable toilets.

1. The contractor shall provide coverage, based on proper reporting of classification codes and payroll amounts and filing of any coverage agreements, which meets the statutory requirements of Texas Labor Code 401.011 (44) for all employees of the contractor providing services on the project for the duration of the project.
2. The contractor must provide a certificate of coverage to the governmental entity prior to being awarded the contract.
3. If the coverage period shown on the contractor's current certificate of coverage ends during the duration of the project, the contractor must, prior to the end of the coverage period, file a new certificate of coverage with the governmental entity showing the coverage has been extended.
4. The contractor shall obtain from each person providing services on a project, and provide to the governmental entity:
 - a. a certificate of coverage, prior to that person beginning work on the project, so the governmental entity will have on file certificates of coverage showing coverage for all persons providing services on a project; and
 - b. no later than seven (7) days after receipt by the contractor, a new certificate of coverage showing extension of coverage, if the coverage period shown on the current certificate of coverage ends during the duration of the project.
5. The contractor shall retain all required certificates of coverage for the duration of the project and one year thereafter.
6. The contractor shall notify the governmental entity in writing by certified mail or personal delivery, within 10 days after the contractor knew or should have known, of any change that materially affects the provision of coverage of any person providing services on the project.
7. The contractor shall post on each project site a notice, in the text, form and manner prescribed by the Texas Workers' Compensation Commission, informing all persons providing services on the project that they are required to be covered, and stating how a person may verify coverage and report lack of coverage.
8. The contractor shall contractually require each person with whom it contracts to provide services on a project, to:
 - a. provide coverage, based on proper reporting of classification codes and payroll amounts and filing of any coverage agreements, which meets the statutory requirements of Texas Labor Code, Section 401.011 (44) for all of its employees providing services on the project, for the duration of the project;
 - b. provide to the contractor, prior to that person beginning work on the project, a certificate of coverage showing that coverage is being provided for all employees of the person providing services on the project, for the duration of the project;
 - c. provide the contractor, prior to the end of the coverage period, a new certificate of coverage showing extension of coverage, if the coverage period shown on the current certificate of coverage ends during the duration of the project;
 - d. obtain from each other person with whom it contracts, and provide to the contractor:
 - 1) a certificate of coverage, prior to the other person beginning work on the project; and

- 2) a new certificate of coverage showing extension of coverage, prior to the end of the coverage period, if the coverage period shown on the current certificate of coverage ends during the duration of the project.
 - e. retain all required certificates of coverage on file for the duration of the project and for one year thereafter;
 - f. notify the governmental entity in writing by certified mail or personal delivery, within 10 days after the person knew or should have known, of any change that materially affects the provisions of coverage of any person providing services on the project; and
 - g. contractually require each person with whom it contracts to perform as required by paragraphs a - g, with the certificates of coverage to be provided to the person for whom they are providing services.
9. By signing this contract or providing or causing to be provided a certificate of coverage, the contractor is representing to the governmental entity that all employees of the contractor who will provide services on the project will be covered by workers’ compensation coverage for the duration of the project, that the coverage will be based on proper reporting of classification codes and payroll amounts, and that all coverage agreements will be filed with the appropriate insurance carrier or, in the case of self-insured, with the commission’s Division of Self-Insurance Regulation. Providing false or misleading information may subject the contractor to administrative penalties, criminal penalties, civil penalties, or other civil actions.
10. The contractor’s failure to comply with any of these provisions is a breach of contract by the contractor which entitles the governmental entity to declare the contract void if the contractor does not remedy the breach within ten days after receipt of notice of breach from the governmental entity.
11. The Contractor shall post the following language:

REQUIRED WORKERS’ COMPENSATION COVERAGE

“The law requires that each person working on this site or providing services related to this construction project must be covered by workers’ compensation insurance. This includes persons providing, hauling, or delivering equipment or materials, or providing labor or transportation or other service related to the project, regardless of the identity of their employer or status as an employee.”

“Call the Texas Workers’ Compensation Commission at 512 - 440 - 3789 to receive information on the legal requirements for coverage, to verify whether your employer has provided the required coverage, or to report an employer’s failure to provide coverage.”

B. <u>Comprehensive General Liability</u>	<u>Minimum Limits</u>
Bodily Injury	\$1,000,000/occurrence \$1,000,000/aggregate, products & completed operations \$1,000,000/occurrence \$1,000,000/aggregate

Or

\$1,000,000 combined single limit for BI & PD

Coverage shall include

1. Premises - Operations;
2. Contractor's Protective Liability (if any work sublet);
3. Contractual Liability to cover indemnity agreement of "Hold Harmless" clause in contract;
4. Property Damage Liability insurance shall include coverage for the following hazards:
 - a. Damage to completed or partially completed work.
5. Personal Injury Liability in a minimum limit of \$500,000 with employment exclusion deleted;
6. Broad Form C G L Endorsement shall be included;
7. Waiver of Subrogation Endorsement shall be included in favor of (District Name) Independent School District/Agents;
8. Thirty day notice of cancellation or material change endorsement in favor of, (District Name) Independent School District/Agents.
9. The Owner to be named as additional insured on Contractor's policy.
10. The Owner shall be named additional insured on the Contractor's policy as to the subject job.

C.	<u>Comprehensive Automobile Liability</u>	<u>Minimum</u>
	Bodily Injury	\$500,000/person
		\$1,000,000/occurrence
	Property Damage	\$1,000,000/occurrence

Or

\$1,000,000 combined single limit for BI & PH.

Coverage Shall Include

1. All owned, hired and non-owned autos of the Contractor;
2. Waiver of subrogation Endorsement in favor of (District Name) Independent School District/Agents;
3. Thirty day notice of cancellation of material change endorsement in favor of (District Name) Independent School District/Agents;
4. (District Name) Independent School District/Agents to be named as additional insured on Contractor's policy.

D.	<u>Umbrella Liability</u>	<u>Minimum Limits</u>
		\$1,000,000/occurrence
		\$1,000,000/aggregate

Coverage Shall Include:

1. Waiver of Subrogation Endorsement in favor of (District Name) Independent School District/Agents;
2. Thirty day notice of cancellation or material change endorsement in favor of (District Name) Independent School District/Agents;
3. (District Name) Independent School District/Agents to be named as additional insured on Contractor's policy.

11.1.3.2 Property Insurance: The Contractor purchase insurance described in Paragraph 11.3 of AIA Document A201, 1997 Edition, to the full amount of the contract, with the Owner as an additional insured.

11.1.3.3 Waivers of Subrogation: Shall be to the benefit of (District Name) Independent School District or its agents, only and the respective policies listed in Article 11 shall be endorsed accordingly.

11.1.3.4 Certificate of Insurance: The Contractor shall furnish the Owner, Certificates of Insurance showing evidence of coverages required above, prior to beginning construction under this contract. Such certificates shall indicate that policies will not be reduced or canceled without thirty days prior notice to Owner. The required insurance must be written by a company licensed to do business in the State of Texas at the time the policy is issued. The insurance company must be acceptable to the Owner and said insurance companies must have a rating in the current Best's of at least A:XIII.

11.1.3.5 Indemnification: Contractor assumes the entire responsibility and liability and will indemnify and hold (District Name) Independent School District harmless, its agents, servants and employees from and against any and all losses, expenses, demands and claims of whatsoever character that may be claimed or asserted to suit brought against (District Name) Independent School District, its agents, servants and employees by any person, firm or corporation, including any employee or officer of Contractor its Subcontractor, on account of an actual or alleged:

Illness, bodily injury, or death occurring to any person whomsoever (including both parties and their respective officers, agents and employees) or arising out of, in connection with, or resulting from the actual or alleged activities of Contractor or any Subcontractor and their respective officers, agents and employees in the performance of the work in accordance with this Agreement. Contractor agrees that the above indemnification and hold harmless applies to, but is not limited to suits, actions or claims arising under the Structural Work Law (4811.Rev. Stat., PAR 60-69) Protection of Adjacent Land Owners Act (70 111. Rev. Stat., PAR 10), and any other similar law or statute of any other state.

Contractor further agrees to indemnify, protect and defend (District Name) Independent School District against any claim asserted, or suit brought against (District Name) Independent School District by virtue of the action of Contractor or any Subcontractor as heretofore set forth and pay judgment rendered in any such action(s); provided, however that (District Name) Independent School District shall have the right if it so elects to participate at its own expense in the defense of any such claims or suit, but participation shall not operate to affect Contractor's liability and obligations hereunder.

11.4 PERFORMANCE BOND AND PAYMENT BOND

Supplement to Article 11.

11.4.1 The Performance Bond Form and Labor and Material Payment Bond - Substitute the following for Subparagraph 11.4.1 as set forth below:

The Contractor shall furnish a Statutory Performance Bond in an amount equal to One Hundred Percent (100%) of the Contract Sum as security for the faithful performance of this Contract and also a Statutory Labor and Material payment Bond in an amount not less than One Hundred Percent (100%) of the Contract Sum as security for the payment for all persons performing labor on the project under this Contract and furnishing materials in connection with this Contract. The Performance Bond and the Labor and Material Payment Bond may be in one or in separate instruments in accordance with local law and shall be delivered to the Owner not later than the date of execution of the Contract.

- A. The Contractor shall provide an affidavit showing proof that his bonding company meets the following criteria:
 - 1. The Bonding Company must be domiciled in the United States.
 - 2. The Bonding Company must be licensed in the State of Texas.
 - 3. The Bonding Company must be acceptable to the Owner.
- B. Bond forms shall be subject to the Owner's approval. File copies of the bond with the County Clerk and furnish the Owner a file receipt.

- C. Performance and payment bonds shall remain in force throughout the warranty period of the contract.
- D. The work will not be started until the bonds and issuing companies have been accepted as satisfactory by the Owner.
- E. The original bonds will be delivered to the Owner with an attached authorization power of attorney.

ARTICLE 13 - MISCELLANEOUS PROVISIONS

13.6 INTEREST

Delete Subparagraph in its entirety.

ARTICLE 14 - TERMINATION OR SUSPENSION OF THE CONTRACT

Add the following Subparagraph:

14.2.5 Contractor hereby assigns the Owner any and all claims for overcharges associated with this Contract which arise under the antitrust laws of the United States, 15 U.S.C.A. Section 1 ET.SEQ. (1973).

14.4 TERMINATION BY THE OWNER FOR CONVENIENCE

Delete Subparagraph 14.4.3 in its entirety and replace with the following Subparagraph:

14.4.3 In case of such termination for the Owner's convenience, the Contractor shall be entitled to receive payment from the Owner on the same basis provided in Subparagraph 14.1.3.

Add the following Article:

ARTICLE 15 - CLAIMS AND DISPUTES

15.1 CLAIMS

Delete the text of Subparagraphs 15.1.1 and 15.1.3 in their entirety and substitute the following:

15.1.1 Definition. A Claim is a demand or assertion by one of the parties seeking, as a matter of right, adjustment or interpretation of Contract terms, payment of money, extension of time, 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, Architect and Contractor arising out of or relating to the Contract.

15.1.3 Continuing Contract Performance. Pending final resolution of a Claim, unless otherwise agreed in writing, the Contractor shall proceed diligently with performance of the Contract.

15.2 INITIAL DECISION

Delete the text of Subparagraph 15.2.1 and 15.2.2 in their entirety and substitute the following:

15.2.1 Decisions of Architect. Claims including those alleging an error or omission by the Architect shall be referred initially to the Architect for action. If the parties are unable to agree, appeal shall be as stated at ARTICLE 15A.

ARTICLE 15A: Any claims, disputes, or matters arising out of this contract between the Architect, Owner and Contractor, or any combination of those parties, shall be submitted to a court of appropriate jurisdiction.

15.2.2 The Architect will review Claims and taken one or more of the following preliminary actions within ten (10) days of receipt of a Claim: (1) request Additional supporting data from the claimant; (2) submit a schedule to the parties indicating when the Architect expects to take action; (3) reject the Claim in whole or in part, stating reasons for rejection,; (4) recommend approval of the Claim by the other party or (5) suggest a compromise. The Architect shall notify the surety, if any, of the nature and amount of the Claim.

Add the following Subparagraph:

15.2.9 If a Claim has not been resolved after consideration of the foregoing and of further evidence presented by the parties or requested by the Architect, the Architect will notify the parties in writing that the Architect's decision will be made within seven (7) days.

Upon expiration of the time period, the Architect will render to the parties the Architect's written decision relative to the Claim, including and change in the Contract Sum or Contract Time or both. If there is a surety and there appears to be possibility of a Contractor's default, the Architect shall notify the surety and request the surety's assistance in resolving the controversy.

15.4 ARBITRATION

Delete Subparagraphs 15.4.1, 15.4.1.1, 15.4.3, and 15.4.2 in their entirety and all other references to arbitration.

Add the following Subparagraph:

15.4.1 Any claims, disputes, or matters arising out of this contract between the Contractor and the Owner or the Architect not settled by mediation, shall be submitted to a court of appropriate jurisdiction. It is understood and agreed that, in the event that any dispute, controversy, or conflict arises during the design and construction of the Project or following its completion, the parties hereto will cooperate in good faith, if possible, to resolve the issues without resorting to litigation. Should the parties be unable to reach agreement, an independent mediator may be selected by mutual consent of the parties to assist in a further effort to resolve the dispute. Furthermore, if the parties mutually agree to mediation, each party included in the mediation will bear an equal share of all costs related to the mediation.

"Any claims, disputes or matters arising out of the contract will be submitted to mediation only upon the mutual consent of the parties. In the event that mutual consent is not achieved, the parties are free to pursue any claims, disputes or matters in any manner allowed by law."

ARTICLE 16 - LABOR STANDARDS

16.1 PREVAILING WAGE RATES

16.1.1 Contractor and each Subcontractor shall pay to all laborers, workmen, and mechanics employed in execution of this Contract not less than rates set forth by law and as noted in the following Wage Rate Scale, for each craft or type of workman or mechanic needed to execute Contract.

16.1.21 Determination of prevailing wages shall not be construed to prohibit payment of more than rates named.

END OF DOCUMENT 00 73 00

SECTION 01 11 00
SUMMARY OF WORK

CONDITIONS OF THE CONTRACT AND DIVISION 01, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 PROJECT DESCRIPTION

- A. The Project, Garni Laboratory Renovation, Saint Mary's University Campus, San Antonio, Texas for Saint Mary's University.

1.2 SCOPE OF WORK

- A. The Work consists of renovations to the existing facility as described in the Contract Documents.
- B. Renovations to the existing facility include, but are not limited to the following: modifications to architectural and MEP systems at existing laboratories, and accessory spaces.
- C. Structural Services:
 - 1. Per the provided existing As-Built drawings the building was constructed in late 1950-early 1951. The building is a three-story concrete framed structure. The structural floors and roof deck are shown to be constructed of a 2 ½ inch thick concrete slab supported by 5-inch wide by 16-inch deep concrete joists, 25" on center, spanning approximately 26 feet between concrete beams which are supported by concrete columns. The columns vary in plan dimension from 12"x12" to a maximum of 14"x14" with some rectangular sections. The building is supported on 35-foot deep drilled and under-reamed concrete piers. The roof of the building is to have several pieces of mechanical equipment removed and replaced with new equipment. The roofing material around the equipment will also have to be removed and replaced. The openings through the concrete roof slab should be re-used for the new equipment. Cutting into the existing structural concrete joists to enlarge the existing openings for the ducts should be avoided. The width of any new opening to accommodate the new equipment will need to be limited to a maximum of 17 inches, allowing for a 1-inch taper on each side. The length of the new opening could be longer if necessary. Any existing openings through the concrete roof slab that will not be used should be infilled and closed. Details for closing any existing openings will be provided.

1.3 SALVAGED MATERIALS

- A. Owner may salvage all items deemed reusable or necessary to keep from facilities to be demolished prior to the start of demolition.
- B. Contractor shall remove and turn additional items over to the Owner, as directed.
- C. Contractor shall demolish, remove and salvage all other items of demolished work.

1.4 CONTRACTS AND USE OF SITE

- A. Contractor Use of Premises:
 - 1. Confine operations at site to areas permitted by:
 - a. Law
 - b. Ordinances
 - c. Permits
 - d. Contract Documents
 - 2. Do not unreasonably encumber site with materials or equipment.

3. Assume full responsibility for protection and safekeeping of products stored on premises.
 4. Obtain and pay for use of additional storage or work areas as needed for operations.
 5. Contractor shall establish secured staging area for work and coordinate and provide for safe passage and exit from building areas during construction, as determined by City and District officials.
 6. Contractor shall coordinate all construction activities with Owner.
 7. Owner reserves the right to perform construction operations with its own forces or to employ separate contractors on portions of the Project. Contractor shall coordinate with this work in terms of providing site access, work space, and storage space, cooperation of work forces, scheduling, and technical requirements.
 8. Coordinate all utility shutdowns with Owner and, as required, with local utility companies, prior to commencement of shutdown.
- B. Owner Occupancy:
1. Partial Owner Occupancy: The Owner reserves the right to place and install equipment in completed areas of the building, prior to Substantial Completion provided that such occupancy does not interfere with completion of the Work. Such placing of equipment and partial occupancy shall not constitute acceptance of the total Work.
 2. A Certificate of Substantial Completion will be executed in accordance with conditions of the Contract.
 3. Contractor shall obtain a Certificate of Occupancy from local building officials prior to Owner occupancy.
 4. Prior to partial Owner occupancy, mechanical and electrical systems shall be fully operational. Required inspections and tests shall have been successfully completed. Upon occupancy the Owner will provide operation and maintenance of mechanical and electrical systems in occupied portions of the building.
 5. Prior to partial Owner occupancy, emergency and life safety systems shall be fully operational. Emergency and life safety systems include, but are not limited to, fire sprinkler systems, fire alarm systems, and emergency egress devices. For emergency exiting purposes, the path of travel shall be clearly delineated and functional. If required, temporary barricades shall separate on-going construction from occupied spaces as allowed by the governing agency holding jurisdiction over the Project. Required inspections and tests shall have been successfully completed. Upon occupancy the Owner will provide operation and maintenance of emergency and life safety systems in occupied portions of the building.
- C. Owner-Furnished Items:
1. The Owner may provide items to the Contractor for installation in accordance with manufacturer's recommendations and instructions.
 2. The Owner will arrange and pay for delivery of Owner-furnished items in accordance with the Contractor's Construction Schedule, and will inspect deliveries for damage.
 3. If Owner-furnished items are damaged, defective or missing, through no fault of the Contractor, the Owner will arrange for replacement.
 4. The Contractor is responsible for designating the delivery dates of Owner-furnished items in the Contractor's Construction Schedule and for receiving,

unloading and handling Owner-furnished items at the site. The Contractor is responsible for protecting Owner-furnished items from damage, including damage from exposure to elements, and to repair or replace items damaged as a result of his operations.

- D. Coordination with Work by Owner and by Owner's Separate Contractors:
 - 1. The Owner reserves the right to perform other work for the Project, and to engage other separate contractors to perform other work for the Project. Provide site access, space allocation, scheduling, scheduling coordination, coordination of work forces and coordination of technical requirements with other contractors that may be selected and employed by Owner to perform other work simultaneously and in conjunction with the Work of This Contract.
- E. 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 resulting loss or damage but only to the extent the Owner would be responsible for any such losses or damages under state and/or federal law.
- F. The Architect will neither have control over or charge of, nor be responsible 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, except as noted in the above paragraph.
- G. No demolition will be allowed above, below, adjacent to or near any occupied areas of the existing building.

1.5 PROTECTION OF EXISTING PROPERTY

- A. Contractor shall provide and maintain adequate protection of all Owner's existing property during duration of Project.
- B. Contractor shall verify location of all existing underground pipelines on site with the owner of such pipelines and authorities having jurisdiction and shall provide and maintain adequate protection of all such pipelines during duration of Project.
- C. Protection of Trees:
 - 1. Provide wood barricades around trees and shrubs at their drip line in traffic areas to protect them from construction operations until Substantial Completion, or until barricade removal is directed by Architect.

1.6 USE OF ASBESTOS FREE MATERIALS, PRODUCTS AND SYSTEMS

- A. Asbestos containing materials (ACM) are prohibited.

PART 2 – PRODUCTS

1.7 MATERIALS

- A. Refer to Specification Sections.

PART 3 – EXECUTION

1.8 CONSTRUCTION SCHEDULE

- A. The Owner has a critical need for the work to begin upon Notice to Proceed and shall be Substantially Complete by the date identified by the Owner.
- B. Refer to Section 01 32 16 “Construction Progress Schedule” for other scheduling requirements, and to Section 00 73 00 “Supplementary Conditions” for information concerning liquidated damages.

END OF SECTION

SECTION 01 25 13

PRODUCT SUBSTITUTION PROCEDURES

CONDITIONS OF THE CONTRACT AND DIVISION 01, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Specified product compliance, and product quality assurance
- B. Specific administrative and procedural requirements for handling requests for substitutions made prior to award of Contract.
- C. Requirements for product delivery, storage and handling.

1.2 RELATED REQUIREMENTS

- A. Instructions to Offerors: Product options and procedures for submittal of requests for substitutions during the Proposal period.

1.3 DESCRIPTION OF REQUIREMENTS

- A. Definitions: Definitions used in this Section are not intended to negate the meaning of other terms used in the Contract Documents, including such terms as "specialties", "systems", "structure", "finishes", "accessories", "furnishings", "special construction", and similar terms. Such terms are self-explanatory and have recognized meanings in the construction industry.
 - 1. Products: Shall mean items purchased for incorporation in the Work, regardless of whether they were specifically purchased for the project or taken from the Contractor's previously purchased stock. The term "product" as used herein includes the terms "material", "equipment", "system", and other terms of similar intent.
 - a. Named Products: Are those identified by the use of the manufacturer's name for a product, including such items as a make or model designation, as recorded in published product literature, of the latest issue as of the date of the Contract Documents.
 - b. Specified Products: same as Named Products.
 - 2. Materials: Shall mean products that must be substantially cut, shaped, worked, mixed, finished, refined, or otherwise fabricated, processed, or installed to form units of work.
 - 3. Equipment: Is defined as a product with operational parts, regardless of whether motorized or manually operated, and in particular, a product that requires service connections such as wiring or piping.

1.4 PRODUCT QUALITY ASSURANCE

- A. Source Limitations: To the fullest extent possible, provide products of the same generic kind, from a single source, for each unit of work.
 - 1. When it is discovered that specific products are available only from sources that do not or cannot produce an adequate quantity to complete project requirements in a timely manner, consult with the Architect/Engineer for a determination of what product quantities are most important before proceeding. The Architect/Engineer will designate those qualities, such as visual, structural, durability, or compatibility, that are most important. When the Architect/Engineer's determination has been made, select products from those sources that produce products that possess the most important qualities, to the fullest extent possible.

- B. Compatibility of Options: Compatibility of products is a basic requirement of product selection. When the Contractor is given the option of selecting between two (2) or more products for use on the project, the product selected must be compatible with other products previously selected, even if the products previously selected were also Contractor options. The complete compatibility between the various choices available to the Contractor is not assured by the various requirements of the Contract Documents, but must be provided by the Contractor.
- C. Or Equal:
 - 1. Where the phrase “or equal”, “or equivalent”, “or Architects approved equal”, or similar phrasing, occurs in the Proposal Documents, do not assume that materials, equipment, or methods of construction will be approved by the Architect unless the item has been specifically approved for this Work by the Architect.
 - 2. The decision of the Architect shall be final.
- D. Where a proposed substitution involves the work of more than one (1) contractor, each contractor involved shall cooperate and coordinate the work with each other contractor involved, so as to provide uniformity and consistency and to assure the compatibility of products.
- E. Foreign Product Limitations: “Foreign products” as distinguished from “domestic products” are defined as products that are either manufactured substantially (50 percent or more of value) outside of the United States and its possessions, or produced or supplied by entities known to be substantially owned (more than 50 percent) by persons who are not citizens of nor living within the United States and its possessions.
 - 1. Except under one (1) of the following conditions, select and provide domestic, not foreign, products for inclusion in the Work.
 - a. There is no domestic product available that complies with the requirements of the Contract Documents.
 - b. Available domestic products that comply with the requirements of the Contract Documents are available only at prices or other procurement terms that are substantially higher (25 percent or more) than for available foreign products that comply with the requirements of the Contract Documents.
 - c. At the discretion of the Architect or Owner.
 - 2. Final determination and acceptance will be the responsibility of the Architect.
- F. Standards: Refer to Section 01 41 00 “Regulatory Requirements” for the applicability of industry standards to the products specified for the Project, and for the acronyms used in the text of the Specification Sections.

1.5 SUBSTITUTIONS OF PRODUCTS

- A. The products described in the Proposal Documents establish a standard of required function, dimension, appearance and quality to be met by any proposed substitution. The materials and equipment named in, and the procedures covered by these specifications have been selected as a standard because of quality, particular suitability or record of satisfactory performance. It is not intended to preclude the use of equal or better materials or equipment provided that same meets the requirements of the particular project and is approved in an Addendum as a substitution prior to the submission of proposals.
- B. No substitution will be considered prior to receipt of proposals unless written request for approval has been received by the Architect at least seven (7) days prior to the date for receipt of proposals. Each such request shall include the name of the material or equipment for which it is to be substituted and a complete description of the proposed substitute

including drawings, cuts, performance and test data and any other information necessary for an evaluation. The Architect's decision of approval or disapproval of a proposed substitution shall be final.

- C. If the Architect approves any proposed substitution prior to receipt of proposals, such approval will be set forth in an Addendum. Offerors shall not rely upon approvals made in any other manner.
- D. The Architect and Owner reserve the right to disapprove the use of any manufacturer who in their judgment is unsuitable for use on the Project and that decision will be final
- E. The following are not considered as substitutions:
 - 1. Revisions to the Contract Documents, when requested by the Owner, Architect, or any of their consultants are considered as “changes” not substitutions.
 - 2. Specified Contractor options on products and construction methods included in Contract Documents are choices made available to the Contractor and are not subject to the requirements specified in this Section for substitutions.
 - 3. Except as otherwise provided in the Contract Documents, the Contractor's determination of and compliance with governing authorities do not constitute “substitutions” and do not constitute a basis for change orders.
- F. The following may be considered as a reason for a request for substitution:
 - 1. The request is directly related to an “or approved equal” clause or similar language in the Contract Documents.
 - 2. The specified product or method of construction cannot be provided within the Contract Time in accordance with paragraph below concerning availability of specified items.
 - 3. The specified product or method of construction cannot receive necessary approval by a governing authority, and the requested substitution can be approved.
 - 4. A substantial advantage is offered the Owner, in terms of cost, time, energy conservation or other consideration of merit, after deducting offsetting responsibilities the Owner may be required to bear. These additional responsibilities may include such considerations as additional compensation to the Architect/Engineer for redesign and evaluation services, the increased cost of other work by the Owner or separate contractors, and similar considerations.
 - 5. The specified product or method of construction cannot be provided in a manner that is compatible with other materials, and where the Contractor certifies that the substitution will overcome the incompatibility.
 - 6. The specified product or method of construction cannot be coordinated with other materials, and where the Contractor certifies that the proposed substitution can be coordinated.
 - 7. The specified product or method of construction cannot provide a warranty required by the Contract Documents and where the Contractor certifies that the proposed substitution provides the required warranty.
- G. Availability of specified items:
 - 1. Verify prior to submittal of Proposal that all specified items will be available in time for installation during orderly and timely progress of the work.
 - 2. In the event specified items will not be so available, notify the Architect prior to receipt of Proposals. Submit Request for Substitutions in accordance with this section.

3. The request will not be considered if the product or method cannot be provided as a result of the Contractor's failure to pursue the work promptly or coordinate activities properly.
 4. Costs of delays because of non-availability of specified items, when such delays could have been avoided by the Contractor, will be back-charged as necessary and shall not be borne by the Owner.
- H. A request constitutes a representation that Offeror:
1. Has investigated proposed product and determined that it meets or exceeds quality level of specified product.
 2. Will provide same warranty for Substitution as for specified product, except when inability to provide specified Warranty is reason for request for substitution as described above.
 3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to Owner.
 4. Waives claims for additional costs or time extension which may subsequently become apparent.
 5. Will reimburse the Owner and pay for all costs, including Architect/Engineer's redesign and evaluation costs resulting from the use of the proposed substitution, or for review or redesign services associated with re-approval by authorities having jurisdiction.
- I. **No substitutions will be considered after the Award of Contract.**

1.6 SUBSTITUTION REQUEST SUBMITTAL

- A. Requests for Substitutions: Submit three (3) copies of each request for substitution. In each request identify the product or fabrication or installation method to be replaced by the substitution; include related Specifications Section and Drawing numbers, and complete documentation showing compliance with the requirements for substitutions. Include, as appropriate, with each request, the following information:
1. Product data, drawings and descriptions of products, fabrication and installation procedures.
 2. Samples, where applicable or requested.
 3. A detailed comparison of the significant qualities of the proposed substitution with those of the work originally specified. Significant qualities may include elements such as size, weight, durability, performance and visual effect, where applicable.
 4. Coordination information, including a list of changes or modifications needed by other parts of the work and to construction performed by the Owner and separate Contractors that will become necessary to accommodate the proposed substitution.
 5. A statement indicating the effect the substitution will have on the Contractor's Construction Schedule compared to the schedule without approval of the substitution. Indicate the effect of the proposed substitution on overall Contract Time.
 6. Cost information, including a proposal of the net change, if any in the Contract Sum.
 7. Certification by the Contractor to the effect that, in the Contractor's opinion, after thorough evaluation, the proposed substitution will result in work that in every significant respect is equal-to or better than the work required by the Contract Documents, and that it will perform adequately in the application indicated. Include the Contractor's waiver of rights to additional payment or time that may

subsequently become necessary because of the failure of the substitution to perform adequately.

8. A statement indicating the Contractor will reimburse the Owner and pay for all costs, including Architect/Engineer's re-design and evaluation costs resulting from the use of the proposed substitution.
- B. Work-Related Submittals: The Contractor's submittal of, and the Architect/Engineer's acceptance of, Shop Drawings, Product Data, or Samples which are related to work not complying with the Contract Documents, does not constitute an acceptance or valid request for a substitution, nor approval thereof.

1.7 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. General: Deliver, store, and handle products in accordance with manufacturer's recommendations, using means and methods that will prevent damage, deterioration and loss, including theft. Control to prevent overcrowding of construction spaces or overloading of structure. In particular, coordinate delivery and installation to ensure minimum holding or storage times for items known or recognized to be flammable, hazardous, easily damaged, or sensitive to deterioration, theft and other sources of loss.
 1. Deliver products to the site in the manufacturer's sealed containers or other packaging system, complete with labels intact, and instructions for handling, storage, unpacking, installing, cleaning and protecting.
 2. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to avoid condensation or potential degradation of product.
 3. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
 4. Store products at the site or in a bonded and insured off-site storage facility or warehouse in a manner that will facilitate inspection and measurement of quantity or counting of units. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.
 5. Store heavy materials away from the project structure or in a manner that will not endanger the supporting construction.

PART 2 - PRODUCTS

2.1 GENERAL PRODUCT COMPLIANCE

- A. General: Requirements for individual products are indicated in the Contract Documents; compliance with these requirements is in itself a contract requirement. These requirements may be specified in any one (1) of several different specifying methods, or in any combination of these methods. These methods include the following:
 1. Proprietary
 2. Descriptive
 3. Performance
 4. Compliance with Reference StandardsCompliance with codes, compliance with graphic details, allowances, and similar provisions of the Contract Documents also have a bearing on the selection process.
- B. Procedures for Selecting Products: The Contractor's options in selecting products are limited by requirements of the Contract Documents and governing regulations. They are not controlled by industry traditions or procedures experienced by the Contractor on previous construction projects. Required procedures include, but are not limited to the following for the various indicated methods of specifying:
 1. Proprietary and Semi-Proprietary Specification Requirements:

- a. Single Product Name: Where only a single product or manufacturer is named, provide the product indicated, unless the specification indicates the possible consideration of other products. Advise the Architect/Engineer before proceeding, when it is discovered that the named product is not a reasonable or feasible solution.
 - b. Two (2) or More Product Names: Where two (2) or more products or manufacturers are named, provide one (1) of the products named, at the Contractor's option. Exclude products that do not comply with specification requirements. Do not provide or offer to provide an unnamed product, unless the specification indicates the possible consideration of other products. Advise the Architect/Engineer before proceeding where none of the named products comply with specification requirements, or are not feasible for use. Where products or manufacturers are specified by name, accompanied by the term "or approved equal" or similar language, comply with this Section regarding "substitutions" to obtain approval from the Architect/Engineer for the use of an unnamed product.
2. Non-Proprietary Specification Requirements: Where the specifications name products or manufacturers that are available and may be incorporated in the Work, but do not restrict the Contractor to the use of these products only, the Contractor may, at his option, use any available product that complies with the Contract requirements.
 3. Descriptive Specification Requirements: Where the specifications describe a product or assembly generically, in detail, listing the exact characteristics required, but without use of a brand name, provide products or assemblies that provide the characteristics indicated and otherwise comply with Contract requirements.
 4. Performance Specification Requirements: Where the specifications require compliance with indicated performance requirements, provide products that comply with the specific performance requirements indicated, and that are recommended by the manufacturer for the application indicated. The manufacturer's recommendations may be contained in published product literature, or by the manufacturer's individual certification of performance. General overall performance of a product is implied where the product is specified for specific performances.
 5. Compliance with Standards, Codes, and Regulations: Where the specifications require only compliance with an imposed standard, code or regulation, the Contractor has the option of selecting a product that complies with specification requirements, including standards, codes, and regulations.
 6. Visual Matching: Where matching an established sample is required, the final judgement of whether a product proposed by the Contractor matches the sample satisfactorily will be determined by the Architect. Where there is no product available within the specified product category that matches the sample satisfactorily and also complies with other specified requirements, comply with the provisions of this Section regarding "substitutions" and other Contract Documents for "change orders" for the selection of a matching product in another product category, or for non-compliance with specified requirements.
 7. Visual Selection: Except as otherwise indicated, where specified product requirements include the phrase "...as selected from the manufacturer's standard colors, patterns, textures..." or similar phrases, the Contractor has the option of selecting the product and manufacturer, provided the selection complies with other specified requirements. The Architect is subsequently responsible for

selecting the color, pattern and texture from the product line selected by the Contractor.

8. Allowances: Refer to individual sections of the specifications and Section 01 21 00 "Allowances" for an indication of product selections that are controlled by established allowances, and for the procedures required for processing such selections.
- C. Producer's Statement of Applicability: Where individual specification sections indicate products that require a "Statement of Applicability" from the manufacturer or other producer, submit a written-certified statement from the producer stating that the producer has reviewed the proposed application of the product on the project. This statement shall state that the producer agrees with or does not object to the Architect/Engineer's specification and the Contractor's selection of the product on the project is suitable and proper.

2.2 SUBSTITUTIONS

- A. Condition: The Contractor's request for substitution will be received and considered when extensive revisions to Contract Documents are not required, when the proposed changes are in keeping with the general intent of the Contract Documents, when the request is timely, fully documented and properly submitted, and when one (1) or more of the above conditions are satisfied, all as judged and determined by the Architect/Engineer; otherwise the requests will be returned without action except to record non-compliance with these requirements.

PART 3 - EXECUTION

3.1 INSTALLATION OF PRODUCTS

- A. General: Except as otherwise indicated in individual sections of these specifications, comply with the manufacturer's instructions and recommendations for installation of the products in the applications indicated.
- B. Anchor each product securely in place, accurately located and aligned with other work.
- C. Clean exposed surfaces and protect surfaces as necessary to ensure freedom from damage and deterioration at time of acceptance.
- D. Products and assemblies shall be installed complete, in-place, watertight and structurally sound.

3.2 INSTALLATION OF APPROVED SUBSTITUTIONS

- A. Coordinate all approved substitutions with adjacent work.
- B. Comply with the manufacturer's and/or supplier's instructions and recommendations for installation of the products in the applications indicated.
- C. Provide all items required by manufacturer and/or supplier regarding installation, i.e. supplemental supports, anchors, fasteners, painting, etc. whether or not indicated or specified.

END OF SECTION

**SECTION 01 25 13
PRODUCT SUBSTITUTION PROCEDURES – REQUEST FORM**

DATE: _____
TO: _____
ATTENTION: _____
PROJECT: _____

We submit for your consideration the following product as a substitution for the specified product:

Section No.	Paragraph	Specified Product
_____	_____	_____

Proposed Substitution:

Reason for Substitution:

Product Data:

Attach complete technical data for both the specified product and the proposed substitution.
Include information on changes to Contract Documents that the proposed substitution will require
for its proper installation.

Samples:

Attached Will be furnished upon request

Does the substitution affect dimensions shown on Drawings?

No Yes (explain)

Effects of proposed substitution on other Work:

Differences between proposed substitution and specified Product:

Manufacturer's warranties of the proposed substitution are:

Same Different (explain)

Maintenance service and spare parts are available for proposed substitution from:

Previous installations where proposed substitution may be seen:

Project: _____ Owner: _____

Project: _____ Owner: _____

Architect: _____ Architect: _____

Date Installed: _____ Date Installed: _____

Cost savings to be realized by Owner, if proposed substitution is approved:

Change to Contract Time, if proposed substitution is approved:

No Change Add _____ days Deduct _____ days

Submittal constitutes a representation that Construction Manager has read and agrees to the provisions of Section 01 25 13.

Submitted by Construction Manager:

Signature

Firm

For Use by Architect:

Based on the information supplied by the Construction Manager, the Architect has reviewed the proposed substitution on the basis of design concept of the Work and conformance with information given in Contract Documents.

Approved Approved as Noted Rejected

Submit Additional Information:

By: _____

Date:

SECTION 01 26 00

CONTRACT MODIFICATION PROCEDURES

CONDITIONS OF THE CONTRACT AND DIVISION 01, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. Requests for Interpretation
 - 2. Change Procedures
 - a. Minor Changes
 - b. Change Proposal Requests
 - 3. Defect Assessment
- B. Related Requirements
 - 1. Section 01 33 00 "Submittal Procedures"
 - 2. Section 01 40 00 "Quality Control"
 - 3. Section 01 60 00 "Product Requirements"

1.2 REFERENCES

- A. Definitions:
 - 1. Request for Interpretation:
 - a. A written request from the Contractor to the Architect seeking information, interpretation, or clarification of some requirement of the Contract Documents.
 - b. The following are not Requests for Information:
 - 1) Substitution Request
 - 2) Non-Conformance Notice
 - 3) Action Submittals
 - 4) Information Submittals
 - 5) Shop Drawings, Product Data, and Samples required by the Contract Documents
 - 6) Schedule Submittals
 - 7) Project Memos and Letters
 - 2. Drawing/Specification Clarification: A response from the Architect, in response to an inquiry from the Contractor, intended to make some requirement of the Drawings or Specifications more clearly understood. Drawings/Specification clarification may be sketches, drawings, or in narrative form and will not change any requirements of the Drawings or Specifications.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate requirements of this Section with the requirements of the General and Supplementary Conditions of the Contract concerning change procedures.

1.4 REQUEST FOR INTERPRETATION

- A. In the event the Contract Documents require clarification or additional information, Contractor shall submit a "Request for Interpretation" in writing to the Architect on form required by the Owner.
 - 1. Clearly and concisely state the issue for which clarification or additional information is required and why a response from the Architect is needed.
 - 2. State interpretation or understanding of the Contract Documents' requirements along with reasons for reaching the understanding.
 - 3. Response from the Architect will not change requirements of the Contract Documents.
- B. The Architect will review Requests for Interpretation to determine if they are valid within the meaning of the term. If the Architect determines the document is not a Request for Interpretation, the document will be returned to the Contractor for resubmission in the proper form.
- C. Responses to Request for Interpretation will be issued within 5 days of receipt of the request from the Contractor unless the Architect determines that additional time is necessary to provide an adequate response.
 - 1. If it is determined that additional time is necessary, the Architect will notify the Contractor within the 5 days of the anticipated response time.
 - 2. If the Contractor submits a Request for Interpretation on an activity with 5 days or less float on the current Project Schedule, the Contractor shall not be entitled to any time extension due to the time it takes the Architect to respond to the request, provided that the Architect responds within the 5 days set forth above.
- D. A Drawing/Specification Clarification issued by the Architect does not constitute a change to any requirement of the Contract Documents.
 - 1. If the Contractor believes that a Drawing/Specification Clarification to a Request for Interpretation will cause a change to the requirements of the Contract Document, the Contractor shall immediately give written notice to the Architect stating that the Contractor considers the response to be a modification to the Contract.
 - 2. Failure on the part of the Contractor to give such written notice immediately shall waive Contractor's right to seek additional time or cost under Section 01 26 00 "Contract Modification Procedures".
- E. Where a response to a Request for Interpretation constitutes a modification to contract requirements, the Architect will follow administrative procedures under defined within this Section.

1.5 CHANGE PROCEDURES

- A. Submittals: Submit name of individual authorized to receive change documents, and be responsible for informing others in Contractor's employ or Subcontractors of changes to the Work.
- B. Minor Changes: The Architect/Engineer may advise of minor changes in the Work not involving adjustment to Contract Sum/Price or Contract Time by issuing supplemental instructions on Minor Change form or by other similar documents in the form issued by the Architect.
- C. Change Proposal Request: The Architect may issue a Change Proposal Request (CPR) or other similar request for proposal in the form issued by the Architect, including a detailed description of proposed change with supplementary or revised Drawings and Specifications, a change in Contract Time for executing the change and the period of time during which the requested price will be considered valid. Contractor will prepare

and submit estimate in the form of a Change Proposal so as to not cause delays in the Project.

- D. Use of allowances must be approved by issuance of Allowance Expenditure Authorization (AEA) by Architect prior to modification of the schedule of values. The AEA may be comprised of a single executed Change Proposal, an accumulation of executed Change Proposals, or other similar documentation in the form allowed by the Architect in accordance with Document CB, Supplementary Conditions of the Contract.
- E. Contractor may propose changes which, in his opinion, will provide value to the Owner, by submitting a request for change to Architect, describing proposed change and its full effect on the Work. Include a statement describing reason for the change, and effect on Contract Sum/Price and Contract Time with full documentation and a statement describing effect on Work by separate or other Contractors. If accepted by Architect and approved by Owner, submit a Change Order in accordance with the requirements of this Section. This request will not be considered a substitution except as defined by Section 01 25 13 "Product Substitution Procedures". Owner is not obligated to accept this request.
- F. Construction Change Directive: Architect/Engineer may issue directive, on AIA Form G713 Construction Change Directive or other similar document in the form issued by the Architect, and signed by Owner, instructing Contractor to proceed with change in the Work, for subsequent inclusion in a Change Order. Document will describe changes in the Work, and designate method of determining any change in Contract Sum/Price or Contract Time. Promptly execute change.
- G. Document each quotation for change in cost or time with sufficient data to allow evaluation of quotation.
- H. Change Order Forms: AIA G701 - Change Order.
- I. Execution of Change Orders: The Architect will prepare and sign the Change Order, the contractor shall sign the Change Order indicating acceptance of the change, and then the Owner will execute the Change Order.
- J. Correlation Of Contractor Submittals:
 - 1. Promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as separate line item and adjust Contract Sum/Price.
 - 2. Promptly revise progress schedules to reflect change in Contract Time, revise sub-schedules to adjust times for other items of work affected by the change, and resubmit.
 - 3. Promptly enter changes in Project Record Documents.

1.6 DEFECT ASSESSMENT

- A. Replace the Work, or portions of the Work, not conforming to specified requirements at no additional cost to the Owner.
- B. If, in the opinion of the Architect/Engineer or Owner, it is not practical to remove and replace the Work, the Architect will direct appropriate remedy or adjust payment.
- C. The defective Work may remain, but sum/price will be adjusted to new sum/price at the discretion of Architect or Owner.
- D. Individual specification sections may modify these options or may identify specific formula or percentage sum/price reduction.
- E. Authority of Architect/Engineer, or other appropriate agent identified to perform assessment by the Architect/Engineer or Owner, to assess defects and identify payment adjustments, is final.

- F. Non-Payment For Rejected Products: In addition to replacement of rejected Work, payment will not be made for rejected products 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 not completely unloaded from transporting vehicle.
 4. Products placed beyond lines and levels of required Work.
 5. Products remaining on hand after completion of the Work.
 6. Loading, hauling, and disposing of rejected products.

PART 2 – PRODUCTS *(Not Used)*

PART 3 – EXECUTION *(Not Used)*

END OF SECTION

SECTION 01 29 00
PAYMENT PROCEDURES

CONDITIONS OF THE CONTRACT AND DIVISION 01, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Procedures for submitting Applications for Payment.

1.2 GENERAL

- A. Coordinate requirements of this Section with the requirements of the General and Supplementary Conditions of the Contract concerning payment procedures.

1.3 SCHEDULE OF VALUES

- A. Submit printed schedule on AIA Form G703 - Continuation Sheet for G702 in accordance with Section 01 29 73 "Schedule of Values". Contractor's standard form or electronic media printout will be considered but must be approved by the Owner.

1.4 APPLICATIONS FOR PAYMENT

- A. Submit four (4) notarized originals of each application on AIA Form G702 - Application and Certificate for Payment and AIA G703 - Continuation Sheet for G702 or other similar form approved by the Owner.
- B. Content and Format: Utilize Schedule of Values for listing items in Application for Payment.
- C. Submit updated construction schedule with each Application for Payment.
- D. Payment Period: Submit at intervals stipulated in the Agreement in accordance with Document CB, Supplementary Conditions of the Contract.
- E. Only materials stored on the project site shall be paid for unless the materials are stored in a bonded warehouse.
- F. Substantiating Data: When Architect/Engineer requires substantiating information, submit data justifying dollar amounts in question. Items which may be requested by the Architect or Owner to substantiate costs include, but are not limited to the following:
 - 1. Current Record Documents as specified in Section 01 77 00 "Closeout Procedures", for review by Owner which will be returned to Contractor.
 - 2. Labor time sheets, purchase orders, or similar documentation.
 - 3. Affidavits attesting to off-site stored products.

PART 2 – PRODUCTS *(Not Used)*

PART 3 – EXECUTION *(Not Used)*

END OF SECTION

SECTION 01 29 73
SCHEDULE OF VALUES

CONDITIONS OF THE CONTRACT AND DIVISION 01, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 SUMMARY

- A. Work Included: Provide a detailed breakdown of the agreed Contract Sum showing values allocated to each of the various parts of the Work, as specified herein and in other provisions of the Contract Documents.
- B. Coordinate requirements of this Section with the requirements of the General and Supplementary Conditions of the Contract concerning Schedule of Values.

1.2 SUBMITTALS

- A. Prior to the first Application for Payment, submit a proposed schedule of values to the Owner, as outlined below:
 - 1. Meet with the Owner and determine additional data, if any, required to be submitted.
 - 2. Secure the Owner's approval of the schedule of values prior to submitting first Application for Payment.

1.3 QUALITY ASSURANCE

- A. Use required means to assure arithmetical accuracy of the sums described.
- B. When so required by the Owner, provide copies of the subcontracts or other data acceptable to the Owner, substantiating the sums described.

1.4 SCHEDULE OF VALUES

- A. The Schedule of Values shall be broken down into item costs for each specification section as a minimum. After review by the Owner, the Schedule of Values shall be broken down into further items as required. (See following list and refer to the enclosed sample.). In addition, total each Specification Division separately.
- B. Schedule of Values - Items in addition to Specification Sections.
 - 1. Mobilization
 - 2. Clean Up
 - 3. Building Permit
 - 4. Bonds, Insurance
 - 5. Misc. Mechanical Accessories
 - 6. Demolition
 - 7. Rough-In Labor – (Electrical)
 - 8. Rough-In Material – (Electrical)
 - 9. Finish Labor – (Electrical)
 - 10. Finish Material – (Electrical)
 - 11. Allowances (listed separately)
 - 12. Record drawings and close-out documents
 - 13. Submittals listed separately per mechanical, electrical and plumbing
 - 14. Roof warranty as a line item
 - 15. Donated items individually itemized at \$0.00 (zero dollars).

PART 2 – PRODUCTS *(Not Used)*

PART 3 – EXECUTION

3.1 SCHEDULE OF VALUES

- A. Refer to following sample

.

SAMPLE SCHEDULE OF VALUES

SECTION 01 29 73

SCHEDULE OF VALUES - SAMPLE

Item No.	Description of Work	Scheduled Value	Work Completed		Stored Materials	Total Completed	%	Balance To Finish	Retainage
			Previous App.	This App.					
	Div. 1 - General Reqs. Site Work General Conditions Suoverision Mobilization Bonds & Insurance Permits Contractor's Fee Close-Out Documents								
	Div. 1 - Total								
	Div. 2 - Existing Conditions Demolition (As applicable) Erosion Control Div. 2 - Total								
	Div. 3 - Concrete Drill Piers Caps & Beams Slab on Grade Cooling Tower Basin Misc Bldg Conc Floor Sealer Rebar Matl Rebar Labor Lt.Wt.Insul Fill - Materials Lt.Wt.Insul Fill - Labor Close-Out Documents								
	Div. 3 - Total Div 4 - Masonry Brickwork - Labor Brickwork - Matls Concrete Masonry - Labor Concrete Masonry - Materials Str. Glazed Tile-Labor Str. Glazed Tile-Materials Close-Out Documents								
	Div. 4 - Total								
	Div 5 - Metals Structural Steel - Labor Structural Steel - Materials Alternating Stairs Misc. Steel - Materials Steel Joists - Materials Lt. Gauge Steel Framing-Labor Lt. Gauge Steel Framing-Matls Metal Decking - Labor Expansion Joint Covers Metal Decking - Matls Close-Out Documents								
	Div. 5 - Total								

SECTION 01 29 73

SCHEDULE OF VALUES - SAMPLE

Item No.	Description of Work	Scheduled Value	Work Completed		Stored Materials	Total Completed	%	Balance To Finish	Retainage
			Previous App.	This App.					
	Div. 6 - Wood & Plastics Rough Carpentry - Labor Rough Carpentry - Materials Millwork - Labor Millwork - Materials Close-Out Documents								
	Div. 6 - Total								
	Div. 7 - Thermal and Moisture Protection Waterpfng / Dampprfng-Matls Waterpfng / Dampprfng-Labor Building Insulation - Labor Building Insulation - Materials Fireproofing - Labor Fireproofing - Materials Metal Roof - Labor Metal Roof - Materials Metal Roof Guarantee Built-up Roofing-Labor Built-up Roofing-Materials Built-up Roofing Guarantee Roof Accessories Building Sheet Metal - Labor Building Sheet Metal - Matls Bldg. Sheet Metal Guarantee Roof Curbs Roof Hatches Sealants Close-Out Documents								
	Div. 7 - Total								
	Div. 8 - Doors and Frames Finish Carpentry/Door - Labor Finish Hardware - Matls Thresholds & Seals - Matls+B66 Hollow Metal Doors & Frames - Matls Plastic Faced Doors-Matls Overhead Doors & Grilles-Labor Overhead Doors & Grilles - Matls Alum. Entrances & Store-fronts - Labor Alum. Entrances & Store-fronts - Matls Alum. Windows - Labor Alum Windows - Matls Glass & Glazing-Labor Glass & Glazing-Matls Close-Out Documents								

SECTION 01 29 73

SCHEDULE OF VALUES - SAMPLE

Item No.	Description of Work	Scheduled Value	Work Completed		Stored Materials	Total Completed	%	Balance To Finish	Retainage
			Previous App.	This App.					
	Div. 8 - Total								
	Div. 9 - Finishes Lath & Plaster-Labor Lath & Plaster-Matls Gypsum Wallboard Systems - Labor Gypsum Wallboard Systems - Matls Ceramic Tile - Labor Ceramic Tile - Matls Quarry Tile - Labor Quarry Tile - Matls Terrazzo-Labor Terrazzo-Matls Acoustic Clg. - Labor Acoustic Clg. - Matls Acoustic Wall Panels Resilient Flooring - Labor Resilient Flooring - Matls Carpet - Labor Carpet - Matls Athletic Flooring - Materials Athletic Flooring - Labor Floor Sealer Painting - Labor Painting - Mtls Close-Out Documents								
	Div. 9 - Total								
	Div. 10 - Specialties Visual Display Boards & Tackboards - Materials Visual Display Boards & Tackboards - Labor Toilet Partitions - Labor Toilet Partitions - Matls Louvers Aluminum Flag Pole Graphics Lockers Cubicle Curtains & Track Fire Extinguisher Cabinets Demountable Partitions-Labor Demountable Partitions-Matls Shelving Toilet Room Accessories-Matls Toilet Room Accessories-Lbr Close-Out Documents								
	Div. 10 - Total								
	Div. 11 - Equipment								

SECTION 01 29 73

SCHEDULE OF VALUES - SAMPLE

Item No.	Description of Work	Scheduled Value	Work Completed		Stored Materials	Total Completed	%	Balance To Finish	Retainage
			Previous App.	This App.					
	Stage Curtains Misc. Appliances Food Service Eqpt-Labor Food Service Eqpt-Matls Close-Out Documents								
	Div. 11 - Total								
	Div. 12 - Furnishings Horizontal Blinds Projection Screens Casework - Labor Casework - Matls Science Casework - Labor Science Casework - Matls Close-Out Documents								
	Div. 12 - Total								
	Div. 13 - Specialties Stage Curtains and Draperies Music Instrument Storage Bleachers Press Box Pre-eng. Metal Bldg. Stadium Seating Close-Out Documents								
	Div. 13 - Total								
	Div. 14 - Conveying Systems Platform Lifts Elevators Close-Out Documents								
	Div. 14 - Total								
	Div. 21, 22 - Plumbing Shop Drawings As-Builts/Close-Out/ O&M Manuals Sanitary Underground - Labor Sanitary Underground - Matls Storm Underground - Labor Storm Underground - Matls Domestic Water - Labor Domestic Water - Matls Plumbing Insulation - Matls Plumbing Insulation - Labor Gas Piping - Matls Gas Piping - Labor Grease Trap								

SECTION 01 29 73

SCHEDULE OF VALUES - SAMPLE

Item No.	Description of Work	Scheduled Value	Work Completed		Stored Materials	Total Completed	%	Balance To Finish	Retainage
			Previous App.	This App.					
	Plumbing Fixtures - Mats Plumbing Fixtures - Labor Coordination Drawings Close-Out Documents								
	Div. 21, 22 Plumbing - Total								
	Div. 23 - Mechanical Shop Drawings As-Builts/Close-Out/ O&M Manuals Chillers - Mats Chillers - Labor Cooling Towers - Mats Cooling Towers - Labor Boilers - Mats Boilers - Labor AHU's - Mats AHU's - Labor Fans - Mats Fans - Labor Grilles - Mats Grilles - Labor Ductwork - Mats Ductwork - Labor Pumps - Mtls Pumps - Labor Water Treatment - Labor Water Treatment - Mats Isolation - Labor Isolation - Mats Pipe Flex - Mats Pipe Flex - Labor Connections Sheet Metal - Mats Sheet Metal - Labor Duct Insulation - Mats Duct Insulation - Labor Pipe Insulation - Mats Pipe Insulation - Labor VAV Boxes - Materials VAV Boxes - Labor Refrigerant Monitor - Mats Refrigerant Monitor - Labor Unit Heaters - Materials Unit Heaters - Labor Startup Controls - Mats Control - Labor Engineer / Submittals Modules / End Devices Low Voltage Wiring Startup								

SECTION 01 29 73

SCHEDULE OF VALUES - SAMPLE

Item No.	Description of Work	Scheduled Value	Work Completed		Stored Materials	Total Completed	%	Balance To Finish	Retainage
			Previous App.	This App.					
	Close-Out Documents Fire Sprinkler Engineer / Submittals Piping - Materials Piping - Labor Equipment - Materials Equipment - Labor Trimout - Materials Trimout - Labor Pipe, Valves, Fittings - Labor Pipe, Valves, Fittings - Matls Misc. - Matls Insulation - Matls Insulation - Labor Sanitary Above Slab-Labor Sanitary Above Slab-Matls Storm Above Slab - Labor Storm Above Slab - Matls Gas - Labor Gas - Matls Fixtures - Labor Fixtures - Matls Permits Coordination Drawings Close-Out Documents								
	Div. 23 Mechanical - Total								
	Div. 26 - Electrical Mobilization+B220 Shop Drawings As-Builts/Close-Out/ O&M Manuals Underground Conduit - Labor Conduit - Matl Wire - Labor Wire - Matls Feeder Wire - Labor Feeder Wire - Matls Switches/Recpt. Switchgear - Labor Switchgear - Matls Temporary - Materials Temporary - Labor Gas Generator - Materials Gas Generator - Labor Fixtures - Labor Fixtures - Matls Communications - Labor Communications - Matls Fire Alarm - Labor Fire Alarm - Matls								

SECTION 01 29 73

SCHEDULE OF VALUES - SAMPLE

Item No.	Description of Work	Scheduled Value	Work Completed		Stored Materials	Total Completed	%	Balance To Finish	Retainage
			Previous App.	This App.					
	Security - Labor Security - Matls Low Voltage Ltng Sys-Matls Low Voltage Ltng Sys-Labor Voice System - Materials Voice System - Labor Video System - Materials Video System - Labor Data System - Materials Data System - Labor Master Clock - Materials Master Clock - Labor+B277 Coordination Drawings Close-Out Documents								
	Div. 26 - Total								
	Divs. 31, 32 and 33 - Earthwork, Exterior Improvments and Utilities								
	Site Clearing & Grubbing Building Pad - Materials Building Pad - Labor Paving Subgrade Signage / Striping Bike Racks Landscaping - Materials Landscaping - Labor Hydro Mulch - Materials Hydro Mulch - Labor Irrigation - Materials Irrigation - Labor Earthwork Finish Grading Stabilization - Materials Stabilization - Labor Site Drainage - Materials Site Drainage - Labor Chain Link Fence-Materials Chain Link Fence-Labor Paving - Labor Paving - Materials Sidewalks Close-Out Documents								
	Div. 31, 32 and 33 - Total								
	General Conditions								
	Mobilization Temp. Facilities Final Cleaning Record Documents/Close-out/ O&M Manuals Supervision Permits Bonds								

SECTION 01 29 73

SCHEDULE OF VALUES - SAMPLE

Item No.	Description of Work	Scheduled Value	Work Completed		Stored Materials	Total Completed	%	Balance To Finish	Retainage
			Previous App.	This App.					
	Insurance Allowances Alternates (list) Change Orders A. PR# B. PR# C. PR#								

END OF SECTION

2017 SET Laboratory Renovation – Garni
St. Mary's University
Issue for Construction

PBK Architects
PBK Job #1760G
Date: March 17, 2017

END OF SECTION

SECTION 01 31 13
PROJECT COORDINATION

CONDITIONS OF THE CONTRACT AND DIVISION 01, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 SUMMARY

- A. Administrative and procedural requirements governing Project coordination.

1.2 REQUIREMENTS

- A. General: notify the Architect whenever there is need of clarification or interpretation of the Contract Documents prior to commencement of work.
- B. Commencement of work without Architect's prior notification means Contractor's acceptance of responsibility.
- C. Commencement of work without Architect's prior notification implies Contractor's understanding of conditions, assemblies, methods, or procedures.
- D. The project superintendent shall notify the Owner on an ongoing basis of ongoing work.

1.3 PRE-INSTALLATION CONFERENCE

- A. General: Notify the Architect 48 hours in advance of certain stages of construction, and, as required by the Architect, organize a pre-installation meeting with each trade individually prior to commencement of their portion of the Work. At a minimum, representatives of the Architect, the General Contractor's project superintendent, and the Sub-contractor's Foreman and Project Manager shall be present at each meeting. The Engineer shall be notified as applicable.
- B. As indicated in each specific section of this Project Manual, or as required by the Architect, these stages generally include, but are not necessarily limited to the following:
 - 1. Section 02 40 00 "Demolition"
 - 2. Section 05 50 00 "Metal Fabrications": Miscellaneous metals, ladders, brackets, pipe rails, etc.
 - 3. Section 06 20 00 "Finish Carpentry": Finish Carpentry and Millwork
 - 4. Division 07: installation of waterproofing, air barriers, vapor barriers, flashing and sheet metal
 - 5. Division 07: Installation of roofing system(s) and associated work
 - 6. Section 07 81 23 "Intumescent Fireproofing": Application of fireproofing
 - 7. Section 07 84 00 "Firestopping": Installation of firestopping and fire safing
 - 8. Section 07 92 00 Joint Sealant": Installation of building and glazing sealants
 - 9. Section 08 80 00 "Glazing": Installation of glazing
 - 10. Division 09: Installation of plaster and gypsum board products
 - 11. Division 09: Installation of flooring
 - 12. Section 09 51 00 Acoustical Ceilings": Installation of acoustical ceiling (grid and panels)
 - 13. Division 09 - Installation of resilient flooring and base
 - 14. Section 09 90 00 "Painting and Coating": Painting and staining (each coat)
 - 15. Division 10: Installation of specialty items, markerboards
 - 16. Division 10: Installation of operable walls and folding partitions

17. Division 12: Installation of laboratory casework
 18. Divisions 22, 23 and 26: Completion of roughing-in of plumbing, heating, air conditioning and electrical work (prior to concealment)
 19. Division 22: Installation of plumbing fixtures
 20. Division 23: Installation of heating, ventilating and air conditioning
 21. Division 26: Installation of all electrical fixtures
 22. Divisions 22, 23 and 26: Any and all testing specified for equipment, mechanical, electrical and plumbing systems
- C. In addition to notifying the Architect, notify the Structural Engineer (48 hours) prior to the following stages:
1. Drilling, reinforcing, and placing of first piers and footings.
 2. Placing first reinforcing and grade beams.
 3. Erecting structural steel elements.

PART 2 – PRODUCTS (*Not Used*)

PART 3 – EXECUTION

3.1 PRE-CONSTRUCTION CONFERENCE

- A. The Contractor shall contact Architect at least ten (10) days prior to commencing construction in order for Architect to schedule a pre-construction meeting with Contractor, Architect, and Owner. This meeting must occur prior to commencement of any construction.

3.2 CONFERENCES AND MEETINGS

- A. Refer to Section 01 31 19, "Project Meetings" for requirements pertaining to Pre-construction Conference, Progress Meetings, and Pre-installation Conferences.

END OF SECTION

SECTION 01 31 19
PROJECT MEETINGS

CONDITIONS OF THE CONTRACT AND DIVISION 01, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 SUMMARY

- A. Administrative and procedural requirements governing Project meetings, including:
 - 1. Pre-Construction Conference
 - 2. Progress Meetings
 - 3. Pre-Installation Conferences
 - 4. Pre-Closeout Meeting

1.2 REQUIREMENTS INCLUDE

- A. The Architect's:
 - 1. Scheduling of each meeting (pre-construction meeting, periodic project meetings, and specialty called meetings throughout the progress of the Work).
 - 2. Preparation of agenda for meetings.
 - 3. Presiding at minutes, including all significant proceedings and decisions.
 - 4. Recording, reproducing, and distributing copies of meeting minutes within two (2) working days, excluding weekends and holidays, after each meeting to:
 - a. All participants in the meeting.
 - b. All parties affected by decisions made at the meeting.
 - 5. Providing status report of allowance funds.
- B. The Contractor's:
 - 1. Making physical arrangement for meetings.
 - 2. Participation in all meetings and conferences.
 - 3. Scheduling attendance of Job Superintendent, Project Coordinator, and other parties affecting or affected by decisions made at meetings and conferences as their interests require.
 - 4. Scheduling Pre-installation conferences.
 - 5. Scheduling Pre-Closeout Meeting
 - 6. Providing updated schedules.
 - 7. Providing status reports/logs of CPRs, MCs, and shop drawings/submittals.

PART 2 – PRODUCTS *(Not Used)*

PART 3 – EXECUTION

3.1 PRE-CONSTRUCTION CONFERENCE

- A. Contractor shall contact Architect at least ten (10) days prior to commencing construction in order for Architect to schedule a pre-construction meeting with Contractor, Architect, and Owner. This meeting must occur prior to commencement of any construction.
- B. Architect will:
 - 1. Administer pre-construction conference for the establishment of communication methods, procedures and Owner requirements.
 - 2. Administer site mobilization conference for clarification of Owner and Contractor.

- C. Location: At Project site as designated by the Architect.
- D. Attendance:
 - 1. Contractor or Contractor's Representative
 - 2. Job Superintendent
 - 3. Project Coordinator (Manager)
 - 4. Owner or Owner's Representative
 - 5. Major subcontractors
 - 6. Major suppliers
 - 7. Architect's Representative
 - 8. Architect's Field Representative
 - 9. Consultants as needed
 - 10. Others as appropriate
- E. Meeting Agenda, may include, but is not limited to:
 - 1. Discussion on major subcontracts and suppliers and projected construction schedules.
 - 2. Critical work sequencing.
 - 3. Major equipment deliveries and priorities. Discussion of long lead time items.
 - 4. Project coordination and designation of responsible personnel.
 - 5. Procedures and processing of field decisions, proposal requests, submittals, minor changes, change orders and applications for payment.
 - 6. Method of distribution of Contract Documents.
 - 7. Procedures for maintaining Record Documents.
 - 8. Use of premises, office work and storage areas, on-site parking, and Owner's requirements.
 - 9. Construction facilities and temporary utilities.
 - 10. Housekeeping procedures.

3.2 PROGRESS MEETINGS

- A. Architect will:
 - 1. Schedule project meetings throughout progress of the work at weekly intervals, and specially called meetings.
 - 2. Set agenda and administer said meetings.
 - 3. Preside at meetings.
 - 4. Record meeting minutes, including all significant proceedings and decisions.
 - 5. Reproduce and distribute copies of meeting minutes within two (2) working days, excluding weekends and holidays, after each meeting to:
 - a. All participants in the meeting.
 - b. All parties affected by decisions made at the meeting.
- B. Contractor shall:
 - 1. Make physical arrangements for meetings.

- C. Attendance:
 - 1. Contractor or Contractor's Representative
 - 2. Job Superintendent
 - 3. Project Coordinator (Manager)
 - 4. Owner or Owner's Representative
 - 5. Major subcontractors
 - 6. Major suppliers
 - 7. Architect's Field Representative
 - 8. Consultants as needed
 - 9. Others as appropriate
- D. Meeting Agenda, may include, but is not limited to:
 - 1. Review and approval of minutes of previous meeting.
 - 2. Review of Work progress since previous meeting.
 - 3. Field observations, problems, and conflicts.
 - 4. Review of off-site fabrication and delivery schedules.
 - 5. Corrective measures and procedures to regain projected schedule.
 - 6. Revisions to Construction Schedule.
 - 7. Plan progress and schedule during succeeding work period.
 - 8. Coordination of schedules.
 - 9. Review submittal schedules and expedite as required.
 - 10. Maintenance of quality standards.
 - 11. Allowance balances.
 - 12. Review of proposed changes and substitutions for:
 - a. Effect on Construction Schedule and on completion date.
 - b. Effect on other contracts of the Project.
 - 13. Status of Allowance Expenditure Authorizations (AEAs).
 - 14. Status of Change Proposal Requests (CPRs).
 - 15. Status of Minor Changes (MCs).
 - 16. Status of submittals, review of submittal log.
 - 17. Other items and critical issues affecting Work.

3.3 PRE-INSTALLATION CONFERENCES

- A. In accordance with the requirements of Section 01 31 13 "Project Coordination", the Contractor will convene pre-installation conferences when required by individual specification Sections or as required by the Architect, prior to the Contractor commencing Work of the Section.
- B. Attendance, optional:
 - 1. General Contractor or Contractor's Representative
 - 2. Project Coordinator (Manager)
 - 3. Owner or Owner's Representative
 - 4. Architect's Project Manager (Project Executive)

- C. Attendance, required:
 - 1. Project Superintendent
 - 2. Architect's Field Representative
 - 3. Sub-contractor's Project Manager
 - 4. Sub-contractor's Foreman
 - 5. Engineer's Representative, as needed.
 - 6. Manufacturer's Representative, as needed.
 - 7. Governing Agency Official, as required
 - 8. Inspection Agency Representative, as required.
 - 9. Others affecting or affected by Work.
- D. Meeting Agenda, may include, but is not limited to:
 - 1. Review of conditions of installation.
 - 2. Preparation and installation procedures.
 - 3. Coordination with related work
 - 4. Review of the contract document requirements.
 - 5. Review of code enforcement or testing requirements.
 - 6. Questions related to work required.

3.4 PRE-CLOSEOUT MEETING

- A. In accordance with the requirements of Section 01 77 00 "Closeout Procedures", the Contractor will convene a pre-closeout meeting when he considers the Work or designated portion of the Work is sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the work for its intended use.
- B. Attendance, required:
 - 1. Owner or Owner's Representative
 - 2. Project Coordinator (Manager)
 - 3. General Contractor or Contractor's Representative
 - 4. Project Superintendent
 - 5. Architect's Project Manager (Project Executive)
 - 6. Architect's Field Representative
 - 7. Engineer's Representative, as needed.
- C. Meeting Agenda, may include, but is not limited to:
 - 1. Review of the contract document requirements for Substantial Completion and Project Closeout
 - 2. Review of Work which remains to be completed or corrected.
 - 3. Closeout Document review schedule and log
 - 4. Review of closeout procedures including, but not limited to Record Drawings, Warrantees, Operation and Maintenance Manuals, and Owner Demonstrations and Start-up.
 - 5. Review of code enforcement or testing requirements.

6. Questions related to work required.

END OF SECTION

SECTION 01 32 16

CONSTRUCTION PROGRESS SCHEDULE

CONDITIONS OF THE CONTRACT AND DIVISION 01, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes: Requirements for preparation of Construction Schedules for the Work of This Contract.
 - 1. Create a Construction Schedule using Critical Path Method (CPM) computer software capable of mathematical analysis of Precedence Diagramming Method (PDM) schedules. Provide printed activity listings and bar charts in formats described in this Section.
 - 2. Combine activity listings and bar charts with a narrative report to form the Contractor's Construction Schedule submittal to the Architect.
- B. Related Requirements:
 - 1. Section 01 31 13 "Project Coordination"
 - 2. Section 01 31 19 "Project Meetings"
 - 3. Section 01 33 00 "Submittal Procedures"
 - 4. Section 01 77 00 "Close-out Procedures"

1.2 DEFINITIONS

- A. Activity: A task or discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling construction of the Project. Activities included in a construction schedule consume time and resources.
 - 1. Critical activities are activities on the critical path. They must start and finish on the planned early start and finish times.
 - 2. Predecessor activities are activities that must be completed before another given activity can be started.
- B. CPM: Critical Path Method, a method of planning and scheduling a construction project in which activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of the Project.
- C. Critical Path: The longest continuous chain of activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- D. Event: The starting or ending point of an activity.
- E. Float: The measure of leeway in starting and completing an activity.
 - 1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and the Contract completion dates.
 - 2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the following activity.
 - 3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.
- F. Fragnet: A partial fragmentary network that breaks down activities into smaller activities for greater detail.
- G. Major Area: A story of construction, a separate building, or other significant construction element.

- H. Milestone: A key or critical point in time for reference or measurement.
- I. Network Diagram: A graphic diagram of a network schedule, showing activities and activity relationships.

1.3 SUBMITTALS

- A. Submittals Schedule: Arrange the following information in a tabular format.
 - 1. Specification section number and title
 - 2. Name of subcontractor
 - 3. Description of the Work covered
 - 4. Scheduled date for first submittal from vendor coordinated with construction schedule
 - 5. Scheduled date for Architect's final release or approval
 - 6. Submittal category (action or informational)
 - 7. Fabrication time
 - 8. Date material to be delivered to site
- B. Preliminary Construction Schedule:
 - 1. Phasing of construction:
 - a. Preconstruction services
 - b. Construction services
 - c. Major Areas
 - d. Close-out
 - 2. Owner coordinated activities as identified in the Contract Documents
 - 3. Milestones:
 - a. Project mobilization and demobilization
 - b. Concrete slab completion
 - c. Paving completion
 - d. Envelope dry-in
 - e. Climate control initiation
 - f. Final cleaning
 - g. Close-out
 - 1) Final inspection and testing
 - 2) Owner training
 - 3) Punchlist re-walk
 - 4) Close-out document submission
 - 4. The scheduling software shall be capable of producing activity listings and bar charts with the following information for each activity in the schedule:
 - a. Activity ID
 - b. Activity Description
 - c. Estimated (Original) Duration
 - d. Percentage Complete
 - e. Early Start Date

- f. Late Start Date
 - g. Early Finish Date
 - h. Late Finish Date
 - i. Free Float
 - j. Total Float
 - k. Activity Codes (for Major Areas, work types, specification sections, subcontractors, etc.)
5. Predecessor/successor listing sorted by Activity ID which meets the criteria outlined in this section and which is produced by the Contractor's approved scheduling software.
 6. Include a logic network diagram with the first construction schedule submittal.

1.4 QUALITY ASSURANCE

- A. Pre-scheduling Conference: Conduct conference at Project site. Review method and procedures related to the Preliminary Construction Schedule and Project Construction Schedule, including but not limited to the following:
 1. Review software limitations and content and format for reports
 2. Verify availability of qualified personnel needed to develop and update schedule
 3. Discuss constraints
 4. Review delivery dates for Owner-furnished products
 5. Review schedule for work of Owner's separate constraints
 6. Review time required for review of submittals and re-submittals
 7. Review requirements for tests and inspections by independent testing and inspecting agencies
 8. Review time required for completion and startup procedures
 9. Review and finalize list of construction activities to be included in schedule
 10. Review submittal requirements and procedures
 11. Review procedures for updating schedule

1.5 COORDINATION

- A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contractors.
- B. Coordinate Project Construction Schedule with the Schedule of Values, list of subcontracts, Submittals Schedule, progress reports, payment requests, and other required schedules and reports.
 1. Secure time commitments for performing critical elements of the Work from parties involved.
 2. Coordinate each construction activity in the network with other activities and schedule in proper sequence.

1.6 RELIANCE UPON SCHEDULE

- A. The Construction Schedule as reviewed by the Architect will be an integral part of the Contract and will establish conditions for various activities and phases of construction.

PART 2 – PRODUCTS

2.1 PROJECT CONSTRUCTION SCHEDULE, GENERAL

- A. Prepare schedules using an industry-accepted software program developed specifically to manage construction project schedules.

2.2 PRELIMINARY CONSTRUCTION SCHEDULE

- A. Bar-Chart Schedule: Submit preliminary horizontal bar-chart-type construction schedule within ten (10) days of Notice of Award.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Outline significant construction activities for the duration of construction.

2.3 PROJECT CONSTRUCTION SCHEDULE

- A. General: Prepare network diagrams using the Precedence Diagramming Method (PDM).
- B. CPM Schedule:
 - 1. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
 - 2. Use “calendar days” as the unit of time, not to exceed the number of calendar days identified in the Contract Documents.
 - 3. Activity durations shall be limited to 15 calendar days, excepting only submittal review and approval, fabrication and delivery or other exceptions as approved by the Owner.
- C. Initial Issue of Schedule: Prepare initial network diagram from a list of straight “early start-total float” sort. Identify critical activities. Prepare tabulated reports showing the following:
 - 1. Description of activity
 - 2. Principal events of activity
 - 3. Immediate preceding and succeeding activities
 - 4. Designated critical path
 - 5. Early and late start dates
 - 6. Early and late finish dates
 - 7. Activity duration in workdays
 - 8. Total float or slack time
- D. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:
 - 1. Identification of activities that have changed
 - 2. Changes in early and late start dates
 - 3. Changes in early and late finish dates
 - 4. Changes in activity durations in workdays
 - 5. Changes in the critical path
 - 6. Changes in total float or slack time
 - 7. Changes in the Contract Time

PART 3 – EXECUTION

3.1 PROJECT CONSTRUCTION SCHEDULE

- A. Meetings: Provide look-ahead schedule generated from construction schedule software for review at each Subcontractor Coordination and OAC Meeting.
- B. Project Construction Schedule Updating: At monthly intervals, on a regular monthly date specifically identified in the pre-construction conference, the Contractor shall update the schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting. Submit schedule with each application for payment.
 - 1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
 - 2. Include a report with updated schedule that indicates every change, including but not limited to, changes in logic, duration, actual starts and finishes, and activity duration.
 - 3. As the Work progresses, indicate Actual Completion percentage for each activity.
- C. Distribution: Distribute copies of approved schedule to Architect, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
 - 1. Post copies in Project meeting rooms and temporary field offices.
 - 2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their portion of the Work and are no longer involved in performance of construction activities.
- D. Recovery: If at any time during the course of the project, the critical path demonstrates the project is in excess of 15 calendar days behind schedule the Contractor shall provide within 5 days of notification, revisions to the schedule demonstrating the ability to return the project to the milestone and project delivery dates identified in the Contract Documents. In addition, the Contractor will revise all remaining work as necessary to reflect any changes in the planned execution.

END OF SECTION

SECTION 01 33 00
SUBMITTAL PROCEDURES

CONDITIONS OF THE CONTRACT AND DIVISION 01, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 SUBMITTAL PROCEDURES

- A. Transmit to the Architect/Engineer each item indicated in individual specification sections with approved form identifying:
 - 1. Date of submission and dates of any previous submissions.
 - 2. Project title and number
 - 3. Contract identification
 - 4. Names of Contractor, Supplier, Manufacturer
 - 5. Pertinent drawing sheet and detail number, and specification section number, as appropriate
 - 6. Deviations from Contract Documents.
- B. Contractor shall be responsible for initial review prior to submittal to Architect/Engineer to verify adequacy and conformance to contract requirements. Lack of review by Contractor may be grounds for rejection.
- C. Apply Contractor's stamp, signed, to each item submitted, certifying that review and verification of products, field dimensions, adjacent construction work and coordination of information is in accordance with the requirements of the work and contract documents.
- D. Transmit each item in accordance with approved schedule, and in such sequence as to cause no delay in the work or in the work of any other Contractor. Allow minimum of ten (10) days for adequate Architect/Engineer review of each submittal. Time may vary according to scope and complexity of item under review. Allow adequate time in schedule for revisions and resubmittal as deemed necessary.
- E. Submit one (1) opaque print or copy of the submittal to the Architect plus one (1) electronic original. Transmit the printed copy of consultant and engineering submittals directly to respective consultants with a transmittal and the electronic original to the Architect. The Architect and Consultant will make up the printed copy and return to the Contractor upon completion of review. It will be the Contractors responsibility to scan and distribute the necessary quantity of copies of the reviewed submittal to all concerned parties.
- F. Submit each item according to individual specification sections and identified by Division, Section, and individual submittal number. Maintain log according to each Division.
- G. Revise and resubmit submittal as required; identify all changes made since previous submittal.
 - 1. Make any corrections or changes in the submittals required by the Architect/Engineer and resubmit until approved.
 - 2. Submit new submittal as required for initial submittal.

1.2 PROPOSED PRODUCTS LIST

- A. Within 30 days after date of Notice to Proceed, submit list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.
- B. For products specified only by reference standards, give manufacturer, trade name, model or catalog designation, and reference standards.

1.3 PRODUCT DATA

- A. Submit to Architect for review for limited purpose of checking for conformance with information given and design concept expressed in Contract Documents.
- B. Submit the number of copies of product data and samples which the Contractor and his subcontractors need for their use PLUS two (2) additional sets for the Architect, one (1) additional set for the Owner and one (1) additional set for each of the Architect's consultants involved with the particular Section of Work.
- C. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project

1.4 MATERIAL SAFETY DATA SHEETS (MSDS)

- A. The Texas Asbestos Health Protection Rules (Title 25. Health Services, Part I. Texas Department of Health Chapter 295 - Occupational Health, Subchapter C - Texas Asbestos Health Protection) were approved and became effective on October 20, 1992, and amended March 27, 2003. The Rules established the procedures and means to implement the provisions of Senate Bill 1341 and House Bill 79.
- B. Pursuant to the above referenced Rules, submit MSDS Sheets showing that materials used in the Project, contain 1.0 percent or less asbestos. This requirement pertains to every material in every Section of the Specifications, as applicable to the Project, whether written therein, or not. Submit MSDS Sheets for materials, including, but not limited to the following, as applicable to the Project.
 - 1. Surfacing Materials:
 - a. acoustical plaster;
 - b. textured paint/coating;
 - c. joint compound; and
 - d. spackling compounds
 - 2. Thermal System Insulation:
 - a. taping compounds (thermal)
 - b. HVAC duct insulation;
 - c. breaching insulation;
 - d. pipe insulation; and
 - e. thermal paper products
 - 3. Miscellaneous Material:
 - a. asphalt/vinyl floor tile
 - b. vinyl sheet flooring/vinyl wall coverings;
 - c. floor backing;
 - d. construction mastic;
 - e. ceiling tiles/lay-in ceiling panels;
 - f. packing materials;
 - g. high temperature gaskets;
 - h. laboratory hoods/table tops
 - i. ductwork flexible fabric connections;
 - j. heating and electrical ducts;
 - k. electrical panel partitions;

- l. electrical cloth/electrical wiring insulation;
- m. roofing shingles/tiles;
- n. roofing felt;
- o. base flashing;
- p. caulking/putties;
- q. adhesives/mastics; and
- r. wallboard

1.5 SHOP DRAWINGS

- A. Submit to Architect/Engineer for review for limited purpose of checking for conformance with information given and design concept expressed in Contract Documents.
- B. Indicate special utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- C. All dimensions indicated on the drawings are based on the specific models and manufacturers of products, equipment, fixtures and miscellaneous items specified. If the Contractor uses an approved product by another listed manufacturer which is different than the specific model and manufacturer listed in these specifications, then the Contractor shall be solely responsible for the coordination of any dimensional changes required, including structural, relocation of walls, equipment, fixtures, ceilings and miscellaneous items. When dimensional changes are required in these situations, the Contractor shall submit a proposed modification drawing to the Architect for approval prior to proceeding with the work. All causes and effects of the dimensional change shall be indicated on the Contractor's drawing submittal.

1.6 SAMPLES

- A. Submit for review for limited purpose of checking for conformance with information given and design concept expressed in Contract Documents.
- B. Submit for aesthetic, color, or finish selection. Submit full range of manufacture's standard colors, textures, and patterns for Architect's selection.
- C. Submit samples to illustrate functional characteristics of the Product, with integral parts and attachment devices. Coordinate submittal of different categories for interfacing work.
- D. Submit the number specified in respective Specification Section; minimum of two (2), of which one (1) will be retained by Architect.
- E. Reviewed samples which may be used in the Work are indicated in individual specification sections.
- F. Samples will not be used for testing purposes unless specifically stated in specification section.

1.7 DESIGN DATA

- A. When required, submit for Architect/Engineer's knowledge as contract administrator or for Owner.
- B. Submit design data for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.

1.8 TEST REPORTS

- A. In accordance with Section 01 45 23 "Testing and Inspecting Services", submit test reports for Architect/Engineer's knowledge as contract administrator or for Owner. Architect will determine whether corrective action is required.

- B. Submit test reports for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.

1.9 CERTIFICATES

- A. When specified in individual specification sections, submit certification by manufacturer, installation/application subcontractor, or Contractor to Architect, in quantities specified.
- B. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
- C. Certificates may be recent or previous test results on material or product, but must be acceptable to Architect and Owner.
- D. Submit required certificates in duplicate.

1.10 GUARANTEES

- A. When specified in individual specification sections, submit warranties by manufacturer, installation/application subcontractor, fabricator, or Contractor to Architect, in quantities specified.
- B. Submit warranties in accordance with Section 01 77 00 "Closeout Procedures".

1.11 MANUFACTURER'S INSTRUCTIONS

- A. When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, to Architect for delivery to Owner in quantities specified.
- B. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.
- C. Submit required instructions in duplicate.

1.12 MANUFACTURER'S FIELD REPORTS

- A. Submit reports for Architect/Engineer's benefit as contract administrator or for Owner.
- B. Submit report in quantity specified or required within ten (10) days of observation to Architect for information. Architect will determine whether corrective action is required.
- C. Submit for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.

1.13 ERECTION DRAWINGS

- A. When required, submit drawings for Architect/Engineer's benefit or for Owner.
- B. Submit for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.
- C. Data indicating inappropriate or unacceptable Work may be subject to action by Architect/Engineer or Owner. Architect will determine whether corrective action is required.

1.14 CONSTRUCTION PHOTOGRAPHS

- A. Provide photographs monthly of site and construction throughout progress of Work produced by an experienced photographer, acceptable to Architect/Engineer.
- B. Photographs: digital; sent to Architect via email, or provide on non-rewritable compact disk. Along with Application for Payment, include one (1) reproducible copy of contact sheet of all photographs taken during that period indicating Work completed and identified as stated below.
- C. Photograph project conditions five (5) days maximum prior to submitting indicating relative progress of the Work. Do not photograph conditions previously photographed if

no work has proceeded. As able, take photographs from same position indicating same view in successive installments.

- D. Take photographs as evidence of existing project conditions as follows:
1. Site: Take four (4) site photographs at project corners
 2. Interior views: Take two (2) minimum interior photographs of each space under construction from differing directions or as required.
 3. Details: Take as required to document concealed conditions, including, but not limited to, underground construction, utility penetrations and installation, steel erection, concrete and masonry reinforcing, waterproofing and flashing, and roofing installation.
- E. Identify each photograph with name of Project, room or view, and date.

PART 2 – PRODUCTS *(Not Used)*

PART 3 – EXECUTION *(Not Used)*

END OF SECTION

SECTION 01 35 16

ALTERATION PROJECT PROCEDURES

CONDITIONS OF THE CONTRACT AND DIVISION 01, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. This Section contains general provisions and requirements pertaining to all remodeling, removal, and relocation of Work in the existing building and becomes a part of each Section and Division performing remodeling, removal and relocation Work for this Project with the same force and effect as if written in full therein.
 - 2. Take all necessary precautions to keep trespassers out of the Work areas. Secure Work areas from entry when Work is not in progress.
 - 3. Perform all alterations, remodeling, demolition, removal and relocation of Work in strict accordance with Owner's instructions and applicable Federal, State and local health and safety standards, codes and ordinances. Where conflicts occur, the more restrictive requirement shall govern.
- B. Related Sections
 - 1. Section 02 41 00 "Demolition"

1.2 EXISTING CONDITIONS

- A. Obvious existing conditions, installations and obstructions affecting the Work shall be taken into consideration as necessary Work to be done, the same as though they were completely shown or described.
- B. Items of existing construction indicated to remain upon completion of the Contract, but which require removal to complete the Work, shall be carefully removed and replaced as required. The replaced Work shall match its condition at the start of the Work unless otherwise required.
- C. Visit the site to determine by inspection all existing conditions, including access to the site, the nature of structures, objects and materials to be encountered, and all other facts concerning or affecting the Work. Information on the Drawings showing existing conditions does not constitute a guarantee that other items may not be found or encountered.
- D. Utilities: Do not interrupt existing utilities serving occupied or used facilities, except when authorized by the Architect in writing two (2) weeks in advance. Provide temporary services during interruptions to existing utilities.

PART 2 – PRODUCTS

2.1 SALVAGED MATERIALS

- A. The Owner reserves the right of first refusal on all salvage items. Remove remaining items from the site as Work progresses. Storage or sale of items on site is not permitted. Burning or burying of removed materials on site is not permitted.
- B. Store salvaged items in a dry, secure place on site.
- C. Salvaged items not required for use in repair of existing Work shall remain the property of the Owner.
- D. Do not incorporate salvaged or used material in new construction except with permission of the Architect.

2.2 PRODUCTS FOR PATCHING, EXTENDING AND MATCHING

- A. Contract Documents do not define products or standards of workmanship present in existing construction. Determine products by inspection and by use of the existing. Provide same or similar quality products or types of construction as that in existing structure when needed to patch or extend existing Work.
- B. If reasonably matching products are not obtainable, improve appearance by minor relocating of some existing products and grouping new ones in some pattern arranged by the Architect. Do not replace products scheduled for retaining because matching ones are not obtainable, except as directed by Change Order.

PART 3 – EXECUTION

3.1 PROTECTION OF WORK TO REMAIN

- A. Protect existing Work from damage. Use barricades, tarpaulins, temporary walls, plywood, planking, masking, or other suitable means and methods as approved by the Architect.
- B. If Work to remain in place is damaged, restore to original condition at no additional cost to the Owner.
- C. Concealed Conditions: If conditions cause changes in the Work from requirements of the Contract Documents, the Contract Sum will be adjusted in accordance with the General Conditions.

3.2 EXAMINATION

- A. Verify that areas are ready for alteration and remodeling.
- B. Discrepancies: Verify dimensions and elevations indicated in layout of existing work.
 - 1. Prior to commencing work, carefully compare and check Contract Documents for discrepancies in locations or elevations of work to be executed.
 - 2. Refer discrepancies among Drawings and existing conditions to Architect for adjustment before work affected is performed.

3.3 PREPARATION

- A. Construct temporary fire-rated partitions to separate existing occupied areas from construction and alteration areas. Comply with provisions of Section 01 50 00 "Temporary Facilities and Controls."
- B. Cut, move, or remove items as necessary for access to alteration and renovation Work.
 - 1. Remove unsuitable material not marked for salvage, such as rotted wood, corroded metals, deteriorated masonry and concrete, and other deteriorated materials. Replace materials as specified for finished Work.
 - 2. Remove debris and abandoned items from area and from concealed spaces.
- C. Cutting and Removal: Perform cutting and removal work to remove minimum necessary, and in manner to avoid damage to adjacent work. Cut finish surfaces such as masonry, tile, plaster, or metals by methods to terminate surfaces in straight line at natural point of division.
- D. Prepare surface and remove surface finishes as necessary to provide for proper installation of new materials and finishes.
- E. Close openings in exterior surfaces to protect existing Work from weather and extremes of temperature and humidity. Insulate ductwork and piping to prevent condensation in exposed areas.
- F. Provide temporary barriers and closures to control operations to prevent spread of dust to occupied portions of building.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.
- B. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
 - 1. Where heating or cooling is needed and permanent enclosure is not complete, provide insulated temporary enclosures. Coordinate enclosure with ventilating and material drying or curing requirements to avoid dangerous conditions and effects.
 - 2. Vertical Openings: Close openings of 25 sq. ft. or less with plywood or similar materials.
 - 3. Horizontal Openings: Close openings in floor or roof decks and horizontal surfaces with load-bearing, wood-framed construction.
 - 4. Install tarpaulins securely using fire-retardant-treated wood framing and other materials.
 - 5. Where temporary wood or plywood enclosure exceeds 100 sq. ft. in area, use fire-retardant-treated material for framing and main sheathing.
- C. Temporary Partitions: Erect and maintain dustproof partitions and temporary enclosures to limit dust and dirt migration and to separate areas from fumes and noise.
 - 1. Construct non-fire-rated dustproof partitions of not less than nominal 4-inch studs, 1/2-inch gypsum wallboard with joints taped on occupied side, and 1/2-inch fire-retardant plywood on construction side.
 - 2. Insulate partitions to provide noise protection to occupied areas.
 - 3. Seal joints and perimeter.
 - 4. Equip partitions with dustproof doors and security locks.
 - 5. Protect air-handling equipment.
 - 6. Weatherstrip openings.
- D. Temporary Fire-Rated Partitions: Erect and maintain dustproof fire-rated partitions and temporary enclosures to limit dust and dirt migration and to separate occupied areas from construction, fumes, and noise. Fire-rated partitions shall be provided to separate existing occupied areas from construction areas in accordance with NFPA 241.
 - 1. Construct fire-rated dustproof partitions of not less than nominal 4-inch studs, 1/2-inch or 5/8-inch Type X gypsum wallboard on both sides, with joints taped.
 - 2. Extend partitions up to underside of existing structure to the greatest extent possible.
 - 3. Insulate partitions to provide noise protection to occupied areas.
 - 4. Seal joints and perimeter with fire-resistant joint sealant.
 - 5. Equip partitions with dustproof doors and security locks.
 - a. Protect openings in 1-hour fire-rated partitions with 45-minute hollow metal or solid core wood doors.
 - 6. Protect air-handling equipment.
 - 7. Weatherstrip openings.

- E. Temporary Fire Protection: Until fire-protection needs are supplied by permanent facilities, install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241.
 - 1. Provide fire extinguishers, installed on walls on mounting brackets, visible and accessible from space being served, with sign mounted above.
 - a. Field Offices: Class A stored-pressure water-type extinguishers.
 - b. Other Locations: Class ABC dry-chemical extinguishers or a combination of extinguishers of NFPA-recommended classes for exposures.
 - c. Locate fire extinguishers where convenient and effective for their intended purpose; provide not less than one extinguisher on each floor at or near each usable stairwell.
 - 2. Store combustible materials in containers in fire-safe locations.
 - 3. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire-protection facilities, stairways, and other access routes for firefighting. Prohibit smoking in hazardous fire-exposure areas.
 - 4. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition.
 - 5. Permanent Fire Protection: At earliest feasible date in each area of Project, complete installation of permanent fire-protection facility, including connected services, and place into operation and use. Instruct key personnel on use of facilities.
 - 6. Develop and supervise an overall fire-prevention and first-aid fire-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.

3.5 MOISTURE AND MOLD CONTROL

- A. Contractor's Moisture-Protection Plan: Avoid trapping water in finished work. Document visible signs of mold that may appear during construction. Remove and replace materials with mold.
- B. Exposed Construction Phase: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:
 - 1. Protect porous materials from water damage.
 - 2. Protect stored and installed material from flowing or standing water.
 - 3. Keep porous and organic materials from coming into prolonged contact with concrete.
 - 4. Remove standing water from decks.
 - 5. Keep deck openings covered or dammed.
- C. Partially Enclosed Construction Phase: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:
 - 1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
 - 2. Keep interior spaces reasonably clean and protected from water damage.
 - 3. Periodically collect and remove waste containing cellulose or other organic matter.
 - 4. Discard or replace water-damaged material.

5. Do not install material that is wet.
 6. Discard, replace or clean stored or installed material that begins to grow mold.
 7. Perform work in a sequence that allows any wet materials adequate time to dry before enclosing the material in drywall or other interior finishes.
- D. Controlled Construction Phase of Construction: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:
1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
 2. Use permanent HVAC system to control humidity.
 3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.
- E. Wet and Water-Damaged Materials:
1. Hygroscopic materials that may support mold growth, including wood and gypsum-based products, that become wet during the course of construction and remain wet for 24 hours are considered defective.
 2. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record daily readings over a forty-eight hour period. Identify materials containing moisture levels higher than allowed. Report findings in writing to Architect.
 3. Remove materials that cannot be completely restored to their manufactured moisture level within 48 hours.

3.6 PROCEDURES

- A. Refinishing At Removed Work: Cut below surface of substrate materials and patch over area of removal with finish materials so removal is not apparent.
- B. Remove and replace existing ceilings, and cut, patch, or replace existing walls, partitions and floors as may be necessary for access to valves, piping, conduit and tubing by mechanical and electrical trades as directed and approved by the Architect, and performed by the appropriate subcontractor for the Work involved, or by other properly qualified subcontractors.
- C. Patch and extend existing Work using skilled mechanics who are capable of matching existing quality and workmanship. Quality of patched or extended Work shall be not less than that specified for new Work.
- D. Cutting:
1. Concrete and Masonry: Saw cut where feasible.
 2. Plaster: Cut back to sound plaster on straight lines, and back-bevel edges of remaining plaster. Trim and prepare existing lath for tying of new lath.
 3. Woodwork: Cut back to a joint or panel line. Undamaged removed materials may be reused.
 4. Resilient Tiles: Remove in whole units to natural breaking points or straight joint lines with no damaged or defective existing tiles remaining where joining new construction.
 5. Salvaged Materials: Carefully remove to avoid damage, thoroughly clean and reinstall as indicated, or as directed.
 6. Doors: Remove in such a manner as to facilitate filling in of openings or installation of new Work, as required by Drawings.

7. Structural Elements: Remove only as shown on the Structural Drawings. If not specifically shown, but removal is required, perform such removal or alteration only upon written approval of the Architect. Do not damage or alter any structural element of the existing building.
- E. Patching:
1. Match existing Work where possible; if unavailable, use salvage material for patching and provide totally new material in areas where salvage has been removed; consult with the Architect concerning locations for salvaging materials.
 2. Repairs or continuations of existing Work shall be relatively imperceptible in the finished Work when viewed under finished lighting conditions from a distance of six (6) feet.
 3. Patching, Repairing and Finishing of Existing Work: Perform in compliance with the applicable requirements of the Specification Section covering the Work to be performed and the requirement of this Section.
- F. Erect scaffolding as necessary to gain access to the various parts of the Work. Provide structurally sound, rigidly braced and properly constructed scaffolding, shoring and bracing as necessary to positively protect the affected elements and building, and to support the activities or workmen and loads. Design and construction of scaffolds and supports shall be in accordance with applicable safety regulations. Material used shall be adequate to support anticipated loads with a properly calculated margin of safety.
- G. Noise Producing Equipment: Minimize use of noise producing equipment. Limit excessive noise to periods of vacancy or provide sound control. Arrange schedules in advance with the Architect.

3.7 EXISTING FURNITURE AND EQUIPMENT

- A. Owner Salvaged Items: Personal items in areas subject to remodeling will be removed before construction in those areas commences.
- B. Furniture Items: Before remodeling commences, Owner will remove all furniture and equipment from each space, store items as necessary. Owner will replace these items to the same locations after each remodeling phase is complete. Contractor to coordinate activities with Owner.

3.8 PAINTING

- A. Preparation: Prepare patched areas as required for new Work. Wash existing painted surfaces with neutral soap or detergent, thoroughly rinse, and sand when dry.
- B. Painting and Finishing: Conform to the applicable provisions of the Painting Section. Prepare bare areas and patches in existing painted surfaces with specified primer and intermediate coats, sanded smooth and flush with adjoining surfaces.

3.9 DISPOSAL OF DEBRIS

- A. Remove material, debris and rubbish resulting from Work of this Section from the building and site as it accumulates. Keep all areas of Work in "broom clean" condition as the Work progresses.
- B. At completion of renovation and remodeling Work in each area, provide final cleaning and return space to a condition suitable for use by the Owner.

END OF SECTION

SECTION 01 40 00
QUALITY REQUIREMENTS

CONDITIONS OF THE CONTRACT AND DIVISION 01, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
 - 1. Specific quality assurance and quality 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 quality control procedures that facilitate compliance with Contract Document requirements.
 - 3. Requirements for Contractor to provide quality assurance and quality control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions.
 - 4. Specific test and inspection requirements are not specified in this Section.

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 constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and, where indicated, qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.
 - 1. Laboratory Mockups: Full size physical assemblies constructed at testing facility to verify performance characteristics.
 - 2. Integrated Exterior Mockups: Mockups of exterior envelope erected separately from the building but on Project site, consisting of multiple products, assemblies, and subassemblies.
 - 3. Room Mockups: Mockups of typical interior spaces complete with wall, floor, and ceiling finishes, doors, windows, millwork, casework, specialties, furnishings and equipment, and lighting.
- D. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the work, to verify performance or compliance with specified criteria.

- E. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
- F. Source Quality Control Testing: Tests and inspections that are performed at the source, e.g., plant, mill, factory, or shop.
- G. Field Quality Control Testing: Tests and inspections performed on site for installation of the work and for completed work.
- H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- I. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform particular construction operation, including installation, erection, application, and similar operations.
 - 1. Use of trade specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).
- J. Experienced: When used with an entity or individual, *experienced* means having successfully completed a minimum of five years documented experience with projects similar in nature, size, and extent; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.3 CONFLICTING REQUIREMENTS

- A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Architect for a decision before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.4 SUBMITTALS

- A. Shop Drawings: Submit plans, sections, and elevations, indicating materials and size of mockup construction.
 - 1. Indicate manufacturer and model number of individual components.
 - 2. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.
- B. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility sent to authorities having jurisdiction before starting work on the following systems:
 - 1. Seismic force resisting system, designated seismic system, or component listed in the designated seismic system quality assurance plan prepared by Architect.
 - 2. Main wind force resisting system or wind resisting component listed in the wind force resisting system quality assurance plan prepared by Architect.
- C. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
 - 1. Specification Section number and title.
 - 2. Entity responsible for performing tests and inspections.

3. Description of test and inspection.
4. Identification of applicable standards.
5. Identification of test and inspection methods.
6. Number of tests and inspections required.
7. Time schedule or time span for tests and inspections.
8. Requirements for obtaining samples.
9. Unique characteristics of each quality control service.

1.5 REPORTS AND DOCUMENTS

- A. Test and Inspection Reports: Prepare and submit certified written reports specified. Include the following:
 1. Date of issue.
 2. Project title and number.
 3. Name, address, and telephone number of testing agency.
 4. Dates and locations of samples and tests or inspections.
 5. Names of individuals making tests and inspections.
 6. Description of the work and test and inspection method.
 7. Identification of product and Specification Section.
 8. Complete test or inspection data.
 9. Test and inspection results and an interpretation of test results.
 10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
 11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
 12. Name and signature of laboratory inspector.
 13. Recommendations on retesting and reinspecting.
- B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
 1. Name, address, and telephone number of technical representative making report.
 2. Statement on condition of substrates and their acceptability for installation of product.
 3. Statement that products at site comply with requirements.
 4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
 5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 6. Statement whether conditions, products, and installation will affect warranty.
 7. Other required items indicated in individual Specification Sections.

- C. Factory Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory authorized service representative's tests and inspections specified in other Sections. Include the following:
 - 1. Name, address, and telephone number of factory-authorized service representative making report.
 - 2. Statement that equipment complies with requirements.
 - 3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 - 4. Statement whether conditions, products, and installation will affect warranty.
 - 5. Other required items indicated in individual Specification Sections.
- D. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.6 QUALITY ASSURANCE

- A. Qualifications establish the minimum qualification levels required; refer to individual Specification Sections for additional requirements.
- B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated and sufficient production capacity to produce required units.
- C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated and with record of successful in service performance, as well as sufficient production capacity to produce required units.
- D. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the State of Texas, experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar in material, design, and extent to those indicated.
- F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
 - 1. Requirements of authorities having jurisdiction supersede requirements for specialists.
- G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
 - 1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
 - 2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

- H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products.
- I. Factory Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products.
- J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:
 - 1. Contractor responsibilities include the following:
 - a. Provide test specimens representative of proposed products and construction.
 - b. Submit specimens with sufficient time for testing and analyzing results to prevent delaying the work.
 - c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
 - d. Build site assembled test assemblies and mockups using installers who will perform same tasks for Project.
 - e. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed work.
 - f. When testing is complete, remove test specimens, assemblies, mockups, and laboratory mockups; do not reuse products on Project.
 - 2. Testing Agency Responsibilities: Submit certified written report of each test, inspection, and similar quality assurance service to Architect, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.
- K. Mockups: Before installing portions of the work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed work:
 - 1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect.
 - 2. Notify Architect a minimum of seven days in advance of dates and times when mockups will be constructed.
 - 3. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed during the construction.
 - 4. Demonstrate the proposed range of aesthetic effects and workmanship.
 - 5. Obtain Architect's approval of mockups before starting work, fabrication, or construction. Allow **seven** days for initial review and each re-review of each mockup.
 - 6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed work.
 - 7. Demolish and remove mockups when directed unless otherwise indicated.
- L. Laboratory Mockups: Comply with requirements of preconstruction testing and those specified in individual Specification Sections.

1.7 QUALITY CONTROL

- A. Owner Responsibilities: Where quality control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform the services.
1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
 2. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.
- B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality control activities required to verify that the work complies with requirements, whether specified or not.
1. Unless otherwise indicated, provide quality control services specified and those required by authorities having jurisdiction. Perform quality control services required of Contractor by authorities having jurisdiction, whether specified or not.
 2. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform the quality control services. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
 3. Notify testing agencies at least 24 hours in advance of time when work that requires testing or inspecting will be performed.
 4. Where quality control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality control service.
 5. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
 6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. Manufacturer's Field Services: Where indicated, engage a factory authorized service representative to inspect field assembled components and equipment installation, including service connections. Report results in writing as specified in Section 013300.
- D. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.
- E. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- F. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
 3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.

4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
 5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
 6. Do not perform any duties of Contractor.
- G. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the work.
 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
 4. Facilities for storage and field curing of test samples.
 5. Delivery of samples to testing agencies.
 6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
 7. Security and protection for samples and for testing and inspecting equipment at Project site.
- H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.
- I. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality control services required by the Contract Documents. Coordinate and submit concurrently with Contractor's construction schedule. Update as the work progresses.
1. Distribution: Distribute schedule to Owner, Architect, testing agencies, and each party involved in performance of portions of the work where tests and inspections are required.

1.8 SPECIAL TESTS AND INSPECTIONS

- A. Special Tests and Inspections: Owner will engage a qualified testing agency or special inspector to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner:
- B. Special Tests and Inspections: Conducted by a qualified testing agency or special inspector as required by authorities having jurisdiction, as indicated in individual Specification Sections.
1. Verifying that manufacturer maintains detailed fabrication and quality control procedures and reviews the completeness and adequacy of those procedures to perform the work.
 2. Notifying Architect and Contractor promptly of irregularities and deficiencies observed in the work during performance of its services.
 3. Submitting a certified written report of each test, inspection, and similar quality control service to Architect with copy to Contractor and to authorities having jurisdiction.
 4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.

5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
6. Retesting and reinspecting corrected work.

PART 2 - PRODUCTS (*NOT USED*)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

- A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
 1. Date test or inspection was conducted.
 2. Description of the Work tested or inspected.
 3. Date test or inspection results were transmitted to Architect.
 4. Identification of testing agency or special inspector conducting test or inspection.
- B. Maintain log at site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's reference during normal working hours.

3.2 REPAIR AND PROTECTION

- A. On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
 1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 01 73 00 "Execution".
- B. Protect construction exposed by or for quality control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality control services.

END OF SECTION

SECTION 01 41 00
REGULATORY REQUIREMENTS

CONDITIONS OF THE CONTRACT AND DIVISION 01, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Quality Assurance
- B. References Standards
- C. Definitions
- D. Abbreviations
- E. Format and Specification Context Explanations
- F. Drawing Symbols
- G. General Requirements

1.2 QUALITY ASSURANCE

- A. General:
 - 1. For products or workmanship specified by a standard of an association, trade, or Federal standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable code authorities having jurisdiction.
 - 2. The contractual relationship of the parties to the Contract should not be altered from the Contract Documents by mention or inference otherwise in any reference standard.
 - 3. Obtain copies of standards when required by Contract Documents.
 - 4. Maintain copy of standards at jobsite during submittals, planning, and progress of the specific work for which the standards pertain, until the date of Substantial Completion.
 - 5. In the absence of specific instructions in the specifications, materials, products, equipment and their installation shall conform to the applicable codes, regulations and standards specified therein. When a conflict exists between the applicable code, regulation and standard and that specified, the more stringent code regulation or standard shall prevail, except as authorized by applicable authorities having jurisdiction.
- B. Specifications and Drawings: The Drawings and Specifications are correlative and have equal authority and priority. Base disagreements in themselves or in each other on the most expensive combination of quantity and quality of work indicated. In the event of such disagreement bring it to the attention of the Architect, who will determine the appropriate method to perform the work.
- C. Industry Standards: Where compliance with two (2) or more industry standards or sets of requirements are specified, and overlapping of those different standards or requirements establishes different or conflicting minimums or levels of quality, the most stringent requirement is intended and will be enforced, unless specifically detailed language written into Contract Documents clearly indicates that a less stringent requirement is to be fulfilled. Refer apparently equal-but-different requirements, and uncertainties as to which level of quality is more stringent, to the Architect for a decision before proceeding.
- D. Contractor's Option: Except for overlapping or conflicting requirements, where more than one (1) set of requirements are specified for a particular unit of work, option is intended to be Contractor's regardless of whether or not it is specifically indicated as such.

- E. Minimum Quality/Quantity: In every instance, the quality level or quantity shown or specified is intended to be the minimum for the work to be performed or provided. Except as otherwise specifically indicated, the actual work may either comply exactly with the minimum (within specified tolerances), or may exceed that minimum within reasonable limits. In complying with requirements, indicated numeric values are either minimums or maximums as noted or as appropriate for context of requirements. Refer instances of uncertainty to Architect for decision before proceeding.
- F. Specialists' Assignments: In certain instances, specification text requires (or implies) that specific work is to be assigned to specialists, who are engaged for performance of work. Such assignments shall be recognized as special requirements over which the Contractor has no choice or option. These requirements should not be interpreted so as to conflict with applicable regulations, union jurisdiction settlements and similar conventions. Such assignments are intended to establish which party or entity involved in a specific unit of work is recognized as "expert" for the indicated construction processes or operations. Nevertheless, the final responsibility for fulfillment of the entire set of requirements remains with the Contractor.

1.3 REFERENCE STANDARDS

- A. Dates of codes, regulations and standards specified shall be the latest date of issue of that code, regulation or standard prior to the date of issue of this Project Manual or Document, except as modified or otherwise directed by the applicable codes and their supplements and amendments adopted by the code authorities having jurisdiction.
 - 1. Date of Issue - The "date of issue" as it appears in the statement above, means the date which appears on the cover of the Project Manual or Document corresponding to the date of issue of the Contract Documents.
 - 2. Code Authorities: The "code authorities" as it appears in the statement above, means the authorities responsible for code enforcement.

1.4 DEFINITIONS

- A. General Explanation: A substantial amount of specification language consists of definitions for terms found in other Contract Documents, including those in the AIA A201 General Conditions of the Contract for Construction, Supplementary Conditions, the Drawings, and the Specifications. Drawings must be recognized as being diagrammatic in nature and not completely descriptive of requirements indicated thereon. Certain terms used in the Contract Documents are defined in the General Conditions, Supplementary Conditions, and in this Section. Definitions and explanations contained in this Section are not necessarily either complete or exclusive, but are general for this Work to the extent that they are not stated more explicitly in another element of the Contract Documents. In the event of a conflict in definitions or explanations within the Contract Documents or whenever there is need of clarification or interpretation of definitions within or between the Contract Documents, notify the Architect immediately and proceed as directed. Except in cases where definitions are determined by code authorities having jurisdiction, the Architect's interpretation of all definitions will take precedence.
- B. General Requirements: The provisions or requirements of Division 1 - Sections apply to entire Work of Contract and, where indicated, to other elements which are included in the Project.
- C. Special Conditions: Wherever the term "Special Conditions", appears in the Contract Documents, it refers collectively to all requirements of the Owner in addition to the sections in Division 01, General Requirements, and to Articles contained in the General Conditions and Supplementary Conditions.
- D. Architect: Wherever the term "Architect" or any derivative thereof appears in the Contract Documents, it means PBK Architects, 601 NW Loop 410, Suite 400, San Antonio, Texas 78216, (210) 829-0123, or their authorized representative(s).

- E. Bid, Competitive Sealed Proposal (CSP), Response, Offer, etc.: Wherever the term "Bid", "Competitive Sealed Proposal (CSP)", "Response", "Offer", "Proposal", or any derivative thereof, or similar term appears in the Contract Documents, they mean one and the same, and shall mean Competitive Sealed Proposal, which by definition allows the Owner to accept the "best value" based on factors other than cost in selecting the Contractor.
- F. Contractor, General Contractor, Construction Manager, etc: Wherever the term "Contractor", "General Contractor", "Construction Manager" or any derivative thereof, or similar term appear in the Contract Documents, they mean one and the same.
- G. Subcontractor, Sub-subcontractor, Bidder, etc.: Wherever the term "Subcontractor", "Sub-subcontractor", "Bidder", "Bidder/Vendor", "Vendor", "Installer", "Integrator", "Respondent", "Offeror", or any derivative thereof, or similar term appears in the Contract Documents, they mean one and the same, and shall refer to the entity (person or firm) licensed and meeting all applicable regulations of the State of Texas and Department of Labor to perform the Work, or their authorized representative(s).
 - 1. Responsibilities: To avoid any misunderstanding or lack of interpretation, the responsibility for performing the Work is totally that of the entity defined above, and the resolutions proposed in his shop drawings and related documentation shall be demonstrated throughout the Work and specified warranty period.
 - 2. In the event of a controversy involving the Contract Documents or interpretation of Project requirements, the decision of the Architect will take precedence.
- H. University, Owner, etc.: Wherever the term "University", "Owner" or similar such term appears in the Contract Documents, it means St. Mary's University, One Camino Santa Maria San Antonio, TX 78228, or its authorized representative(s).
- I. Consultants: Wherever the term "Consultant", or any derivative thereof appears in the Contract Documents, it means the following to whom that portion of the work applies.
 - 1. Architect's Consultants:
 - a. Structural Engineer: Intelligent Engineering Services, Union Square II, 10001 Reunion Place, Ste. 200, San Antonio, TX 78216 (210) 349-9098, or their authorized representative(s).
 - b. MEP Engineer: PBK, 601 NW Loop 410, Suite 400, San Antonio, Texas 78216, (210) 829-0123, or their authorized representative(s).
- A. Indicated: Wherever the term "indicated", or any derivative thereof appears in the Contract Documents, it means a cross-reference to graphic representations, notes, or schedules on Drawings, to other paragraphs or schedules in the Specifications, and to similar means of recording requirements in the Contract Documents. Where terms such as "shown", "noted", "scheduled", and "specified" are used in lieu of "indicated", it is for the purpose of helping reader locate cross-reference, and no limitation of location is intended except as specifically noted.
- B. Directed, Requested, Etc: Where not otherwise explained, terms such as "directed", "requested", "authorized", "selected", "approved", "required", "accepted", and "permitted" or any derivative thereof appears in the Contract Documents, it means as "directed by the Architect", "requested by the Architect", and similar phrases with actions taken by the Architect. However, no meaning or otherwise shall be interpreted to extend the Architect's responsibility into Contractor's area of construction supervision.
- C. Approve: Wherever the term "Approve", or any derivative thereof appears in the Contract Documents, it means only the Architect, or an individual designated by him as his representative, can approve or disapprove contract actions. Even if the specifications indicate that an individual other than the Architect, such as the "Engineer" or "Consultant" will approve or disapprove an action, it is understood that only the Architect has this authority unless the individual is so designated by him in writing. Even when an individual

is so designated, the Contractor may appeal the action to the Architect and the Architect's decision will be final. In no case will "approval" by the Architect be interpreted as a release of the Contractor from responsibility to fulfill requirements of the Contract Documents.

- D. **Furnish:** Wherever the term "Furnish", or any derivative thereof appears in the Contract Documents, it means supply or deliver to Project site, ready for unloading, unpacking, assembly, erection, placing, installing, anchoring, applying, curing, finishing, protecting, cleaning and similar operations, as applicable in each instance.
- E. **Install:** Wherever the term "Install", or any derivative thereof appears in the Contract Documents, it means performing the operations at the Project site, of unloading, unpacking, assembly, erection, placing, installing, anchoring, applying, curing, finishing, protecting, cleaning and similar operations, as applicable in each instance.
- F. **Provide:** Wherever the term "Provide", or any derivative thereof appears in the Contract Documents, it means furnish and install at the Project site, complete and ready for intended use, as applicable in each instance.
- G. **Project, Site:** Wherever the term "Project", "Site", or similar such term appears in the Contract Documents, it means the space available to the Contractor for performance of the Work, either exclusively or in conjunction with others performing work as part of the Project. The extent of project or site is shown on the Drawings, and may or may not be identical with description of land upon which Project is to be built.
- H. **Installer:** Wherever the term "Installer", or any derivative thereof appears in the Contract Documents, it means the entity (person or firm) engaged by the Contractor or its subcontractor or sub-subcontractor for performance of a particular unit of work at the Project, including installation, erection, application and similar required operations. It is a general requirement that such entities (Installers) be expert in operations they are engaged to perform.
- I. **Specialist:** Wherever the term "Specialist", or any derivative thereof appears in the Contract Documents, it means an individual or firm of established reputation (or if newly organized, whose personnel have previously established a reputation in the same field), which is regularly engaged in, and which maintains a regular force of workmen skilled in either (as applicable) manufacturing or fabricating items required by the Contract, installing items required by the Contract, or otherwise performing work required by the Contract. Where the Contract Specification requires installation by a specialist, that term shall also be deemed to mean either the manufacturer of the item or firm who will perform the work under the manufacturer's direct supervision.
- J. **Testing Laboratory:** Wherever the term "Testing Laboratory", or any derivative thereof appears in the Contract Documents, it means an independent entity engaged to perform specific inspections or tests of the work, either at the Project site or elsewhere; and to report and (if required) interpret results of those inspections or tests.

1.5 FORMAT AND SPECIFICATION CONTEXT EXPLANATIONS

- A. **Underscoring:** Is used strictly to assist reader of specification text in scanning text for key words (for quick recall). No emphasis on or relative importance is intended where underscoring is used.
- B. **Capitalization:** Except for manufacturer, product, or trademark names, capitalization is used strictly to assist reader of specification text in scanning text for key words (for quick recall). No emphasis on or relative importance is intended where capitalization is used.
- C. **Imperative language:** Is used generally in specifications. Except as otherwise indicated, requirements expressed imperatively are to be performed by Contractor. For clarity of reading at certain locations, contrasting subjective language is used to describe responsibilities which must be fulfilled indirectly by the Contractor, or when so noted, by others.

- D. Section Numbering: Is used to facilitate cross-reference in Contract Documents. Sections are placed in Project Manual in numeric sequence; however, numbering sequence is not complete, and listing of sections at beginning of Project Manual must be consulted to determine numbers and names of specification sections in Contract Documents.
- E. Page Numbering: Pages are numbered independently for each section. The section number is shown preceded by the project number and followed by the page number at the bottom of each page, to facilitate the location of text. The project number is given to identify the project, for which specification was written, should the section become separated from the Project Manual.
- F. Specifying Methods: The techniques or methods of specifying to record requirements varies throughout text, and may include “prescriptive, “open-generic descriptive”, “compliance with standards”, “performance”, or a combination of these. The method used for specifying one unit of work has no bearing on requirements for another unit of work.
- G. Abbreviations: The language of Specifications and other Contract Documents is of the abbreviated type in certain instances, and implies words and meanings which will be appropriately interpreted. Actual work abbreviations of a self-explanatory nature have been included in texts. Specific abbreviations have been established, principally for lengthy technical terminology and primarily in conjunction with coordination of specification requirements with notations on drawings and in schedules. These are frequently defined in section at first instance of use. Trade association names and titles of general standards are frequently abbreviated. Singular words will be interpreted as plural and plural words will be interpreted as singular where applicable and where full context of the Contract Documents so indicates. A list of typical abbreviations, includes, but is not limited to the following trade associations and organizations. Refer to Drawings and other Contract Documents for other abbreviations.

AA	Aluminum Association
AAMA	Architectural Aluminum Manufacturer's Assn.
AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
ACIL	American Council of Independent Laboratories
AGA	American Gas Association
AGC	Associated General Contractors of America
AHA	American Hardboard Association
AHGA	American Hotdip Galvanizers Association
AI	Asphalt Institute
AIA	American Institute of Architects
AISC	American Institute of Steel Construction
AISI	American Iron & Steel Institute
AITC	American Institute of Timber Construction
ANSI	American National Standards Institute
APA	American Plywood Association
ARI	Air Conditioning & Refrigeration Institute
ASA	Acoustical Society of America
ASA	American Subcontractors Association
ASAHC	American Society of Architectural Hardware Consultants

ASC	Adhesive & Sealant Council, Inc.
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigeration, and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASPE	American Society of Professional Engineers
ASPI	American Wood Preserver's Institute
ASTM	ASTM International
AWI	Architectural Woodwork Institute
AWS	American Welding Society
BIA	Brick Institute of America
BRI	Building Research Institute
CRA	California Redwood Association
CLFMI	Chain Link Fence Manufacturers Institute
CRSI	Concrete Reinforcing Steel Institute
CSI	Construction Specifications Institute
DHI	Door and Hardware Institute
EPA	Environmental Protection Agency
FTI	Facing Tile Institute
FGMA	Flat Glass Marketing Association
GA	Gypsum Association
HPMA	Hardwood Plywood Manufacturers Association
IBC	International Building Code
ICBO	International Conference of Building Officials
ICC	International Code Council
IEEE	Institute of Electrical and Electronic Engineers
JSMA	Joint Sealer Manufacturers Association
MFMA	Maple Flooring Manufacturers Association
ML/SFA	Metal Lath/Steel Framing Association
NAAMM	National Association of Architectural Metal Manufacturers
NAMM	National Association of Mirror Manufacturers
NBLP	National Bureau of Lathing & Plastering
NCPI	National Clay Pipe Institute
NCMA	National Concrete Masonry Association
NEMA	National Electrical Manufacturers Assn.
NESC	National Environmental Systems Contractors
NFPA	National Fire Protection Association
NFPA	National Forest Products Association
NHLA	National Hardwood Lumber Association
NOMMA	National Ornamental Metal Manufacturers Assn

NPVLA	National Paint, Varnish and Lacquer Assn.
NRMCA	National Ready Mixed Concrete Assn.
NRCA	National Roofing Contractors Association
NSPE	National Society of Professional Engineers
NWMA	National Woodwork Manufacturers Assn., Inc.
OSHA	Occupational Safety and Health Administration
PDCA	Painting and Decorating Contractors of America
PI	Perlite Institute, Inc.
PCA	Portland Cement Association
RFCI	Resilient Floor Covering Institute
RVFC	Rubber and Vinyl Floor Council
SBCCI	Southern Building Code Congress International, Inc.
SFPA	Southern Forest Products Association
SHLMA	Southern Hardwood Lumber Manufacturing Assn.
SDI	Steel Deck Institute
SDI	Steel Door Institute
SJI	Steel Joist Institute
SSPC	Steel Structures Painting Council
TCA	Tile Council of America, Inc.
UL	Underwriter's Laboratories, Inc.
VBI	Venetian Blind Institute
VFI	Vinyl Fabrics Institute
WCLIB	West Coast Lumber Inspection Bureau
WRCLA	Western Red Cedar Lumber Association
WWPA	Western Wood Products Association

1.6 DRAWING SYMBOLS

- A. General: Except as otherwise indicated, graphic symbols used on drawings are those symbols recognized in the construction industry for purposes indicated. Where not otherwise noted, symbols defined by "Architectural Graphic Standards", published by the American Institute of Architects (AIA) and John Wiley & Sons, Inc., latest edition. Refer instances of uncertainty to Architect for clarification before proceeding.
- B. Mechanical/Electrical Drawings: Graphic symbols used in Mechanical/Electrical Drawings are generally aligned with symbols recommended by American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE). Where appropriate, those symbols are supplemented by more specific symbols as recommended by other recognized technical organizations, including, but not limited to American Society of Mechanical Engineers (ASME), American Society of Professional Engineers (ASPE), Institute of Electrical and Electronic Engineers (IEEE) and similar organizations. Refer instances of uncertainty to Architect for clarification before proceeding.

1.7 GENERAL REQUIREMENTS

- A. Color, Texture, or Pattern Requirements:
1. When color, texture, or pattern is specified, the item, product, or material shall be furnished in the specified color, texture, or pattern, as applicable.
 2. When more than one (1) approved manufacturer is named in the Specifications, Contractor may select any of the approved manufacturers and submit the full range of colors, textures, and patterns (standard and special) available of that manufacturer for the Architect's review and selection.
 3. When the term "match existing", or any derivative thereof appears in the Contract Documents, it means that the sample must match the Owner's existing work in every respect as to color, texture, and pattern, as applicable.
 4. When the term "match Architect's approved sample", or any derivative thereof appears in the Contract Documents, it means that the Architect has selected a sample which must be matched in every respect as to color, texture, and pattern, as applicable.
 5. When an item or product is specified of a manufacturer for which only one (1) color, texture, or pattern is available, and a color, texture, or pattern other than that one is specified, Contractor shall bring it to the attention of the Architect for a decision prior to proceeding with the work. Do not proceed with the work until Architect has approved the color, texture, and pattern, as applicable.
 6. When an item or product is specified of a manufacturer for which no color, texture, or pattern is specified, and colors, textures, and patterns are available, Contractor shall bring it to the attention of the Architect and submit the full range of colors, textures, and patterns (standard and special) available of that manufacturer for the Architect's review and selection. Do not proceed with the work until Architect has selected and approved the color, texture, and pattern, as applicable.
 7. When due to the nature of the item, product, or material, i.e. face brick, tile pavers, natural stone, etc, Contractor shall submit sample or samples which exhibits the full range of characteristics (colors, i.e. lights and darks, as well as textures, and patterns) for which the item, product, or material is available. The Architect will select the color, texture, and pattern, as applicable, from those available and request a sample panel exhibiting the approved characteristics. The approved color range, texture, and pattern, as applicable will then become the standard for which all work on the project will be judged. Architect will be final judge as to having performed work in conformance with approved characteristics.
 8. Under no circumstances are colors, textures, patterns, or any other characteristics for which an item, product, or material are available to be selected by anyone other than the Architect or his authorized representative.
 9. Non-conforming work shall be removed from the site and replaced with new conforming work at no additional expense to Owner.
- B. Continuity of Building Envelope, Full Height Partitions, and Fire Rated Construction:
1. Continuity of Building Envelope:
 - a. All materials such as exterior sheathing, membrane flashings, vapor barriers, insulations, dampproofing, waterproofing, roofing, flashings, etc. and all penetrations, holes, gaps, joints, and openings through such materials shall be sealed to ensure continuity of building envelope, whether indicated or not.
 - b. Refer instances of uncertainty to Architect for clarification before proceeding with work.

2. Full Height Partitions:
 - a. All full height partitions shall be from floor to bottom of deck structure and shall be made to fit around steel joists, beams, etc., whether indicated or not.
 - b. Seal joints at top of partitions, in flutes of steel deck, and around structural elements with a compressible filler and/or sealant to accommodate movement due to expansion, contraction, and deflection, whether indicated or not. Treat seals in joints of fire rated partitions as specified below for fire rated construction, whether indicated or not.
 - c. Refer instances of uncertainty to Architect for clarification before proceeding with work.
3. Fire Rated Construction:
 - a. All seals in fire rated construction, whether at top, bottom, or penetrations through fire rated construction, shall be made with firestopping and fire safing materials to maintain fire rating integrity of construction and satisfy authorities having jurisdiction, whether indicated or not.
 - b. Refer instances of uncertainty to Architect for clarification before proceeding with work.
- C. Plumbing Line Protection:
 1. Placing or washing materials, including, but not limited to the following, down any plumbing line or fixture is strictly forbidden.
 - a. Concrete, cement, sludge, mortar, grout, plaster, or any other cementitious material
 - b. Paint, paint thinner, turpentine, kerosene, gasoline, oil, or any other petroleum or hazardous products.
 2. Cleaning painting equipment, including brushes in new or existing plumbing fixtures is strictly prohibited.
 3. If requested, Contractor shall certify that all affected plumbing lines and fixtures are clean, free flowing and running. Plumbing lines and fixtures damaged as a result of any of the above shall be repaired or replaced at no expense to Owner. Contractor shall bear responsibility and all costs of fines, penalties, and legal fees attributed to violations as levied by authorities having jurisdiction.
- D. Hanging Items from Deck and Structure: Ducts, pipes, conduits, equipment, and other items indicated to be supported from the structure shall be accomplished using approved hangwires, hangers, or devices of type, size and material recommended to suit the application and installed in accordance with recommendations of the hanger or device manufacturer, Architect and/or Structural Engineer, or code authorities having jurisdiction, whichever is the more stringent requirement. Nothing shall be hung from the deck and structure unless directed to do so by the Architect and/or Structural Engineer. Powder activated devices in metal deck are not permitted.
- E. Ducts, Pipes, Conduits, and Wires: Shall be concealed in walls, chases, and enclosed areas out of view, unless specifically indicated as exposed or where exposure is required for proper function of item, such as air registers, air returns, louvers, grilles, vents, thermostats, electrical receptacles, telephone/data terminals and jacks, light switches, etc. Refer instances of uncertainty to Architect for clarification before proceeding.
- F. Fasteners:
 1. Unless specifically indicated or directed otherwise, all fasteners in work exposed to view, shall be concealed in the finished work.

2. No fasteners shall show through or telegraph through exposed face of finished work and all finished surfaces shall be free of all evidence of the existence of fasteners.
 3. Fasteners shall be spaced to accurately and rigidly secure work in place.
 4. If not shown or otherwise required or recommended by manufacturer, standard, or code authorities having jurisdiction, fastener spacing shall not exceed 12 inches on center.
 5. Non-conforming work shall be removed from the site and replaced with new conforming work at no additional expense to Owner.
- G. Exposed Metal Work:
1. Unless specifically indicated or directed otherwise, all exposed metal work shall be flat with all surfaces free of distortions, oil canning, waves, dents, scratches, weld marks, and other surface defects detrimental to good appearance or function.
 2. All steel exposed to exterior weather or moisture, either exposed or concealed in work, shall be hot-dip galvanized, phosphate treated for paint retention and shop prime painted.
 3. Non-conforming work shall be removed from the site and replaced with new conforming work at no additional expense to Owner.
- H. Continuous Date and Time Code Operated Devices:
1. Devices used in the construction of this Project which use continuous date and time codes in their operation, whether software or hardware, and whether upgradable or not, including, but not limited to air handling, lighting, alarm, communication, security, and instrumentation systems, elevators, escalators and other conveying systems. In addition, such devices shall remain compliant for 100 years or the life of the device, whichever comes first.

PART 2 – PRODUCTS *(Not Used)*

PART 3 – EXECUTION *(Not Used)*

END OF SECTION

SECTION 01 45 00
QUALITY CONTROL

CONDITIONS OF THE CONTRACT AND DIVISION 01, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Quality Assurance: Requirements for material and product quality and control of installation.
- B. Tolerances
- C. References and Standards
- D. Mock-ups
- E. Testing Laboratory Services
- F. Inspection Services
- G. Manufacturers' Field Services

1.2 RELATED SECTIONS

- A. Section 01 33 00 "Submittal Procedures"
- B. Section 01 41 00 "Regulatory Requirements"
- C. Section 01 45 23 "Testing and Inspecting Services"
- D. The Work of this Section shall be included as a part of all Sections of Work, whether referenced therein or not.

1.3 DESCRIPTION OF REQUIREMENTS

- A. Unless specifically noted otherwise, perform all Work shown, mentioned, or reasonably inferred and comply with all work restrictions.
- B. Many of the requirements specified elsewhere are included herein for reference and convenience. Where a conflict occurs between the Contract Documents, either within themselves or each other, the more stringent requirement or the most expensive combination of materials and workmanship shall prevail.
- C. Contractor shall:
 - 1. perform Work in accordance with the General Conditions, as specified herein, and with the quality control requirements of each Specification Section;
 - 2. perform Work in the highest quality workmanship, unless specified otherwise;
 - 3. join materials with a uniform and accurate fit so they meet with neat straight lines, free of smears, overlaps or irregularities, as applicable to the work;
 - 4. install all exposed materials appropriately level, plumb, and at accurate angles as shown and flush with adjoining materials;
 - 5. attach materials with sufficient strength, and with number and spacing of fasteners and attachments that will not fail until materials joined are broken or permanently deformed;
 - 6. use concealed fasteners, unless shown or directed otherwise.

1.4 QUALITY ASSURANCE AND CONTROL OF INSTALLATION

- A. Monitor quality control over suppliers, manufacturers, Products, services, site conditions, and workmanship, to produce Work of specified quality.
- B. Comply with manufacturers' instructions, including each step in sequence.

- C. Should manufacturer's instructions conflict with Contract Documents, request clarification from Architect/Engineer before proceeding.
- D. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Perform Work by persons qualified to produce required and specified quality.
- F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.
- G. Secure Products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

1.5 TOLERANCES

- A. Monitor fabrication and installation tolerance control of Products to produce acceptable Work. Do not permit tolerances to accumulate.
- B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Architect/Engineer before proceeding.
- C. Adjust Products to appropriate dimensions; position before securing Products in place.

1.6 REFERENCES AND STANDARDS

- A. For Products or workmanship specified by association, trade, or other consensus standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- B. Conform to reference standard by date of issue current on date of Owner-Contractor Agreement except where specific date is established by code.
- C. Obtain copies of standards where required by product specification sections.
- D. When specified reference standards conflict with Contract Documents, request clarification from Architect/Engineer before proceeding.
- E. Neither contractual relationships, duties, responsibilities of parties in Contract nor those of Architect/Engineer shall be altered from Contract Documents by mention or inference otherwise in reference documents.
- F. Refer to Section 01 41 00 "Regulatory Requirements", for additional information concerning applicable reference and standards requirements.

1.7 TESTING SERVICES

- A. Owner will appoint, employ, and pay for specified services of an independent firm to perform testing.
- B. The independent firm will perform tests and other services specified in individual specification sections and as required by the Architect/Engineer, Owner, or authority having jurisdiction.
- C. Testing and source quality control may occur on or off the project site. Perform off-site testing as required by the Architect/Engineer or the Owner.
- D. Reports will be submitted by the independent firm to the Owner, Architect/Engineer, and Contractor, indicating observations and results of tests and indicating compliance or non-compliance with Contract Documents.

- E. Cooperate with independent firm; furnish samples of materials, design mix, equipment, tools, storage, safe access, and assistance by incidental labor as requested.
 - 1. Notify Architect/Engineer and independent firm 48 hours prior to expected time for operations requiring services, or as specified in individual specification sections.
 - 2. Make arrangements with independent firm and pay for additional samples and tests required.
- F. Testing does not relieve Contractor to perform Work to contract requirements.
- G. Re-testing required because of non-conformance to specified requirements shall be performed by the same independent firm on instructions by the Architect/Engineer. Payment for re-testing will be charged to the Contractor by deducting testing charges from the Contract Sum/Price.
- H. Refer to Section 01 45 23 "Testing and Inspecting Services", for additional information concerning testing, and submittal procedures and requirements for Testing Reports.

1.8 INSPECTION SERVICES

- A. Owner will appoint, employ, and pay for specified services of an independent firm to perform inspection.
- B. The independent firm will perform inspections and other services specified in individual specification sections and as required by the Architect/Engineer, Owner, or authority having jurisdiction.
- C. Inspecting may occur on or off the project site. Perform off-site inspecting as required by the Architect/Engineer or the Owner.
- D. Reports will be submitted by the independent firm to the Owner, Architect/Engineer, and Contractor, indicating inspection observations and indicating compliance or non-compliance with Contract Documents.
- E. Cooperate with independent firm; furnish safe access and assistance by incidental labor as requested.
 - 1. Notify Architect/Engineer and independent firm 48 hours prior to expected time for operations requiring services, or as specified in individual specification sections.
- F. Inspecting does not relieve Contractor to perform Work to contract requirements.
- G. Refer to Section 01 45 23 "Testing and Inspecting Services", for additional information concerning inspections, and submittal procedures and requirements for Inspection Reports.

1.9 MANUFACTURERS' FIELD SERVICES

- A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust and balance of equipment as required, and to initiate instructions when necessary.
- B. Submit qualifications of observer to Architect/Engineer within ten (10) days after receipt of Notice to Proceed, in advance of required observations. Observer subject to approval of Architect/Engineer and Owner.
- C. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.
- D. Refer to Section 01 33 00 "Submittal Procedures", for additional information concerning submittal procedures and requirements for Manufacturers Field Reports.

PART 2 – PRODUCTS *(Not Used)*

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Verify existing site conditions and substrate surfaces are acceptable for subsequent Work. Beginning new Work means acceptance of existing conditions.
- B. Verify existing substrate is capable of structural support or attachment of new Work being applied or attached.
- C. Examine and verify specific conditions described in individual specification sections.
- D. Verify utility services are available, of correct characteristics, and in correct locations.

3.2 PREPARATION

- A. Clean substrate surfaces prior to applying next material or substance.
- B. Seal cracks or openings of substrate prior to applying next material or substance.
- C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying new material or substance in contact or bond

END OF SECTION

SECTION 01 45 23

TESTING AND INSPECTING SERVICES

CONDITIONS OF THE CONTRACT AND DIVISION 01, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. A qualified independent testing laboratory and/or geotechnical engineering service selected and paid by Owner and approved by Architect, will perform professional testing and laboratory services specified herein.
- B. Inspecting agency shall make and perform all inspections and tests in accordance with the rules and regulations of the building code, local authorities, Specifications of ASTM, and these Contract Documents.
- C. Materials and workmanship not meeting required standards or performance obligations are to be removed and replaced. Replacement and subsequent testing shall be at Contractor's expense.
- D. Where terms "Inspector" and "Laboratory" are used, they mean and refer to an officially designated and accredited inspector of the testing laboratory or geotechnical service engaged by Owner.
- E. All testing laboratory services will be provided and paid for by the Owner and the Contractor shall be notified as soon as possible.
- F. The Owner will pay for the initial laboratory services of materials that comply with the requirements of the Contract Documents. The Contractor shall pay for testing and re-testing of materials that do not comply with the requirements of the Contract Documents.
- G. Laboratory inspection shall not relieve the Contractor or Fabricator of his responsibility to furnish materials and workmanship in accordance with the Contract Documents.
- H. Contractor or Fabricator shall cooperate with the testing laboratory in all matters pertaining to the work.

1.2 RELATED REQUIREMENTS

- A. Conditions of the Contract: Inspections and testing required by laws, ordinances, rules, regulations, orders or approvals or public authorities.
- B. Respective Sections of Specifications. Certification of products.
- C. Each Specification Section Listed: Inspection and laboratory test required and standards for inspection and testing.
- D. Testing laboratory inspection, sampling and testing is required for:
 - 1. Division 05 "Metals": As specified or required for structural steel, open web steel joists, steel deck, miscellaneous metals, etc.
 - 2. Division 07 "Thermal and Moisture Protection": As specified or required for waterproofing and roofing.
 - 3. As requested by the Construction Manager/Contractor, Owner, Architect, or Engineer(s).

1.3 QUALIFICATIONS

- A. Testing agencies shall meet requirements of ASTM E329, "Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction" and ASTM E543, "Standard Practices for Agencies Performing Non-Destructive Testing".
- B. Testing agencies shall be insured against errors and omissions by a professional liability insurance policy having a minimum limit of liability of \$500,000.00.

- C. Inspection and testing services of testing agency shall be under the direction of a Registered Engineer licensed in the State of Texas, charged with engineering managerial responsibility, and having a minimum of five (5) years engineering experience in inspection and testing of construction materials.
- D. Inspecting personnel monitoring concrete work shall be ACI certified inspectors.
- E. Primary inspectors performing structural steel inspection shall be currently certified AWS Certified Welding Inspectors (CWI), in accordance with the provisions of AWS QCI, "Standard and Guide for Qualification and Certification of Welding Inspectors". Inspector may be supported by assistant inspectors who may perform specific inspection functions under supervision of the inspector. Assistant inspectors shall be currently certified AWS Certified Associate Welding Inspectors (CAWI). Work of assistant inspectors shall be regularly monitored by the inspector, generally on a daily basis.
- F. Testing machines shall be calibrated at intervals not exceeding 12 months by devices of accuracy traceable to the National Bureau of Standards.

1.4 RESPONSIBILITIES OF CONTRACTOR

- A. See respective technical sections for specific requirements.
- B. Deliver to the laboratory, without cost to Owner, adequate quantities of representative samples of materials proposed for use which are required to be tested.
- C. Advise laboratory and Architect sufficiently in advance of construction operations to allow laboratory to complete any required checks or tests and to assign personnel for field inspection and testing as specified.
- D. Provide adequate facilities for safe storage and proper curing of concrete test samples on project site for the first 24 hours and also for subsequent field curing as required by ASTM C31.
- E. Furnish such nominal labor and equipment as is required to assist laboratory personnel in obtaining and handling samples at the site and in accessing work for inspection.
- F. Furnish concrete mix designs, in accordance with ACI 301, Section 3.9, made by an independent testing laboratory or qualified concrete supplier. Where mix designs by an independent testing laboratory are required, the laboratory shall be selected and paid by the Contractor.
- G. Obtain required inspections or approvals of the building official. All inspection requests and notifications required by building code are responsibility of the Contractor.
- H. Provide current welder certificates for each welder to be employed.
- I. Furnish fabrication/erection inspection and testing of all welds in accordance with AWS D1.1, Chapter 6.
- J. Prequalification of all welding procedures to be used in executing the work.

1.5 AUTHORITY AND DUTIES OF LABORATORY PERSONNEL

- A. A representative of the testing laboratory, who has reviewed and is familiar with the project and specifications, shall participate in all pre-construction conferences. He shall coordinate material testing and inspection requirements with the Contractor and his subcontractors consistent with the planned construction schedule. The laboratory representative shall attend, throughout the course of the project, such conferences as may be required or requested to address quality control issues.
- B. Laboratory personnel shall inspect and/or test materials, assemblies, specimens, and work performed, including design mixes, methods and techniques and report to the Architect the progress thereof.

- C. If material furnished and/or work performed fails to meet requirements of Contract Documents, laboratory inspector shall promptly notify the Construction Manager, Architect, Engineers, supplier and/or subcontractor providing or preparing the materials or work being tested of such failure.
- D. Laboratory technicians do not act as foremen, or perform other duties for Contractor. Work will be checked as it progresses, but failure to detect any defective work or materials shall not, in any way, prevent later rejection when such defect is discovered.
- E. Laboratory inspector is not authorized to revoke, alter, relax, enlarge, or release any requirement of the Contract Documents or to approve or accept any portion of work, except where such approval is specifically called for in the Specifications.
- F. Comply with all building code requirements for "Special Inspection" whether or not such inspections are specified herein.

1.6 SUBMITTALS

- A. Submit copies of reports of each and every inspection and test as follows:
 - 1. Owner, Program or Project Manager, Architect, and each Engineer or outside consultants regarding their particular phase of the project: One (1) each
 - 2. Construction Manager, if applicable, and Contractor: Two (2) each
- B. State in report all details of each inspection and test. Indicate compliance or noncompliance with requirements of Contract Documents. Also state in report any and all unsatisfactory conditions.
- C. In addition to furnishing a written report, notify Construction Manager, if applicable, and Contractor verbally of any uncorrected conditions or failures to comply with requirements of the Contract Documents, and immediately Fax corresponding report to the Architect and Engineer.
- D. At completion of each trade or branch of work requiring inspecting and testing, submit a final certificate attesting to satisfactory completion of work and full compliance with requirements of Contract Documents.
- E. Submit copies of test results, sealed by a Registered Engineer, to municipal authorities having jurisdiction, as required.

1.7 REFERENCED STANDARDS

- A. Latest adopted edition of all standards referenced in this Section shall apply, unless noted otherwise. In case of conflict between these Contract Documents and a referenced standard, the Contract Documents shall govern. In case of conflict between Contract Documents and the Building Code, the more stringent shall govern.

1.8 TESTING LABORATORY GUIDELINES AND PROCEDURES

- A. Technicians scheduled to perform specific testing services must be qualified to review and perform other services that overlap, i.e. earthwork, foundation inspections, rebar inspection, and concrete when scheduled concurrently at the Project site.
- B. Technician time for services performed will be reimbursed at a regular time rate. Compensation at the overtime rate will be considered for any hours over eight (8) hours spent at the job site on a single day, field testing services performed on a Saturday or Sunday, and any field services performed on a recognized holiday.
- C. There will be a three (3) hour minimum for each scheduled testing service. Vehicle charges will be included on a \$25.00 per trip basis.
- D. Cylinder pick-up will be handled by the technician performing test on a scheduled pick-up day. If there are no testing services scheduled, the cylinder pick-up fee will be \$40.00 on week days and \$50.00 on weekends and holidays with no technician or vehicle charge.

- E. Contractor shall bear the responsibility of scheduling all of the test services. The Contractor and the testing laboratory shall assume full responsibility to coordinate the testing services. Cancellations and/or failed test will be reimbursable to the Owner by the responsible party for the cancellations or failure of a test or service.

PART 2 – PRODUCTS *(Not Used)*

PART 3 – EXECUTION

3.1 GENERAL

- A. Testing services shall include, but not be limited to those specified below or which are necessary or required during course of construction to ascertain specification compliance and which may be deemed necessary by Architect, Engineer, or Owner to ensure the quality of the Work.
- B. The Owner reserves the right to add to or delete any or all inspection and testing specified herein, excluding testing as required by the applicable building codes.
- C. If conflicts arise between Drawings and Specifications, notify Architect immediately. In any case the most stringent requirements shall dictate procedure.

3.2 METAL ROOF DECK

- A. Field inspection shall consist of the following:
 - 1. Checking types, gauges and finishes for conformance with Contract Documents and shop drawings.
 - 2. Examination for proper erection of all metal deck, including fastenings at supports and side laps, reinforcing of holes, and miscellaneous deck supports.
 - 3. Certification of welders.
 - 4. Visual inspection of at least 25 (twenty-five) percent of all welds.

3.3 TESTING OF ROOFING

- A. Inspection and Observation Services (As required):
 - 1. Inspection of roof deck prior to start of work.
 - 2. Inspect on-site condition of stored roofing materials.
 - 3. Inspection during roofing, roof insulation, and sheet metal work to ascertain compliance with Contract Documents.
 - 4. Observation of roof test cuts performed by Contractor to ascertain that they are properly made.
 - 5. Observation of patching of roof test cuts to ascertain that they are properly made.
- B. Testing Services (As required):
 - 1. Perform dissection and analysis on cuts provided by Contractor to confirm number of plies, bonding of plies, weight of bitumen and softening temperature to ascertain compliance with specifications.

END OF SECTION

SECTION 01 50 00

TEMPORARY FACILITIES AND CONTROLS

CONDITIONS OF THE CONTRACT AND DIVISION 01, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 SUMMARY

- A. Section includes
 - 1. Specific administrative and procedural minimum actions are specified in this Section, as extensions of provisions in other Contract Documents. These requirements have been included for special purposes as indicated. Nothing in this Section is intended to limit types and amounts of temporary work required, and no omission from this Section will be recognized as an indication that such temporary activity is not required for successful completion of the Work and compliance with requirements of the Contract Documents. Provisions of this Section are applicable to, but are not limited to the temporary power, temporary water, temporary heat, field office, mobile telephone, sanitary facilities, storage facilities, signs, barriers, security, construction fence, cleaning, first aid facilities, fire protection, construction aids, parking facilities, storm water control and pollution prevention plan, as further expanded in this Section.
- B. Related Requirements
 - 1. Section 01 74 19 "Construction Waste Management and Disposal"
 - 2. Section 01 81 13 "Sustainable Design Requirements"

1.2 JOB CONDITIONS

- A. General: Establish and initiate use of each temporary facility at time first reasonably required for proper performance of the Work. Terminate use and remove facilities at earliest reasonable time, when no longer required or when permanent facilities have, with authorized use, replaced their need.
- B. Conditions of Use:
 - 1. Install, operate, maintain and protect temporary facilities in a manner and at locations which will be safe, non-hazardous, sanitary, and protective of persons and property, and free of deleterious effects.
 - 2. Be responsible for overloading or excess use of or damage resulting from the overloading or excess use of existing utilities.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Materials, not specifically described herein, but required for proper completion of Work of this Section, may be new or used as selected by the Contractor, but shall be of design, type, size, and strength recommended to suit intended purpose.
- B. Items required to protect the tenants, workmen, and public from danger, shall be sufficiently designed to protect them. Where required, exclude the public from all hazards.

PART 3 – EXECUTION

3.1 UTILITIES

- A. Temporary Power: Provide temporary power and all wiring, lamps, distribution of power, and equipment required for construction, inspection and testing of Work.
- B. Temporary Water: Provide temporary water and all hoses and equipment required for construction, inspection and testing of Work.

- C. Temporary Climate Control: Provide temporary climate control (heating, cooling and humidity control) required for construction of Work. \
 - 1. Provide heat to prevent freezing and to avoid damage to materials in storage, during and after installation, and during curing and drying of materials and finishes. Provide and maintain such dependable source of supply of heat, cooling, and humidity control as necessary until the Work is accepted. No open fire heaters will be permitted. No mold, mildew, rust, or sagging materials due to humidity will be allowed. Contractor shall remediate any and all evidence of mold, mildew, or rust per applicable state standards and requirements.

3.2 FIELD OFFICE

- A. Furnish a job trailer installed at a suitable location on site for use by the Contractor and the Architect.
- B. Provide and maintain a weather tight building with operable and lockable door and windows, to serve as a job office available to the Contractor, subcontractors, and the Owner and Architect. Provide lights, electricity, air conditioning and heat, as required. Remove office from premises when one can be set up inside the building. Provide job telephone and other miscellaneous items as outlined below.
 - 1. Provide a separate locked room to serve as an office for the Owner and Architect, of an area of 100 SF, or provide in a separate building in close proximity to Contractor's office.
 - 2. Contractor's office shall be of a size, and furnished, so that it may be used for small progress meetings.
 - 3. Provide adequate artificial lighting, heating and cooling to provide comfortable conditions for occupants.
 - 4. Provide direct line telephone service, for both voice communication and facsimile machines at Contractor's office and Owner/Architect's office.
 - 5. Provide high speed wireless internet access (provide access to the Owner and Architect); DSL or broadband. Dial-up connection is not acceptable.
 - 6. Maintain a complete set of Construction Documents, Submittals, Record Documents, and other pertinent information for Contractor, Architect, Engineer, and Owner use.
 - 7. Furnishings Required:
 - a. For Contractor's office: Racks and files for Contract Documents and for Record Documents; conference table and chairs; and desks and chairs as required by Contractor.
 - b. For Owner/Architect's office: One four (4) drawer metal file cabinet, one lay-out drafting table 36 inch by 72 inch by 36 inch high; and drafting stool. Provide one drawing rack for 30 inch by 42 inch drawings. The Contractor will pay the monthly phone charges for all calls and base service charges for phone lines and fax lines that are brought into the Owner/Architect office. Provide the Owner and Architect with a key to the Owner/Architect office only.

3.3 MOBILE TELEPHONE

- A. Furnish and maintain a mobile telephone for his superintendent's use for the duration of the Project.

3.4 SANITARY FACILITIES

- A. Furnish and maintain temporary sanitary facilities. Comply with regulations of State Department of Health and other authorities having jurisdiction. The Contractor may not

use the Owner's facilities.

3.5 STORAGE FACILITIES

- A. Provide and maintain adequate weathertight lockable storage facilities, raised above the ground, with sides and top enclosed.
- B. Replace materials improperly stored and damaged by weathered conditions.
- C. Remove storage facilities when materials can be stored within the structure in a weathertight condition.
- D. Provide for temporary freeze protection as needed.

3.6 SIGNS

- A. Furnish and install a project sign 6'-0" by 8'-0" in size. Image will be provided to the graphics printing company by the Architect after Award of Contract. Contractor will be responsible for the cost of printing the image, mounting the sign on an aluminum substrate and installing the sign at the site. The sign will include the name of the project, District, name and title of Board of Trustees, District Superintendent, Contractor, Architect, and each of the project consultants.
- B. Other signs permitted at the site:
 - 1. Warning signs.
 - 2. Directional signs.
 - 3. Identification signs at field offices.
 - 4. Emergency medical services sign.
 - 5. Signs required by Authorities Having Jurisdiction
 - 6. Storm Water Pollution Prevention Plan sign (SWPPP)
- C. Contractor shall allow no other signs to be displayed at the project site, unless authorized by the Owner.

3.7 BARRIERS

- A. Provide temporary barricades on all portions of the site adjacent to the construction and accessible to the public.

3.8 TREE AND PLANT PROTECTION

- A. Locate and clearly flag existing trees, shrubs and other vegetation designated to remain or to be relocated. Protect and maintain in healthy condition.
- B. Provide approved barriers around trees and plants designated to remain to protect against vehicular traffic, stored materials, dumping, chemically injurious materials, water puddling, and continuous running water.
- C. Tree and Plant Protection: Install temporary fencing or other barriers located as indicated, or if not indicated, outside the drip line of trees, to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.
- D. Restoration and Replacement:
 - 1. Restore damaged vegetation to a condition as good as or better than its condition at commencement of operations under this Contract.
 - 2. Employ a licensed arborist to repair tree and shrub damage.
 - 3. Replace damaged trees that cannot be restored to full growth, as determined by arborist.

3.9 SECURITY

- A. Determine if and when watchmen are necessary for protection of the Work, and provide such services when necessary. Neither the provision of watchmen nor the failure to provide watchmen shall relieve the Contractor of responsibility in event of injury to persons or damage to property.

3.10 CONSTRUCTION FENCE

- A. Provide a minimum 6 feet-0 inch high chain link construction fence around the perimeter of the construction area for the duration of the construction period. Said temporary construction fence shall have lockable access gates necessary to adequately access the site in order to execute the project. Access gates shall be locked at the completion of each day's work.

3.11 CLEANING

- A. **Trash Collection:** Trash generated by demolition, construction, and related activities shall be placed in appropriate collection containers which are designed to prevent the generation of windborne litter.
- B. **Trash Removal:** Clear the building and site of trash at least once a week. When rapid accumulation occurs, make more frequent removals. Remove highly combustible trash such as paper and cardboard daily. Dumpsters will not be allowed to overflow and should be emptied on a regular basis.
- C. **Disposition of Debris:** Remove debris from site and make legal disposition. Locations for disposal shall be of the Contractor's choice within the above restriction. Neither debris nor material may be buried or burned at the site. Take necessary precautions to prevent accidental burning of materials by avoiding large accumulations of combustible materials.
- D. **Final Cleaning:** Thoroughly clean the Work, including the removal of smudges, marks, stains, fingerprints, soil, dirt, paint spots, dust, lint, discolorations, and other foreign materials.

3.12 TEMPORARY FIRST AID FACILITIES

- A. Provide first aid equipment and supplies, with qualified personnel continuously available to render first aid at the site.
- B. Provide a sign, posted at the field office telephone, listing the telephone numbers for emergency medical services: Physicians, ambulance services and hospitals.

3.13 TEMPORARY FIRE PROTECTION

- A. Provide a fire protection and prevention program for employees and personnel at the site; and provide and maintain fire extinguishing equipment ready for instant use at all areas of the Project and at specific areas of critical fire hazard.
- B. **Equipment:**
 - 1. Hand extinguishers of the types and sizes recommended by the National Board of Fire Underwriters to control fires from particular hazards.
 - 2. Barrels of water with buckets designated for fire-control purposes.
 - 3. Water hoses connected to an adequate water pressure and supply system.
 - 4. Construction period use of permanent fire protection system.
- C. **Enforce fire-safety discipline:**
 - 1. Store volatile materials in an isolated, protected location.
 - 2. Avoid accumulations of flammable debris and waste in or about the Project.
 - 3. Prohibit smoking in the vicinity of hazardous conditions.

4. Closely supervise and provide fire watches as required by authorities having jurisdiction during and after welding and torch-cutting operations in the vicinity of combustible materials and volatile conditions.
 5. Supervise locations and operations of portable heating units and fuel.
- D. Contractor shall maintain fire-extinguishing equipment in working condition, with current inspection certificate attached to each extinguisher.

3.14 CONSTRUCTION AIDS

- A. Provide construction aids and equipment required to assure safety for personnel and to facilitate the execution of the Work; Scaffolds, staging, ladders, stairs, ramps, runways, platforms, railings, hoists, cranes, chutes and other equipment.
- B. Maintain all equipment in a first-class, safe condition.

3.15 PARKING FACILITIES

- A. Coordinate location of parking for personnel and employees at the facility to avoid interference with traffic, walks, work and storage areas, or with materials-handling equipment.
- B. Grade and provide drainage facilities to assure runoff of rainwater and to avoid blockage of flow from adjacent areas.

3.16 STORM WATER CONTROL AND POLLUTION PREVENTION PLAN

- A. Grade and provide drainage facilities to assure runoff of rainwater and to avoid blockage of flow from adjacent areas. Refer to Civil Drawings for additional requirements.
- B. Provide and maintain a Storm Water Pollution Prevention Plan in accordance with Federal EPA requirements.
- C. File an EPA "Notice of Intent" Form with the EPA **before construction begins.**

3.17 DUST CONTROL

- A. Dust associated with demolition and construction activities shall be controlled by a means complying with TCEQ Chapter 111, Section 111.145 "Construction and Demolition."

END OF SECTION

SECTION 01 60 00
PRODUCT REQUIREMENTS

CONDITIONS OF THE CONTRACT AND DIVISION 01, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 SECTION REQUIREMENTS

- A. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
- B. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced.
 - 1. Show compliance with requirements for comparable product requests.
 - 2. Architect will review the proposed product and notify Contractor of its acceptance or rejection.
- C. Basis-of-Design Product Specification Submittal: Show compliance with requirements.
- D. Compatibility of Options: If Contractor is given option of selecting between two or more products, select product compatible with products previously selected.
- E. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft. Comply with manufacturer's written instructions.
 - 1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
 - 2. Deliver products to Project site in manufacturer's original sealed container or packaging, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
 - 3. Inspect products on delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.
 - 4. Store materials in a manner that will not endanger Project structure.
 - 5. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
- F. 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.

PART 2 – PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

- A. Provide products that comply with the Contract Documents, are undamaged, and, unless otherwise indicated, are new at the time of installation.
 - 1. Provide products complete with accessories, trim, finish, and other devices and components needed for a complete installation and the intended use and effect.
 - 2. Where products are accompanied by the term "as selected," Architect will make selection.
 - 3. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.

- B. Where the following headings are used to list products or manufacturers, the Contractor's options for product selection are as follows:
 - 1. Products:
 - a. Where requirements include "one of the following," provide one of the products listed that complies with requirements.
 - b. Where requirements do not include "one of the following," provide one of the products listed that complies with requirements or a comparable product.
 - 2. Manufacturers:
 - a. Where requirements include "one of the following," provide a product that complies with requirements by one of the listed manufacturers.
 - b. Where requirements do not include "one of the following," provide a product that complies with requirements by one of the listed manufacturers or another manufacturer.
 - 3. Basis-of-Design Product: Provide the product named, or indicated on the Drawings, or a comparable product by one of the listed manufacturers.
- C. Where Specifications require "match Architect's sample," provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
- D. Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 COMPARABLE PRODUCTS

- A. Architect will consider Contractor's request for comparable product when the following conditions are satisfied:
 - 1. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
 - 2. Detailed comparison of significant qualities of proposed product with those named in the Specifications.
 - 3. List of similar installations for completed projects, if requested.
 - 4. Samples, if requested.

PART 3 – EXECUTION *(Not Used)*

END OF SECTION

SECTION 01 71 23
FIELD ENGINEERING

CONDITIONS OF THE CONTRACT AND DIVISION 01, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. Measures to ensure adequate quality control and quality assurance for all Work in accordance with Conditions of the Contract, as specified herein, and with the quality control and quality assurance requirements of each Specification Section, and authorities having jurisdiction.
- B. Related Requirements
 - 1. All Sections of Work requiring layout, survey, reference points and their verification and protection, and quality control and assurance monitoring requirements.

1.2 REFERENCES

- A. Definitions
 - 1. Survey and Field Engineering: Wherever the terms “Survey”, “Field Engineering” or any derivative thereof, or similar term appears within this Section, they mean one and the same, and shall mean the survey or field engineering work performed by the Field Engineer as defined below and is separate from that of the survey work provided by the Owner.
 - 2. Field Engineer: Wherever the term “Field Engineer” or any derivative thereof, or similar term appears in the Contract Documents, it shall refer to the General Contractor’s employee(s) that are expert in, routinely engaged in, and have at least five (5) years experience in, the practice of construction project field engineering, building and project layout, construction measurements and monitoring, etc.
 - 3. “Construction Surveyor”: Wherever the term “Construction Surveyor”, or any derivative thereof, or similar term appears in the Contract Documents, the entity (person or firm) licensed as a Registered Professional Land Surveyor or Professional Engineer of the discipline required for specific service on the Project in the State in which the Project occurs, with five (5) years minimum experience, and meeting all applicable regulations of the State in which the Project occurs and Department of Labor, and other authorities having jurisdiction to perform the Work. To avoid any misunderstanding or lack of interpretation, the entity responsible for performing the Work of this Section shall be employed by the General Contractor, and the responsibility, including methods and means, is totally that of the General Contractor.
 - 4. Quality Control and Quality Assurance: Wherever the terms “Quality Control”, “Quality Assurance” or any derivative thereof, or similar term appears in the Contract Documents, they mean one and the same, and shall mean an aggregate of activities of the General Contractor, such as design analysis and statistical sampling with inspection for defects, designed to ensure adequate quality in materials and workmanship whether factory manufactured or jobsite produced.

1.3 QUALITY CONTROL AND QUALITY ASSURANCE

- A. Employ a Construction Surveyor complying with the definition above and acceptable to the Owner and Architect, to perform all Construction Surveying. Provide full responsibility

for the Construction Surveyor and accuracy of the performance of all items of Work shown on Drawings, specified herein, or in other Specification Sections.

1.4 SUBMITTALS

- A. Submit name, address, telephone number, fax number, and registration number of the proposed Construction Surveyor prior to starting Work of this Section.
- B. Submit evidence of Construction Surveyor's Errors and Omissions insurance coverage in the form of an Insurance Certificate, if different from Construction Manager's.
- C. Upon request by Architect, submit documentation verifying accuracy of all Survey Work, including a certificate sealed and signed by the Construction Surveyor, that the elevations and locations of the Work are in conformance with Contract Documents and such information has been incorporated into the Project Record Documents.
- D. Submit Project Record Documents under provisions of Section 01 77 00 "Closeout Procedures".

PART 2 – PRODUCTS *(Not Used)*

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Verify locations of survey control points prior to starting work.
- B. Promptly notify Architect of discrepancies discovered.

3.2 SURVEY REFERENCE POINTS

- A. Locate and protect survey control and reference points.
- B. Control datum for survey is that established by the Owner provided survey and as indicated on Drawings.
- C. Protect survey control points prior to starting site work; preserve permanent reference points during construction.
- D. Promptly report to Architect the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.
- E. Replace dislocated survey control points based on original Owner's survey control. Make no changes without prior written permission of Architect.

3.3 FIELD ENGINEERING AND CONSTRUCTION SURVEYOR REQUIREMENTS

- A. Establish a minimum of two (2) permanent benchmarks on site, referenced to established control points. Record locations, with horizontal and vertical data, on Project Record Documents.
- B. Field Engineer shall establish elevations, lines and levels. Locate, lay out, and monitor by instrumentation and similar appropriate means Work, including, but not be limited to:
 - 1. elevations of structural steel, including, steel joists/trusses, steel decks, and associated miscellaneous metals;
 - 2. elevations and slopes of roofing, including those for lightweight insulating concrete deck system, if applicable.
 - 3. elevations and layout of work as required to ensure proper operation, clearances, and tolerances, including plumbing and mechanical work; and
 - 4. monitoring of movement and protection of existing or adjacent structures, as applicable.
- C. Throughout course of Work, verify existing conditions and layouts by same means as originally used to ensure conformance with design requirements and details. Notify Architect immediately, if discrepancies are found.

- D. Provide one (1) copy each of reduced Field Engineer's notes to the Architect, Owner, Construction Surveyor, and affected Consultant within four (4) working days of completion of each portion of the Field Engineering Work.
- E. Field Engineer's notes shall be clear and complete. The Field Engineer shall be available at no expense to the Owner, Architect, or Consultants for note interpretation, if required.
- F. Field Engineer shall perform surveys to determine quantities of unit cost work, including control surveys to establish measurement reference lines. Notify Architect prior to starting work.

3.4 PROJECT RECORD DOCUMENTS

- A. Maintain a complete and accurate log of control and Field Engineer work as it progresses.
- B. Upon completion of Work, including, but not limited to earthwork, formwork, foundation, structural steel erection, and major site improvements, prepare Project Record Documents illustrating dimensions, locations, angles, and elevations of construction and site work.
- C. Submit Project Record Documents as specified in Paragraph 1.4.

END OF SECTION

SECTION 01 73 00

EXECUTION

CONDITIONS OF THE CONTRACT AND DIVISION 01, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements governing execution of the Work including, but not limited to, the following;
 - 1. Construction layout
 - 2. Field engineering and surveying
 - 3. General installation of products
 - 4. Coordination of Owner-installed products
 - 5. Progress cleaning
 - 6. Starting and adjusting
 - 7. Protection of installed construction
 - 8. Correction of the Work

1.2 RELATED SECTIONS

- A. Section 01 31 13 "Project Coordination"
- B. Section 01 33 00 "Submittal Procedures"
- C. Section 01 73 29 "Cutting and Patching"
- D. Section 01 77 00 "Closeout Procedures"

1.3 SUBMITTALS

- A. Certificates: Submit certificate signed by land surveyor certifying that location and elevation of improvements comply with requirements.

1.4 QUALITY ASSURANCE

Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.

PART 2 – PRODUCTS *(Not Used)*

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Existing Conditions: The existence and location of site improvements, utilities, and other 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.
 - 1. Before construction, verify the location and points of connection of utility services
- 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. Written Report: Where a written report listing conditions detrimental to performance of the Work is required, include the following:
 - a. Description of the Work.
 - b. List of detrimental conditions, including substrates.

- c. List of unacceptable installation tolerances.
 - d. Recommended corrections
2. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
 3. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 4. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 5. 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 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 CONSTRUCTION LAYOUT

- A. **Verification:** Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.
- B. **Record Log:** Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

3.4 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 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 Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.

- E. Tools and Equipment: Do not use tools or equipment that produces 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.

3.5 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 changes in actual construction progress.
 - 2. Pre-Installation Conferences: Include Owner's construction forces at pre-installation conferences covering portions of the Work that are to receive Owner's work. Attend pre-installation conferences conducted by Owner's construction forces if portions of the Work depend on Owner's construction.

3.6 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.
 - 2. Do not hold materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 80 deg F.
 - 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
- B. Site: Maintain Project site free of waste materials and debris.

- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
 - 1. Remove liquid spills promptly.
 - 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period.
- J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.7 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 Section 01 40 00 "Quality Requirements".

3.8 PROTECTION OF INSTALLED CONSTRUCTION

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

3.9 CORRECTION OF THE WORK

- A. Repair or remove and replace defective construction. Restore damaged substrates and finishes. Comply with requirements in Section 01 73 29 "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 29
CUTTING AND PATCHING

CONDITIONS OF THE CONTRACT AND DIVISION 01, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 DESCRIPTION OF REQUIREMENTS

- A. Definition: "Cutting and Patching" includes cutting into existing construction to provide for the installation or performance of other work and subsequent fitting and patching required to restore surfaces to their original undamaged condition, including original fire rating of fire rated construction.
 - 1. Cutting and patching is performed for coordination of the work for access or inspection, to obtain samples for testing, as indicated or required, to remove/replace defective work or work not conforming to the contract documents, to permit alterations to be performed, or for other similar purposes.
 - 2. Cutting and patching performed during the manufacture of products or during the initial fabrication, erection, or installation processes is not considered to be "cutting and patching" under this definition. Drilling of holes to install fasteners and similar operations are also not considered to be "cutting and patching".
- B. Refer to other Sections of these Specifications for specific cutting and patching requirements and limitations applicable to individual units of work.
 - 1. Unless otherwise specified, requirements of this Section also apply to mechanical and electrical work.

1.2 QUALITY ASSURANCE

- A. Visual requirements - Do not cut and patch work exposed on the building's exterior or in its occupied spaces, in a manner that would, in the Architect's opinion, result in lessening the building's aesthetic qualities. Do not cut and patch work in a manner that would result in substantial visual evidence of cut and patchwork. Remove and repair or replace work judged by the Architect to be cut and patched in a visually unsatisfactory manner

1.3 RELATED WORK

- A. All Sections of Work requiring cutting and patching, including electrical requirements.

1.4 SUBMITTALS

- A. Procedural Proposal for Cutting and Patching - Where prior approval of cutting and patching is required, submit proposed procedures for this work well in advance of the time work will be performed and request approval to proceed. Include the following information, as applicable, in the submittal.
 - 1. Describe nature of the work and how it is to be performed, indicating why cutting and patching cannot be avoided. Describe anticipated results of the work in terms of changes to existing work, including structural, operational, and visual changes as well as other significant elements.
 - 2. List products to be used and firms including their qualifications that will perform the work. Also, provide cost proposals when applicable.
 - 3. Give dates when work is expected to be performed.
 - 4. List utilities that will be disturbed or otherwise be affected by work, including those that will be relocated and those that will be disconnected or out-of service temporarily. Indicate how long utility service will be disrupted.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. General - Except as otherwise indicated or as directed by Architect, use materials for cutting and patching that are identical to materials being cut and patched. If identical materials are not available, or cannot be used, use materials that match existing adjacent surfaces to the fullest extent possible with regard to visual effect. Use materials for cutting and patching that will result in equal or better performance characteristics.
 - 1. The use of trade name and supplier's name and address is to indicate a possible source of the material or product. Product of the same type from other sources shall not be excluded provided they possess like physical and functional characteristics, except where specified as no substitutions allowed or where a material or product is specified as the basis of specification and no other approved manufacturers are listed.
 - 2. Use materials, products, and devices to maintain integrity of fire rating of existing fire rated construction which comply with the requirements of authorities having jurisdiction.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Before starting work, examine the surfaces to be cut and patched and the conditions under which the work is to be performed. If unsafe or otherwise unsatisfactory conditions are encountered, take corrective action before proceeding with the work.
 - 1. Before the start of cutting work, meet at the work site with all parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict between the various trades. Coordinate layout of the work and resolve potential conflicts before proceeding with the work.
 - 2. After uncovering work, examine conditions affecting installation of product or performance of work.
 - 3. Report unsatisfactory or questionable conditions to Architect in writing; do not proceed with work until Architect has provided further instructions.

3.2 PREPARATION

- A. Provide temporary support to prevent failure of the work to be cut.
- B. Protect other work during cutting and patching to prevent damage. Provide protection from adverse weather conditions of that part of the Project that may be exposed during cutting and patching operations.
- C. Take precautions not to cut existing pipe, conduit, ducts, or wires serving the building, but scheduled to be removed or relocated until provisions have been made to bypass them.

3.3 PERFORMANCE

- A. General - Employ only skilled workmen to perform the cutting and patching work. Except as otherwise indicated or as approved by Architect, proceed with cutting and patching at the earliest feasible time and complete the work without delay.
- B. Cut the work using methods that are least likely to damage work to be retained or adjoining work. Where possible, review proposed cutting and patching procedures with the original installer and comply with original installer's recommendations.
 - 1. In general, where cutting is required, use hand or small power tools designed for sawing or grinding, not hammering and chopping. Cut through concrete and masonry using a cutting machine such as a Carborundum saw or core drill to insure a neat hole. Cut holes and slots neatly to size required with minimum

- disturbance of adjacent work. To avoid marring existing finished surfaces, cut or drill from the exposed or finished side into concealed surfaces. Temporarily cover openings when not in use.
2. Comply with requirements of other applicable sections where cutting and patching requires excavating and backfilling.
 3. By-pass utility services such as pipe and conduit, before cutting, where such utility services are shown or required to be removed, relocated, or abandoned. Cut-off conduit and pipe in walls or partitions to be removed. After by-passing and cutting, cap, valve, or plug and seal tight remaining portion of conduit and pipe to prevent entrance of moisture, vermin, or other foreign matter.
- C. Patching - Patch with seams which are durable and as invisible as possible. Comply with specified tolerance, if any, for the work.
1. Where feasible, inspect and test patched areas to demonstrate integrity of work.
 2. Restore exposed finishes of patched areas and where necessary extend finish restoration into retained adjoining work in a manner which will eliminate evidence of patching and refinishing.
 3. Where removal of walls or partitions extends one finished area into another finished area, patch and repair floor, wall, and ceiling surfaces in the new space to provide an even surface of uniform color and appearance. If necessary to achieve uniform color and appearance, remove existing floor and wall coverings or materials, and ceiling finish materials and replace with new materials.
 - a. Where patch occurs in a smooth painted surface, extend final paint coat over entire unbroken surface containing patch, after patched area has received prime and base coats.
 4. Patch, repair, or re-hang existing ceilings as necessary to provide an even plane surface of uniform appearance.
 5. Fit work airtight to pipes, sleeves, ducts, conduit and other penetrations through non-fire-rated floors and walls, and through finished surfaces.
- D. Fire Rated Construction - Where cutting and patching is necessary in existing fire rated construction, use sealant and other fire resistive materials, products, and devices as required and acceptable by the authorities having jurisdiction to repair, patch, and otherwise restore original fire rating and integrity of construction.

3.4 CLEANING

- A. Thoroughly clean area and spaces where work is performed or used as access to work. Remove completely: paint, mortar, cement, oils, putty, sealant, and items of similar nature. Thoroughly clean piping, conduit, and similar features before painting or other finishes are applied. Restore damaged pipe covering to its original undamaged condition.

END OF SECTION

SECTION 01 74 19

CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

CONDITIONS OF THE CONTRACT AND DIVISION 01, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
 - 1. Salvaging nonhazardous demolition and construction waste
 - 2. Recycling nonhazardous demolition and construction waste
 - 3. Disposing of nonhazardous demolition and construction waste
- B. Related Sections include the following:
 - 1. Section 01 50 00 "Temporary Facilities and Controls" for environmental-protection measures during construction.
 - 2. Section 01 81 13 "Sustainable Design Requirements" for sustainable design requirements and construction waste management goals.
 - 3. Section 02 40 00 "Demolition" for disposition of waste resulting from demolition of buildings, structures, and site improvements.

1.2 DEFINITIONS

- A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
- B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.
- C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.
- D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.
- E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.
- F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.3 PERFORMANCE REQUIREMENTS

- A. Salvage/Recycle Requirements: Owner's goal is to salvage and recycle as much non-hazardous demolition and construction as possible including the following materials:
 - 1. Demolition Waste:
 - a. Plywood and oriented strand board
 - b. Wood trim
 - c. Glazing
 - d. Acoustical tile and panels
 - e. Cabinets
 - f. Plumbing fixtures
 - g. Piping

- h. Supports and hangers
 - i. Valves
 - j. Mechanical equipment
 - k. Lighting fixtures
 - l. Lamps
 - m. Ballasts
2. Construction Waste:
- a. Wood trim
 - b. Metals
 - c. Roofing
 - d. Insulation
 - e. Gypsum board
 - f. Piping
 - g. Electrical conduit
3. Packaging: Regardless of salvage/recycle goal indicated above, salvage or recycle 100 percent of the following uncontaminated packaging materials:
- a. Paper
 - b. Cardboard
 - c. Boxes
 - d. Plastic sheet and film
 - e. Polystyrene packaging
 - f. Wood crates
 - g. Plastic pails

1.4 SUBMITTALS

- A. Waste Management Plan:
- 1. General: Develop a plan consisting of waste identification and waste reduction work plan.
 - 2. Waste Identification: Indicate anticipated types and quantities of demolition and construction waste generated by the Work. Include estimates quantities and assumptions for estimates.
 - 3. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Include points of waste generation, each means of recovery, and handling and transportation procedures.
 - a. Salvaged Materials for Reuse: For materials that will be salvaged and reused in this Project, describe methods for preparing salvaged materials before incorporation into the Work.
 - b. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.

- c. Disposed Materials: Indicate how and where materials will be disposed. Include name, address, and telephone number of each landfill and incinerator facility.
 - d. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location on Project site where material collection will be located.
- B. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
- C. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.

PART 2 – PRODUCTS *(Not Used)*

PART 3 – EXECUTION

3.1 PLAN IMPLEMENTATION

- A. General: Implement waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.
- 1. Comply with Section 01 50 00 “Temporary Facilities and Controls” for operation, termination, and removal requirements.
- B. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work occurring at Project site.
- C. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
- 1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.
 - 2. Comply with Section 01 50 00 “Temporary Facilities and Controls” for controlling dust and dirt, environmental protection, and noise control.

3.2 SALVAGING DEMOLITION WASTE

- A. Salvaged Items for Reuse in the Work:
- 1. Clean salvaged items.
 - 2. Pack or crate items after cleaning. Identify contents of containers.
 - 3. Store items in a secure area until installation.
 - 4. Protect items from damage during transport and storage.
 - 5. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.
- B. Salvaged Items for Owner's Use:
- 1. Clean salvaged items.
 - 2. Pack or crate items after cleaning. Identify contents of containers.

3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area designated by Owner.
5. Protect items from damage during transport and storage.

3.3 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

- A. General: Recycle paper and beverage containers used by on-site workers.
- B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to Contractor.
- C. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical.
 1. Provide appropriately marked containers or bins for controlling recyclable waste until they are removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.
 - a. Inspect containers and bins for contamination and remove contaminated materials if found.
 2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
 4. Store components off the ground and protect from the weather.
 5. Remove recyclable waste off Owner's property and transport to recycling receiver or processor.

3.4 RECYCLING DEMOLITION WASTE

- A. Wood Materials: Sort and stack members according to size, type, and length. Separate lumber, engineered wood products, panel products, and treated wood materials.
- B. Metals: Separate metals by type.
 1. Structural Steel: Stack members according to size, type of member, and length.
 2. Remove and dispose of bolts, nuts, washers, and other rough hardware.
- C. Acoustical Ceiling Panels and Tile: Stack large clean pieces on wood pallets and store in a dry location.
 1. Separate suspension system, trim, and other metals from panels and tile and sort with other metals.
- D. Equipment: Drain tanks, piping, and fixtures. Seal openings with caps or plugs. Protect equipment from exposure to weather.
- E. Plumbing Fixtures: Separate by type and size.
- F. Piping: Reduce piping to straight lengths and store by type and size. Separate supports, hangers, valves, sprinklers, and other components by type and size.
- G. Lighting Fixtures: Separate lamps by type and protect from breakage.
- H. Electrical Devices: Separate switches, receptacles, switchgear, transformers, meters, panelboards, circuit breakers, and other devices by type.
- I. Conduit: Reduce conduit to straight lengths and store by type and size.

3.5 RECYCLING CONSTRUCTION WASTE

- A. Packaging:
 - 1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
 - 2. Polystyrene Packaging: Separate and bag materials.
 - 3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
 - 4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.
- B. Site-Clearing Wastes: Chip brush, branches, and trees at landfill facility.
- C. Wood Materials:
 - 1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
 - 2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.
- D. Gypsum Board: Stack large clean pieces on wood pallets and store in a dry location.
 - 1. Clean Gypsum Board: Grind scraps of clean gypsum board using small mobile chipper or hammer mill. Screen out paper after grinding.

3.6 DISPOSAL OF WASTE

- A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
 - 1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Burning: Do not burn waste materials.
- C. Disposal: Transport waste materials off Owner's property and legally dispose of them.

END OF SECTION

SECTION 01 77 00
CLOSEOUT PROCEDURES

CONDITIONS OF THE CONTRACT AND DIVISION 01, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 PRE-CLOSEOUT MEETING

- A. Pre-Closeout Meeting: Schedule and convene Pre-Closeout Meeting with Owner and Architect in accordance with Section 01 31 19 "Project Meetings".

1.2 SUBSTANTIAL COMPLETION

- A. The items listed in Section 00 73 00 "Supplementary Conditions" Paragraph 9.8 and the following items shall be completed before Substantial Completion will be granted:
1. Contractor's Completion List (Punch List): Submit a thorough list of items to be completed or corrected, along with a written request for Substantial Completion and for review of the Work or portion of the Work. The Architect/Engineer's Project Representative, at their discretion, may attend and assist in the preparation of the Contractor's Punch List.
 2. Architect's Supplemental Punch List: The Architect/Engineer, along with the Owner at the Owner's discretion, will inspect the Work utilizing the Contractor's prepared Punch List, noting completed items and incomplete items, and will prepare a supplemental list of items that have been omitted or incomplete items that were not previously noted.
 3. Operations and Maintenance Manuals: Submit as described in paragraph 1.3.
 4. Final Cleaning: Provide final cleaning and adequate protection of installed construction as described in paragraph 1.6 and 1.7.
 5. Starting of systems: Start up equipment and systems as described in paragraph 1.8.
 6. Testing and balancing: Testing and balancing of systems must be performed and completed by Owner's forces, and the report submitted and accepted by Architect/Engineer and Owner, as described in the Contract Documents. Make adjustments to equipment as required to achieve acceptance.
 7. Demonstrations: If required by individual specification sections or by Owner, provide demonstrations and instructions for use of equipment as described in paragraph 1.9.
- B. Date of Substantial Completion: Complete or correct items identified on Punch List and confirm that all items have been corrected prior to Architects re-inspection. Architect/Engineer, along with the Owner, will re-inspect the corrected work to establish the Date of Substantial Completion. Incomplete items remaining will be appended to the Certificate of Substantial Completion (AIA G704). The Date of Substantial Completion represents day one (1) of the closeout period, and represents the date of commencement of the Contractors correctional period and all warranty periods as described and required by the Contract Documents, except as amended in the Certificate of Substantial Completion and elsewhere in the Contract Documents.
- C. Certificate of Substantial Completion: When the Work or designated portion thereof is substantially complete, Architect will prepare the Certificate of Substantial Completion to be executed by the Owner and Contractor. Items on the appended Punch List shall be completed or corrected within the time limits established in the Certificate.

1.3 OPERATIONS AND MAINTENANCE MANUAL

- A. As a requirement for Substantial Completion, the final Operation and Maintenance Manual shall be submitted to, and reviewed and accepted by the Architect prior to issuance of the Certificate.
- B. Format:
 - 1. PDF Manuals
 - a. Submit Operation and Maintenance Manual as annotated PDF electronic file.
 - 2. Hardcopy Manuals:
 - a. Prepare 3-ring D-slant binder cover and spline with printed title "OPERATIONS AND MAINTENANCE MANUAL", title of project, and subject matter of binder when multiple binders are required.
 - b. Internally subdivide binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.
 - c. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
- C. Submit one (1) copy of preliminary Operations and Maintenance Manual to respective consultants (Civil, MEP, Structural, *etc.*) for review of conformance with contract requirements prior to submitting final to Architect. Allow time for proper review.
- D. Contents: Prepare indexed Table of Contents with each product or system description identified, in three parts as follows:
 - 1. Part 1: Directory, listing names, addresses, and telephone numbers of Architect/Engineer, Contractor, Subcontractors, and major equipment suppliers.
 - 2. Part 2: Operation and Maintenance, 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. Equipment start-up instructions
 - e. Operating instructions.
 - f. Maintenance instructions for equipment and systems.
 - g. Maintenance instructions for finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents.
 - 3. Part 3: Project documents and certificates, including the following:
 - a. Product data.
 - b. Air and water balance reports.
 - c. Photocopies of warranties, certificates and bonds. Submit originals with Closeout Documents as specified below.
- E. Submit to Architect.

1.4 PROJECT CLOSEOUT

- A. Final Payment will not be authorized by the Architect until the Architect finds the Work acceptable under the Contract Documents, subject to the completion and acceptance of the following requirements and other applicable Contract requirements:
1. Close-out Documents: Provide bound closeout documents as described in paragraph 1.5. Refer to Section 00 73 00 "Supplementary Conditions" Paragraph 9.10 for additional information.
 2. Record Documents: Submit as described in paragraph 1.10.
 3. Extra materials: Provide extra stock, materials, and products as described in paragraph 1.11 when required by individual specification sections.
 4. Locks: Make final changeover of permanent locks and transmit keys to the Owner. Advise the Owner's personnel of changeover in security provisions.
 5. Temporary Facilities: Discontinue and remove temporary facilities from the site, along with mockups, construction aids, and similar elements.
 6. Warranties, Certificates and Bonds: Execute and assemble transferable warranty documents, certificates, and bonds from subcontractors, suppliers, and manufacturers as described in paragraph 1.12.
 7. Final Inspection and Acceptance by Architect is achieved as described in paragraph 1.13.

1.5 CLOSEOUT DOCUMENTS

- A. Coordinate the following items with the requirements of Document CB, Supplementary Conditions of the Contract.
- B. Format:
1. PDF Manuals
 - a. Submit Closeout Documents as bookmarked, indexed, searchable, electronic PDF file.
 2. Hardcopy Manuals:
 - a. Prepare 3-ring D-slant binder cover and spline with printed title "OPERATIONS AND MAINTENANCE MANUAL", title of project, and subject matter of binder when multiple binders are required.
 - b. Internally subdivide binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.
 - c. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
- C. Contents:
1. Directory, listing names, addresses, and telephone numbers of Architect/Engineer, Contractor, Subcontractors, and major equipment suppliers. All General Contractor's vendors/suppliers and subcontractors that provided materials or performed any work related to this project must be listed on this form. Submit Final List of Subcontractors on Document AD.
 2. Closeout Documents and Affidavits, include the following:
 - a. AIA G707 - Consent of Surety to Final Payment;
 - b. AIA G706 - Contractor's Affidavit of Payment of Debts and Claims;
 - c. AIA G706A - Contractor's Affidavit of Release of Liens;

- d. Subcontractor's Release of Lien: Include contractor's, subcontractor's and direct material and equipment supplier's separate final releases. Submit on attached Close-out Form "A" - Affidavit of Subcontractor's Release of Lien.
3. Project documents and certificates, including the following:
 - a. Copy of Certificate of Substantial Completion (AIA G704);
 - b. Copy of All Permits;
 - c. Copy of Final Utility Bill or letter of transfer;
 - d. Copy of Certificate of Occupancy;
 - e. Certification of Project Compliance: Submit on attached Close-out Form "B". Owner and Architect will initiate form and forward to Contractor for signature once Substantial Completion is established;
 - f. Hazardous Material Certificate: Submit on attached Close-out Form "C". Affidavits from Contractor, Subcontractors and General Contractor's vendors or suppliers stating that no hazardous materials/products have been used or installed in this project.
4. Warranties, compile sequentially based on specification sections:
 - a. General Contractor's Warranty: Submit on company letterhead as described below. This Warranty shall state all sections of Work performed by General Contractor's own forces, and warranty period for each section of Work;
 - b. Subcontractor's Warranty: notarized, and submitted on attached Close-out Form "D". This Warranty shall state all sections of Work performed by the subcontractor and warranty period;
5. Receipts:
 - a. Extra Stock: Provide original receipts for delivery of "Extra Stock" items as described below, (if applicable). Receipts must be signed by an authorized Owner's representative;
 - b. Keys: Provide original receipts for delivery of "Keys", (if applicable). Receipts must be signed by an authorized Owner's representative.
- D. In addition to the electronic files listed above, provide Owner with original paper copies of the following:
 1. Certificate of Occupancy.
 2. Manufacture's Special warranties.
- E. Provide Architect with one (1) separate electronic file for their records containing the following:
 1. Directory, listing names, addresses, and telephone numbers of Architect/Engineer, Contractor, Subcontractors, and major equipment suppliers;
 2. All MSDS sheets for the project;
 3. All warranties from Contractor, subcontractors, direct suppliers, and manufacturers.
- F. Failure to complete and close-out project after substantial completion may result in liquidated damages being assessed to the Contractor. Refer to Conditions of the Contract for additional requirements and liquidated damages.

1.6 FINAL CLEANING

- A. Execute final cleaning prior to final project inspection and acceptance.
- B. Clean interior and exterior glass, and surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces, mop hard floor surfaces.
- C. Remove smudges, marks, stains, fingerprints, soil, dirt, spots, dust, lint, and other foreign materials from finished and exposed surfaces
- D. Clean equipment and fixtures to sanitary condition with cleaning materials appropriate to surface and material being cleaned.
- E. Clean and replace filters of operating equipment as required by Contract Documents
- F. Clean debris from roofs, gutters, downspouts, and drainage systems.
- G. Clean site; sweep paved areas, rake clean landscaped surfaces.
- H. Remove waste and surplus materials, rubbish, and temporary construction facilities from site.

1.7 PROTECTING INSTALLED CONSTRUCTION

- A. Protect installed Work and provide special protection where specified in individual specification sections until Work is accepted by Architect and Owner.
- B. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.
- C. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
- D. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
- E. Prohibit traffic or storage upon waterproofed or roofed surfaces. When traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
- F. Prohibit traffic from landscaped areas.

1.8 STARTING OF SYSTEMS

- A. Coordinate schedule for start-up of various equipment and systems.
- B. Notify Architect/Engineer and Owner 48 hours prior to start-up of each item.
- C. Verify each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions which may cause damage.
- D. Verify tests, meter readings, and specified electrical characteristics agree with those required by equipment or system manufacturer.
- E. Verify wiring and support components for equipment are complete and tested.
- F. Execute start-up under supervision of Contractors' personnel, and installer in accordance with manufacturers' instructions.
- G. When specified in individual specification sections or required by manufacturer, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.
- H. When specified in individual specification sections or required by Owner or Architect/Engineer, submit a written report in accordance with Section 01 33 00, Submittal Procedures, that equipment or system has been properly installed and is functioning correctly.

1.9 DEMONSTRATION AND INSTRUCTIONS

- A. Demonstrate operation and maintenance of products to Owner's personnel a minimum of 48 hours prior to date of Final Completion in accordance with Owner's requirements.
- B. Demonstrate Project equipment instructed by qualified manufacturer's representative who is knowledgeable about the Project and equipment.
- C. For equipment or systems requiring seasonal operation, perform demonstration for other season within six (6) months.
- D. Utilize maintenance manuals as basis for instruction. Review contents of manual with Owner's personnel to explain all aspects of operation and maintenance.
- E. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment.
- F. Prepare and insert additional data in maintenance manuals when need for additional data becomes apparent during instruction.
- G. Review and verify proper start-up and operation of equipment prior to scheduling demonstrations with Owner.

1.10 PROJECT RECORD DOCUMENTS

- A. Submit Project Record Documents as described in Section 01 78 39 "Project Record Documents" at Project Closeout. Final Payment will not be authorized by the Architect until final review and acceptance of Record Documents by Architect and Engineers is achieved in accordance with the Owner's requirements.
- B. At the Contractors request, and with associated fee, Architect may provide electronic versions of the BIM, construction drawings, and specification files for Contractor's use, subject to the terms and conditions of Architect's standard electronic document transfer agreement.
- C. Submit semifinal Record Documents to the respective consultants (Civil, Structural, MEP, etc.) for review. Consultants will mark-up corrections and return to Contractor for final revisions. Make final revisions prior to submitting to Architect.
 - 1. Format: Submit all Project Record Documents as a bookmarked, indexed, searchable, annotated electronic PDF file.

1.11 EXTRA STOCK, MATERIALS AND MAINTENANCE PRODUCTS

- A. Furnish extra stock, maintenance, and extra products in quantities specified in individual specification sections.
- B. Deliver to and store in location(s) as directed by Owner; obtain signed receipt(s) from Owner's authorized representative prior to final application for payment. Delivery of materials to or obtaining receipt from anyone other than Owner's authorized representative may constitute breach of this requirement and may require delivery of additional materials at no cost to the Owner if original materials are misplaced.
- C. Include signed receipts for delivery of extra stock and materials, including keys, with Closeout Documents.

1.12 WARRANTIES, CERTIFICATES AND BONDS

- A. Definitions:
 - 1. Standard Product Warranties: preprinted written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to the Owner.

2. Special Warranties: written warranties required by or incorporated in the Contract Documents, either to extend time limits provided by standard warranties or to provide coverage of specific defects, or both.
- B. In accordance with the general warranty obligations under **Section 00 72 00 "General Conditions" Paragraph 3.5**, as amended by the Supplementary Conditions, the General Contractor's warranty shall be for a period of one (1) year following the date of Substantial Completion, hereinafter called the one-year warranty period. The Contractor's one-year general warranty shall include all labor, material and delivery costs required to correct defective material and installation. This warranty shall not limit the Owner's rights with respect to latent defects, gross mistakes, or fraud.
- C. The Contractor's one-year warranty shall run concurrently with the one (1) year period for correction of Work required under **Section 00 72 00 "General Conditions" Paragraph 12.2**.
- D. In addition to the Contractor's one-year warranty, Special Warranties as described in individual specifications sections, shall extend the warranty period for the period specified without limitation in respect to other obligations which the Contractor has under the Contract Documents.
- E. Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the Work that incorporates the products, nor does it relieve the suppliers, manufacturers, and subcontractors required to countersign special warranties with the Contractor.
- F. Warranty Requirements:
 1. When correcting warranted Work that has failed, remove and replace other Work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted Work.
 2. When Work covered by a warranty has failed and been corrected by replacement or reconstruction, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.
 3. Upon determination that Work covered by a warranty has failed, replace or rebuild the Work to an acceptable condition complying with requirements of Contract Documents. The Contractor is responsible for the cost of replacing defective Work regardless of whether the Owner has benefited from use of the Work through a portion of its anticipated useful service life.
 4. Written warranties made to the Owner are in addition to implied warranties, and shall not limit the duties, obligations, rights and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitations on time in which the Owner can enforce such other duties, obligations, rights, or remedies.
 5. The Owner reserves the right to refuse to accept Work for the Project where a special warranty, certification, or similar commitment is required on such Work or designated portion of the Work, until evidence is presented that entities required to countersign such commitments are willing to do so.
- G. Compile copies of each required warranty properly executed by the Contractor and the subcontractor, supplier, or manufacturer. Verify documents are in proper form, contain full information, and are notarized. Co-execute warranties, certificates and bonds when required and include signed warranties with Closeout Documents submitted to the Architect.

1.13 FINAL COMPLETION AND FINAL PAYMENT

- A. Final Notice and Inspection:
 - 1. When all items on the Punch List have been corrected, final cleaning has been completed, and installed work has been protected, submit written notice to the Architect that the Work is ready for final inspection and acceptance.
 - 2. Upon receipt of written notice that the Work is ready for final inspection and acceptance, the Architect and Engineer will make final inspection.
- B. Final Change Order: When the Project Closeout items described above are successfully completed and the Work is found acceptable to Architect/Engineer and Owner, a Final Change Order will be executed. This Change Order will include any Allowance adjustments as required by the Contract Documents.
- C. Final Application for Payment: When all of the above items are successfully complete, submit to the Architect a final Application for Payment and request for release of retainage.
- D. Release of Retainage: Release of retainage will not be authorized by the Architect until Contractor completes all requirements for close-out to the satisfaction of the Owner and Architect as described herein.

1.14 TERMINAL INSPECTION

- A. Immediately prior to expiration of the one (1) year period for correction of the Work, the Contractor shall make an inspection of the work in the company of the Architect and the Owner. The Architect and the Owner shall be given not less than ten (10) days notice prior to the anticipated date of terminal inspection.
- B. Where any portion of the work has proven to be defective and requires replacement, repair or adjustment, the Contractor shall immediately provide materials and labor necessary to remedy such defective work and shall execute such work without delay until completed to the satisfaction of the Architect and the Owner, even if the date of completion of the corrective work may extend beyond the expiration date of the correction period.
- C. The Contractor shall not be responsible for correction of work which has been damaged because of neglect or abuse by the Owner nor the replacement of parts necessitated by normal wear in use.

PART 2 - PRODUCTS *(Not Used)*

PART 3 - EXECUTION *(Not Used)*

END OF SECTION

CLOSE-OUT FORM "A"

SUBCONTRACTOR'S AFFIDAVIT OF RELEASE OF LIEN

STATE OF _____

COUNTY OF _____

KNOW ALL MEN BY THESE PRESENTS:

_____, being first duly sworn, deposes and says:

1. That he / she is the _____ of _____, the subcontractor who supplied, installed, and /or erected the work described below, and that, he /she is duly authorized to make this Affidavit and Subcontractor Release:

Project: _____

Owner: _____ Architect: PBK

Work Performed: _____ Specification Section(s): _____

2. That all work required under the subject subcontractor of the subject construction project has been performed in accordance with the terms thereof, that all material men, sub-subcontractors, mechanics, and laborers have been paid and satisfied in full and that there are no outstanding claims of any character arising out of the performance of said subcontractor which have not been paid and satisfied in full.
3. That to the best of his / her knowledge and belief, there are no unsatisfied claims for damages resulting from injury or death to any employees, sub-subcontractors, or the public at large arising out of the performance of said subcontract, or any suits or claims for any other damages of any kind, nature, or description which might constitute a lien upon the property of the Owner.
4. That he / she has received full payment of all sums due him / her for materials furnished and services rendered by the undersigned in connection with the performance of said subcontract and has and does hereby release the Owner and the Architect and his consultants and the Contractor from any and all claims of any character arising out of or in any way connected with performance of said subcontract.

ATTEST (If Corporation) _____

Name of Subcontractor

Secretary (By) (Title)

JURAT

STATE OF ____

COUNTY OF _____

Sworn to and subscribed before me on this _____ day of _____, 20____.

(Seal)

(Notary Public Signature)

CLOSE OUT FORM “B”

**CERTIFICATION
OF PROJECT
COMPLIANCE**

Completion of this form is required under the provisions of §61.1036(c)(3)(F) TAC for all public school district construction projects. Instructions for completion of this form can be found on page 2.

1. PROJECT INFORMATION

Facility:

Address:

City:

DISTRICT:

ARCHITECT/ENGINEER:

CONTRACTOR/CM:

CONTRACT DATE:

DATE DISTRICT AUTHORIZED PROJECT:

BRIEF DESCRIPTION OF PROJECT:

2. CERTIFICATION OF DESIGN AND CONSTRUCTION

The intent of this document is to assure that the school district has provided to the architect/engineer the required information and the architect/engineer has reviewed the School Facilities Standards as required by the State of Texas, and used his/her reasonable professional judgment and care in the architectural/engineering design and that the contractor has constructed the project in a quality manner in general conformance with the design requirements and that the school district certifies to project completion.

3. The District certifies that the educational program and the educational specifications of this facility along with the identified building code to be used have been provided to the architect/engineer.

DISTRICT:

BY:

DATE:

4. The Architect/Engineer certifies the above information was received from the school district, and that the building(s) were designed in accordance with the applicable building codes. Further, the facility has been designed to meet or exceed the design criteria relating to space (minimum square footage), educational adequacy, and construction quality as contained in the School Facilities Standards as adopted by the Commissioner of Education, June 9, 2003, and as provided by the district.

ARCHITECT/ENGINEER:

BY:

DATE:

5. The Contractor/CM certifies that this project has been constructed in general conformance with the construction documents as prepared by the architect/engineer listed above.

CONTRACTOR/CM: _____ **BY:** _____ **DATE:** _____

6. The District certifies completion of the project (as defined by the architect/engineer and contractor).

DISTRICT: _____ **BY:** _____ **DATE:** _____

INSTRUCTIONS FOR COMPLETION OF “CERTIFICATION OF PROJECT COMPLIANCE” FORM

Section 1. Identify the following:

- name and address of the school facility
- name of the school district
- the Architect/Engineer and Contractor
- the date of execution of the construction contract
- the date that the school district authorized the superintendent to hire an architect/engineer
- scope of the project.

Section 2. This section outlines the intent of the document. No action required.

Section 3. This section is to be executed by the school district upon transmittal of the information (as listed) to the architect/engineer and is to remain in the custody of the school district throughout the entire project.

Section 4. This section is to be executed by the architect/engineer upon completion of the plans and specifications and in conjunction with the completion of the plan review for code compliance (ref. 19 TAC §61.1033 or §61.1036, School Facilities Standards) and returned to the school district’s files.

Section 5. This section is to be executed by the contractor upon substantial completion of the project and retained in the school district’s files.

Section 6. This section is to be executed by the school district upon acceptance and occupancy of the project.

NOTE: DO NOT SUBMIT THIS DOCUMENT TO THE TEXAS EDUCATION AGENCY. The school district will retain this document in their files indefinitely until review and/or submittal is required by representatives of the Texas Education Agency.

CLOSE-OUT FORM “C”

SUBCONTRACTOR HAZARDOUS MATERIAL CERTIFICATE

THE STATE OF _____ PROJECT: _____

COUNTY OF _____ OWNER: _____

ARCHITECT: PBK

SPECIFICATION SECTION(S):

KNOW ALL MEN BY THESE PRESENTS:

_____, being first duly sworn, deposes and says that he / she is the
_____ of _____, the subcontractor / supplier who
constructed or provided the section(s) of work referenced above, and that he / she is duly authorized to
certify to the best of his / her information, knowledge, and belief no asbestos, lead or PCB containing
products have been incorporated into the project.

ATTEST (If Corporation) _____
Name of Subcontractor / Supplier

Secretary (By) (Title)

JURAT

THE STATE OF _____

COUNTY OF _____

Sworn to and subscribed before me on this _____ day of _____, 20_____.

(Seal) _____
(Notary Public Signature)

CLOSE-OUT FORM "D"

SUBCONTRACTOR WARRANTY

STATE OF _____

COUNTY OF _____

KNOW ALL MEN BY THESE PRESENTS:

_____, being first duly sworn, deposes and says:

1. That he / she is the Subcontractor (or the _____ of _____ the subcontractor) who supplied, installed, and / or erected the work described below, and that, he / she is duly authorized to make this Subcontractor Warranty:

Project: _____

Owner: _____ Architect: PBK

Work Performed: _____ Specification Section(s): _____

2. The undersigned Contractor warrants to the Owner and Architect that materials and equipment furnished under the Contract are of good quality and new except where otherwise required or permitted by the Contract Documents, that the Work is free from defects not inherent in the quality required or permitted, and that the Work conforms with the requirements of the Contract Documents. Work not conforming to these requirements, including substitutions not properly approved and authorized, may be considered defective. The Subcontractor's warranty excludes remedy for damage or defect caused by abuse, modifications not executed by the Subcontractor, improper or insufficient maintenance, improper operation, or normal wear and tear under normal usage.
3. In the event of failure of materials, products, or workmanship, during the specified warranty periods, the Subcontractor shall take appropriate measures to assure correction or replacement of the defective items, whether notified by the Contractor, Owner or Architect.
4. The Subcontractor warrants the work performed for a period of _____ months from the date of Substantial Completion, except as follows: _____

ATTEST (If Corporation) _____

Name of Subcontractor

Secretary (By) (Title)

JURAT

STATE OF _____

COUNTY OF _____

Sworn to and subscribed before me on this _____ day of _____, 20____.

(Seal)

(Notary Public Signature)

SECTION 01 78 39

PROJECT RECORD DOCUMENTS

CONDITIONS OF THE CONTRACT AND DIVISION 01, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 PROJECT RECORD DOCUMENTS

- A. Maintain on site one set of the following record documents; record actual revisions to the Work:
 - 1. Drawings
 - 2. Specifications
 - 3. Addenda
 - 4. Architects/Engineers written responses to Minor Change directives, Change Proposal Requests, and other supplemental instructions
 - 5. Change Orders and other modifications to the Contract
 - 6. Reviewed Shop Drawings, Product Data, and Samples
 - 7. Manufacturer's instruction for assembly, installation, and adjusting
- B. Ensure entries are complete and accurate, enabling future reference by Owner. Architect will review documents for general conformance but will not be responsible for completeness or accuracy of the recorded information.
- C. Do not use record documents for construction purposes. Store record documents separate from documents used for construction. Protect record documents from deterioration and loss in a secure, weather-tight location in accordance with Section 01 50 00 "Temporary Facilities and Controls".
- D. Record information concurrent with construction progress, not less than weekly. Provide access to record documents for Architect's reference during normal working hours.
- E. Give particular attention to information on concealed products and installations that would be difficult to identify or measure and record later.
- F. Mark record sets in red erasable colored pencil; use other colors to distinguish between changes for different categories of the Work at the same location.
 - 1. Mark important additional information which was either shown schematically or omitted from original Documents.
 - 2. Note construction change directive numbers, alternate numbers, Change Order numbers and similar identification.
 - 3. Where feasible, the individual or entity who obtained record data, whether the individuals or entity is the installer, subcontractor, or similar entity, is required to prepare the mark-up on record documents.
 - a. Accurately record information in an understandable drawing technique.
 - b. Record data as soon as possible after it has been obtained. In the case of concealed installations, record and check the mark-up prior to concealment.
 - 4. Sign or initial and date each mark-up.
- G. Upon completion of the Work, submit Project Record Documents to Architect for the Owner's records in accordance with Section 01 77 00 "Closeout Procedures".
 - 1. Format: Submit all Project Record Documents as a bookmarked, indexed, searchable, annotated electronic PDF file.

1.2 BUILDING INFORMATION MODEL (BIM)

- A. Provide a Maintenance Level Navisworks Model (architectural/MEP) with Tagged Information for Specification Data on equipment and fixtures, room circuits, panel location (Lighting and Power) etc. Contractor to fully incorporate field notes from jobsite records.
1. Architect will furnish Contractor with BIM for use in recording information.

1.3 RECORD DRAWINGS

- A. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect and Construction Manager. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:
1. Format: Bookmarked, searchable, annotated PDF electronic file with comment function enabled.
 2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
 3. Refer instances of uncertainty to Architect through Construction Manager for resolution.
 4. Architect and/or Engineers will furnish Contractor one set of digital data files of the Contract Drawings containing all CPR's, Clarifications, Minor Changes, and Architectural Supplemental Information for use in recording information.

1.4 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. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
 3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
 4. For each principal product, indicate whether record Product Data has been submitted in operation and maintenance manuals instead of submitted as record Product Data.
 5. Note related Change Orders, record Product Data, and record Drawings where applicable.
- B. Format: Submit record Specifications as bookmarked, searchable, annotated PDF electronic file.

1.5 RECORD PRODUCT DATA

- A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
 3. Note related Change Orders, record Specifications, and record Drawings where applicable.

- B. Format: Submit record Product Data as bookmarked, searchable, annotated PDF electronic file.
 - 1. Include record Product Data directory organized by Specification Section number and title, electronically linked to each item of record Product Data.

1.6 SHOP DRAWINGS

- A. Format: Submit record Shop Drawings as bookmarked, searchable, annotated PDF electronic file.
 - 1. Include record Shop Drawing directory organized by Specification Section number and title, electronically linked to each item of record Shop Drawing.

1.7 MISCELLANEOUS RECORD DOCUMENTS

- A. Refer to other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Immediately prior to Substantial Completion, complete miscellaneous records and place in good order, properly identified and bound or filed, ready for use and reference. Categories of requirements resulting in miscellaneous records, include, but are not limited to the following:
 - 1. Ambient and substrate condition tests.
 - 2. Changes requested by Owner's consultants.
 - 3. Inspections and certifications by governing authorities.
 - 4. Inspection and testing by Owner's inspection agency.
 - 5. Fire resistance and flame spread test results.

1.8 CERTIFICATION

- A. By submittal of Project Record Documents, Contractor certifies, that to the best of his knowledge, informational and belief the documents are a true and complete representation of the actual construction of the Work of this Project.

PART 2 – PRODUCTS *(Not Used)*

PART 3 – EXECUTION *(Not Used)*

END OF SECTION

SECTION 01 81 13
SUSTAINABLE DESIGN REQUIREMENTS

CONDITIONS OF THE CONTRACT AND DIVISION 01, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 SUMMARY

- A. This Section includes general sustainable design requirements and procedures for the Project, but the project will not need to be certified through any rating system.
- B. Contractor is responsible for providing information identified in this section.
- C. Refer to specification Sections for sustainable design requirements specific to the Work of each of those Sections.

1.2 REFERENCES

- A. Abbreviations and Acronyms
 - 1. CxA: Commissioning Authority
 - 2. SCAQMD: South Coast Air Quality Management District
 - 3. SMACNA: Sheet Metal and Air Conditioning Contractors Association
 - 4. SRI: Solar Reflectance Index
 - 5. VOC: Volatile Organic Compound
- B. Definitions
 - 1. Interior: Within the weatherproof membrane
 - 2. Permeable Surface: Surfaces which allow storm water to pass through and infiltrate the soil below.
 - 3. Regional Materials: Materials and products, or portions of products, which comply with both of the following, excluding mechanical, electrical, and plumbing components, specialty items such as elevators, and equipment:
 - a. Regionally Extracted Materials: Raw materials that are extracted, harvested, or recovered within a radius of 500 miles from the Project site.
 - b. Regionally Manufactured Materials: Materials assembled as finished products within a radius of 500 miles from the Project site.
 - 4. Rapidly Renewable Materials: Materials and products made from plants that are typically harvested within a 10-year or shorter cycle.
- C. Reference Standards
 - 1. LEED Reference Guide for Green Building Design and Construction, 2009 Edition
 - 2. SCAQMD Rule Book (<http://www.aqmd.gov/home/regulations/rules/scaqmd-rule-book>)
 - 3. SMACNA IAQ Guidelines for Occupied Buildings Under Construction, 2nd Edition 2007, ANSI/SMACNA 008-2008 (Chapter 3)

1.3 SUBMITTALS

- A. Sustainable Design Action Plans: Provide preliminary submittals within 30 days of date established for commencement of the Work indicating how the following requirements will be met.
 - 1. Provide Construction Activity Pollution Prevention Plan complying with Local Regulations and the requirements of Section 01 50 00 “Temporary Facilities and Controls”

2. Construction waste management plan complying with Section 01 74 19 "Construction Waste Management"
 3. Provide IAQ Management Plan addressing items identified in SMACNA IAQ Guidelines for Occupied Buildings Under Construction.
- B. Product Data:
1. Comply with specification Section 01 74 19 "Construction Waste Management and Disposal"
 2. Product Data for adhesives and sealants used on the interior of the building indicating VOC content
 3. Product Data for interior paints and coatings indicating chemical composition and VOC content
 4. Product Data for flooring system products installed in the interior of the project indicating compliance with the following criteria:
 - a. Floor Sealer, Stain, and Finish: Comply with SCAQMD Rule #1113
 - b. Tile Adhesives and Grouts: SCAQMD Rule #1168
 5. Product Data indicating that composite wood and agrifiber products installed in the interior of the project, excluding FF&E materials, do not contain any added urea-formaldehyde

1.4 CLOSEOUT SUBMITTALS

- A. Provide documentation of execution of Construction Activity Pollution Prevention Plan including a log of routine inspections and post-weather event inspections and photographs of implemented measures.
- B. Provide a log of construction waste indicating amounts (by weight) diverted from landfill through recycling, reuse, and salvage.
- C. Provide documentation of execution of Construction Indoor Air Quality Management Plan. Include the following information:
 1. Product Data for temporary filtration media and for filtration media used during occupancy
 2. Minimum of six photographs at three different occasions during construction along with a brief description of the SMACNA approach employed, documenting implementation of the IAQ management measures

PART 2 – PRODUCTS

2.1 CONSTRUCTION WASTE MANAGEMENT

- A. Provide diversion of demolition and construction waste from landfill through recycling or salvage to the greatest extent possible.

2.2 RECYCLED CONTENT OF MATERIALS

- A. Provide building materials with high recycled content to the greatest extent possible.
 1. Recycled content shall be defined according to the Federal Trade Commission's "Guide for the Use of Environmental Marketing Claims," 16 CFR 260.7 (e).

2.3 REGIONAL MATERIALS

- A. Provide building materials that are harvested, extracted, and manufactured regionally to the greatest extent possible within the budget and schedule of the project.

2.4 LOW-VOC MATERIALS

- A. For interior applications use adhesives and sealants that comply with the following limits for VOC content:
1. Wood Glues: 30 g/L
 2. Metal to Metal Adhesives: 30 g/L
 3. Adhesives for Porous Materials (Except Wood): 50 g/L
 4. Subfloor Adhesives: 50 g/L
 5. Plastic Foam Adhesives: 50 g/L
 6. Carpet and Carpet Pad Adhesives: 50 g/L
 7. VCT, Asphalt Tile, and Cove Base Adhesives: 50 g/L
 8. Gypsum Board and Panel Adhesives: 50 g/L
 9. Rubber Floor Adhesives: 60 g/L
 10. Ceramic Tile Adhesives: 65 g/L
 11. Multipurpose Construction Adhesives: 70 g/L
 12. Fiberglass Adhesives: 80 g/L
 13. Structural Glazing Adhesives: 100 g/L
 14. Wood Flooring Adhesive: 100 g/L
 15. Contact Adhesive: 80 g/L
 16. Plastic Cement Welding Compounds: 250 g/L
 17. ABS Welding Compounds: 325 g/L
 18. CPVC Welding Compounds: 490 g/L
 19. PVC Welding Compounds: 510 g/L
 20. Adhesive Primer for Plastic: 550 g/L
 21. Architectural Sealants: 250 g/L
 22. Architectural Sealant Primers for Nonporous Substrates: 250 g/L
 23. Architectural Sealant Primers for Porous Substrates: 775 g/L
- B. For interior applications use paints and coatings that comply with the following limits for VOC content and the following chemical restrictions:
1. Flat Paints and Coatings: VOC not more than 50 g/L
 2. Non-Flat Paints and Coatings: VOC not more than 50 g/L
 3. Anti-Corrosive Coatings: VOC not more than 250 g/L
 4. Varnishes and Sanding Sealers: VOC not more than 275 g/L
 5. Stains: VOC not more than 100 g/L
 6. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight total aromatic compounds.
 7. Restricted Components: Paints and coatings shall not contain acrolein, acrylonitrile, antimony, benzene, butyl benzyl phthalate, cadmium, di (2-ethylhexyl) phthalate, di-n-butyl phthalate, di-n-octyl phthalate, 1,2-dichlorobenzene, diethyl phthalate, dimethyl phthalate, ethylbenzene, formaldehyde, hexavalent chromium, isophorone, lead, mercury, methyl ethyl ketone, methyl isobutyl ketone, methylene chloride, naphthalene, toluene (methylbenzene), 1,1,1-trichloroethane, or vinyl chloride.

PART 3 – EXECUTION

3.1 MATERIALS AND RESOURCES

- A. Maintain a log of construction waste, indicating total amount of waste (by weight), and amount (by weight) diverted from landfill.

3.2 CONSTRUCTION INDOOR AIR QUALITY MANAGEMENT

- A. Where possible, do not use building air-handling system and protect it from contamination. If building systems are to be used, comply with SMACNA IAQ Guideline for Occupied Buildings under Construction.

END OF SECTION

SECTION 02 40 00
DEMOLITION

CONDITIONS OF THE CONTRACT AND DIVISION 01, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. Partial demolition of existing facilities as required to accommodate renovations as shown on the Drawings, indicated in individual specification Sections, or as required to accomplish scope of work. Include removal of existing utilities as indicated or encountered; removal of mechanical, electrical, and plumbing items as indicated or required.

1.2 SUBMITTALS

- A. Submit the following items.
 - 1. Itemized Demolition Schedule.
 - 2. Demolition plan detailing all demolition methods to be used.

1.3 PERMITS

- A. Procure and pay for all necessary permits or certificates required to complete the work specified. Make any and all required notifications and comply with all applicable Federal, State and local ordinances.

1.4 QUALITY ASSURANCE

- A. Provide at least one (1) person who shall be present and in charge of the Demolition Work at all times and who shall be thoroughly familiar with all phases of all work performed under this Section.
- B. Comply with all pertinent codes and regulations applying to this work.

1.5 JOB CONDITIONS

- A. Use all means necessary to prevent the spread of dust during performance of this work. Provide additional clean filters for the existing air handling system serving those areas to remain to protect them from construction dust.
- B. Use all means necessary to protect the existing building to remain from all types of damage, including fire, water damage, and unnecessary interruption of utility services. In the event of damage of any kind, immediately make all repairs and replacements necessary to the approval of the Owner at no additional cost to the Owner.
- C. Motor driven equipment shall have functional mufflers.
- D. Visit the site and examine the existing structure. Note all conditions as to the character and extent of work involved.

1.6 PRE-INSTALLATION CONFERENCE

- A. Refer to Section 01 31 13 "Project Coordination" requirements.

PART 2 – PRODUCTS

2.1 GENERAL

- A. Provide all barricades, shoring, and bracing necessary to protect the tenants, workmen, and Public from danger. Barricades shall be sufficiently designed to protect and or exclude the public from all hazards.
- B. All other materials not specifically described but required for proper completion of Work of this Section, shall be as selected by the Contractor subject to the approval of the Owner.

- C. The Owner and Architect are not responsible and make no claims for the quality or quantity of the materials being demolished. The General Contractor or subcontractors that undertake or assume the benefits of salvage efforts shall assume all risks associated with that effort.

2.2 DEMOLITION WORK

- A. Perform demolition work in manner so as to allow Owner's safe use of existing facility.
- B. Perform demolition work in order to maintain Owner's construction schedule.

PART 3 - EXECUTION

3.1 DEMOLITION

- A. Before commencing the Work of this Section, verify with the Owner that all items to be removed by the Owner have been removed. Schedule the work in a careful manner with all necessary consideration for the Public and the Owner. All items of existing equipment and materials or any other item of value to the Owner shall be salvaged by the Owner prior to demolition.
- B. All material removed under this Contract, which is not to be salvaged or reused, shall become the property of the Contractor and be promptly removed from the site. At all times use movable debris boxes, covered, to convey the material through the building. Do not store or permit debris to accumulate on the site. Dumpsters shall not overflow and shall be emptied on a regular basis. Remove all debris from the building premises and leave the construction site "Clean" each day. All debris shall be dumped in an approved disposal facility and all fees for this shall be paid by the Contractor. Contractor is responsible for completely removing all demolished materials from the site and disposing of them in accordance with all local, State and Federal Regulations. If Contractor fails to remove debris promptly, Owner reserves the right to have debris removed at Contractor's expense.
- C. Conduct operations so as not to interfere with adjacent occupied spaces, roads, streets, drives, walks, service lines and the like.
- D. Keep all pedestrian areas clear for passage at all times.

3.2 MAINTAINING TRAFFIC

- A. Do not close or obstruct streets, sidewalks, parking lots, drives, trash truck passageways, without obtaining Owner's permission. Do not store materials in streets, drives, or outside of construction limits.
- B. Conduct operations with minimum interference with streets, driveways, sidewalks, and adjacent facilities.
- C. Provide, erect, maintain lights, barriers, fences as required to maintain strict security at construction site and prevent unauthorized access to area of construction site.

3.3 PROTECTION OF STRUCTURES, PROPERTY

- A. Execute demolition work to ensure adjacent property no damage from falling debris or other causes.
- B. Take precautions to guard against movement, settlement, or be liable for such movement, settlement, or collapse; repair promptly such damage when so ordered.
- C. Repair damage to Owner's property or any other person or persons on or off premises by reason of required work.

3.4 DEBRIS

- A. Remove, as it accumulates, debris, except as otherwise specified, resulting from demolition operations. Do not store or permit debris to accumulate on site. If Contractor

fails to remove debris promptly, Owner reserves the right to have same be removed at Contractor's expense.

3.5 MECHANICAL AND PLUMBING DEMOLITION NOTES

- A. Abandon or remove where and to the limits indicated on drawings all gas, water, sewer, and other lines as required. Remove complete all manhole structures, lines, traps, vents, etc., where shown. Plug all lines to be abandoned prior to backfilling operations.

3.6 ELECTRICAL DEMOLITION NOTES

- A. Supervise and be responsible for removal of power lines, fixtures and devices where noted to be removed. Note light poles and fixtures around and within construction site scheduled to remain. Protect from damage.
- B. Disconnect electrical for removal by demolition subcontractor, as required.
- C. Work with Owner, power and telephone companies in coordinating demolition necessary for installing new service to building if needed.

END OF SECTION

SECTION 03 54 00
CAST UNDERLAYMENT

CONDITIONS OF THE CONTRACT AND DIVISION 01, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Provide Self-Leveling Portland cement-based underlayment for use over existing concrete floors where items have been removed and to level or fill in low areas.
 - 2. Extent of Self-Leveling Portland cement-based underlayment as indicated on drawings
 - 3. Sloped application where indicated
 - 4. Gypsum-based products are prohibited

1.2 QUALITY ASSURANCE

- A. Installation of Self-Leveling Portland cement-based underlayment must be by an applicator using mixing equipment and tools approved by the manufacturer.
- B. Underlayment shall be able to be installed from 1/8 inch to 1-1/2 inch in one pour and up to 5 inches with the addition of aggregate. It may also be feathered to match existing elevations.
- C. Underlayment to be applied to a minimum thickness of 1/8 inch over highest point in the subfloor, with an average typical thickness of 1/4 inch.
- D. Underlayment compressive strength shall be 4,100 psi after 28 days in accordance with ASTM C109/mod (air cure only).
- E. Underlayment shall be walkable after 2 hours and allow floor covering to be installed after 16 hours at 70 degrees F.
- F. Manufacturer's certification that the product is Portland cement-based having an inorganic binder content which is a minimum 80 percent Portland cement when tested in accordance with ASTM C150: Standard Specification for Portland Cement.
- G. Qualifications
 - 1. Installer Qualifications: All work in this section shall be preformed by a factory trained applicator with minimum five years experience in the installation of cementitious underlayment material.
 - 2. Manufacturer Qualifications: Obtain required products from a single manufacturer specializing in the production of products of this type for not less than 20 Years.
 - 3. Manufacturer to provide confirmation installation procedures.
- H. Field Samples
 - 1. Prior to the installation of work place field sample of underlayment material at a location directed by or acceptable to the architect.
 - a. Minimum size – 4'-0" by 4'-0".
 - b. Show featheredge condition
 - c. Accepted sample may remain as part of work as directed by architect, rejected samples must be demolished and removed from site.

- I. Allowable Tolerances
 - 1. Variation from level: Do not exceed 1/8 inch in any bay or 10 feet in distance.

1.3 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials in their unopened packages and protect from extreme temperatures and moisture. Protect liquids from freezing.

1.4 SITE CONDITIONS

- A. The product is a cementitious material. Observe the basic rules of concrete work. Do not install below 50 degrees F surface temperature. Install quickly if floor is warm and follow hot weather precautions available from the manufacturer's Technical Service Department. Never mix with cement or additives other than the manufacturer's approved products.
- B. Do not proceed with installation until temperature and relative humidity have been stabilized and been maintained within values established by the manufacturer for optimum quality control.
- C. Provide adequate ventilation to prevent accumulation of hazardous fumes during application of components in enclosed spaces, and maintain ventilation until materials have thoroughly cured.

1.5 WARRANTY

- A. Special Project Warranty: Product and installation warranties may be available for a period of up to 10 years when application is installed by an ARDEX LevelMaster Elite Installer.
 - 1. Minimum Warranty – 5 year product and installation

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturers listed who produce equivalent products to those specified are approved for use on the Project. Other manufacturers must have a minimum of five (5) years experience manufacturing equivalent products to those specified and comply with Division 01 regarding substitution requirements to be considered.
 - 1. ARDEX Americas, Aliquippa, PA
 - 2. BASF Chemrex Inc.
 - 3. MAPEI Corp., Deerfield Beach, FL

2.2 BASIS OF DESIGN PRODUCTS

- A. Products by ARDEX America
 - 1. Product for Level Applications (03 54 00.CUL): ARDEX K 15 Self-Leveling Underlayment Concrete manufactured by ARDEX Americas Aliquippa, PA; (724) 203-5000. No substitutions.
 - 2. Product for sloped applications (03 54 00.CUS): ARDEX SD-P, Self-Drying Patch manufactured by ARDEX Americas Aliquippa, PA; (724) 203-5000. No substitutions.
 - 3. Primer for standard absorbent concrete shall be ARDEX P 51 Primer.
 - 4. Primer for non-porous subfloors, cutback and other non-water soluble adhesive residues, metal, and wooden subfloors shall be ARDEX P 82 Ultra Prime.
 - 5. The additive to be mixed with ARDEX K 15 when used over cutback adhesive, other non-water soluble adhesives, metal, or wooden subfloors shall be ARDEX E 25 Resilient Emulsion.

- B. Aggregate shall be well graded, washed gravel (1/8 inch to 1/4 inch or larger) for use when underlayment is installed over 1-1/2 inches thick.
- C. Water shall be clean, potable, and sufficiently cool (not warmer than 70°F).

2.3 MIX DESIGNS

- A. Standard mixing ratio: ARDEX K 15 is mixed in 2-bag batches at one time. Mix each bag of ARDEX K 15 (55 lb.) with 7 quarts of water. Product shall be mixed in an ARDEX T-10 Mixing Drum using an ARDEX T 1 Mixing Paddle and a 1/2 inch heavy-duty drill (min. 650 rpm). Mix thoroughly for approximately 2-3 minutes to obtain a lump-free mixture. Follow written instructions per the ARDEX K 15 bag label.
- B. Resilient mix for applications over cutback and non-water soluble adhesive residues, wood, and metal: Use 6 qt. of water and 2 qt. of ARDEX E-25 Resilient Emulsion for each bag of ARDEX K 15.
- C. Aggregate mix: For areas to be installed over 1-1/2 inches thick, aggregate may be added to reduce material costs. Mix ARDEX K 15 with water first, then add from 1/3 up to 1 part by volume of aggregate (1/8 inch to 1/4 inch or larger). Do not use sand.
- D. For pump installations, ARDEX K 15 shall be mixed using an ARDEX Levelcraft Automatic Mixing Pump. Start the pump at 210 gallons of water per hour, and then adjust to the minimum water reading that still allows self-leveling properties. Do not over-water. Check the consistency of the product on the floor to ensure a uniform distribution of the sand aggregate at both the top surface and bottom of the pour. If settling is occurring, reduce the water amount and recheck. Conditions during the installation, such as variations in water, powder, substrate, and ambient temperature, require that the water setting be monitored and adjusted carefully to avoid over watering.

PART 3 – EXECUTION

3.1 PREPARATION

- A. All subfloors must be sound, solid, clean, and primed:
 - 1. All concrete subfloors must be of adequate strength, clean, and free of all oil, grease, dirt, curing compounds and any substance that might act as a bondbreaker before priming. Mechanically clean if necessary using shot blasting or other. Acid etching and the use of sweeping compounds and solvents are not acceptable.
 - 2. Wooden subfloors must be clean and free of all foreign matter. Sand to bare wood then vacuum to remove all dust. Re-nail any loose boards exhibiting movement.
 - 3. Metal subfloors must be clean and free of all rust and foreign matter. Where required, a corrosive resistant coating should be applied and allowed to dry before priming.
 - 4. Cutback and other non-water soluble adhesive residues must be wet scraped to a thin, well-bonded layer.
 - 5. Non-porous subfloors such as ceramic and quarry tile as well as terrazzo should be clean and free of all waxes and sealers. If necessary, have the surface professionally cleaned.
 - 6. All cracks in the subfloor shall be repaired to minimize telegraphing through the underlayment.
 - 7. Substrates shall be inspected and corrected for moisture or any other conditions that could affect the performance of the underlayment or the finished floor covering.

- B. Joint Preparation:
1. Moving Joints - honor all expansion and isolation joints up through the underlayment.
 2. Saw Cuts and Control Joints - fill all non-moving joints with ARDEX SD-F Feather Finish or ARDEX SD-P InstantPatch, as required.
- C. Priming:
1. Primer for standard absorbent concrete subfloors: Mix ARDEX P-51 1:1 with water and apply evenly with a soft push broom. Do not leave any bare spots. Remove all puddles and excess primer. Allow to dry to a clear, thin film (min. 3 hours, max. 24 hours). Underlayment shall not be applied until the primer is dry. Primer coverage is approximately 400 to 600 sq. ft. per gallon.
 2. Primer for extremely absorbent concrete subfloors: Make an initial application of ARDEX P-51 mixed with 3 parts water using a soft push broom. Do not leave any bare spots. Remove all puddles and excess primer. Allow to dry thoroughly before proceeding with the standard application of primer as described above for standard absorbent concrete.
 3. Primer for non-porous subfloors, wooden or metal subfloors, or cutback and other non-water soluble adhesive residues over concrete: Prime with ARDEX P-82 Ultra Prime. Mix Part A (red) with Part B (white) and apply with a short-nap or sponge paint roller, leaving a thin coat of primer no heavier than a thin coat of paint. Do not leave any bare spots. Remove all puddles and excess primer. Allow to dry to a clear, slightly tack film (minimum 3 hours, maximum 24 hours). Underlayment shall not be installed until primer is dry. Primer coverage is approximately 200 to 400 square feet per gallon.
 4. Minimum drying time for ARDEX P-82 Ultra-Prime over cutback adhesive is 18 hours.

3.2 APPLICATION OF UNDERLAYMENT

- A. Installation:
1. Wooden subfloors require the use of the mesh-reinforced ARDEX K 15 + E-25 Underlayment System. After priming, install 3.2 or 3.4 galvanized diamond metal lath by stapling to the wooden subfloor approximately every 6 inches on center.
 2. Steel subfloors require that the substrate first be primed with an anti-corrosive paint. After thorough drying of the paint, prime this surface with ARDEX P-82 Ultra Prime.
 3. Pour or pump the liquid ARDEX K 15 and spread in place with the ARDEX T-4 Spreader. Use the ARDEX T-5 Smoother for featheredge and touch-up. Wear baseball or soccer shoes with non-metallic cleats to avoid leaving marks in the liquid ARDEX K 15. Underlayment can be walked on in 2-3 hours at 70 degrees F.

3.3 PREPARATION FOR FLOORING INSTALLATION

- A. Underlayment can accept finish floor covering materials after 16 hours at 70 degrees F and 50 percent relative humidity.
- B. Due to the wide range of adhesives that are used to install floor coverings, some adhesives may dry more quickly over Ardex underlayments than over other substrates. If this condition occurs, priming the surface of the underlayment with ARDEX P-51 Primer diluted 1:3 with water will even out the drying of the adhesive. Allow the primer to dry 1-3 hours before proceeding with the adhesive installation.

3.4 FIELD QUALITY CONTROL

- A. Where specified, field sampling of the Ardex underlayment is to be done by taking an entire unopened bag of the product being installed to an independent testing facility to perform compressive strength testing in accordance with ASTM C 109/modified: air-cure only. There are no in situ test procedures for the evaluation of compressive strength.

3.5 PROTECTION

- A. Prior to the installation of the finish flooring, the surface of the underlayment should be protected from abuse by other trades by the use of plywood, Masonite or other suitable protection course.

END OF SECTION

SECTION 05 77 00
DECORATIVE EXTRUDED METAL

CONDITIONS OF THE CONTRACT AND DIVISION 01, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. Edge-protection and transition profiles for floors
 - 2. Finishing and edge-protection profiles for walls and countertops
 - 3. Movement joint and cove-shaped profiles
- B. Related Requirements
 - 1. Section 07 92 00 "Joint Sealants"
 - 2. Section 09 21 16 "Gypsum Board Assemblies": Gypsum board and tile backer boards

1.2 REFERENCES

- A. Tile Council of North America (TCNA) Handbook for Ceramic Tile Installation
- B. Terrazzo, Tile and Marble Association of Canada (TTMAC) Specification Guide 09300 Tile Installation Manual
- C. American National Standard Specifications for the Installation of Ceramic Tile A108 / A118 / A136.1

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Specifications are based on the products identified as Basis of Design. Listed manufacturers who produce products equivalent to those specified are approved for use on the Project. Other manufacturers must have a minimum of five (5) years experience manufacturing equivalent to those specified and comply with Division 01 requirements regarding substitutions to be considered.
 - 1. Fry Reglet Corporation, Alparetta, GA; (800) 237-9773
 - 2. Schluter Systems, L.P., Plattsburgh, NY; (800) 472-4588

2.2 EDGE-PROTECTION AND TRANSITION PROFILES FOR FLOORS

- A. Flooring Transition, Type 1 (05 77 00.FT1)
 - 1. Basis of Design: Schluter®-RENO-RAMP
 - 2. Description: anodized aluminum profile with textured, sloped exposed surface, tapered leading edge, integrated trapezoid-perforated anchoring leg, and integrated grout joint spacer.
 - 3. Material and Finish:
 - a. AE - Satin Anodized Aluminum
 - 4. Height: Height as required
 - 5. Ramp Length: As required to maintain a slope not greater than on unit vertically in two units horizontally

- B. Flooring Transition, Type 2 (05 77 00.FT2)
 - 1. Basis of Design: Schluter®-RENO-T
 - 2. Description: T-shaped profile with 1/16" (1 mm) thick beveled exposed surface and 11/32" (9 mm) tall integrated vertical anchoring leg.
 - 3. Material and Finish:
 - a. AE - Satin Anodized Aluminum
 - 4. Width: 1"
- C. Flooring Transition, Type 3 (05 77 00.FT3)
 - 1. Basis of Design: Schluter®-RENO-TK
 - 2. Description: profile with sloped exposed surface, 1/4" (6 mm) deep channel below exposed surface, integrated trapezoid-perforated anchoring leg, and integrated grout joint spacer.
 - 3. Anchoring Leg:
 - a. Provide with straight anchoring leg
 - b. Provide with special radius anchoring leg for radius applications
 - 4. Material and Finish:
 - a. AE - Satin Anodized Aluminum
 - 5. Height: Height as required
- D. Flooring Transition, Type 4 (05 77 00.FT4)
 - 1. Basis of Design: Schluter®-RENO-U
 - 2. Description: profile with sloped exposed surface, 5/32" (4 mm) tall leading edge, integrated trapezoid-perforated anchoring leg, and integrated grout joint spacer.
 - 3. Material and Finish:
 - a. AE - Satin Anodized Aluminum
 - 4. Height: Height as required
- E. Flooring Transition, Type 5 (05 77 00.FT5)
 - 1. Basis of Design: Schluter®-RENO-V
 - 2. Description: ball-and-socket hinged profile with sloped exposed surface, tapered leading edge, integrated trapezoid-perforated anchoring leg, and integrated grout joint spacer.
 - 3. Material and Finish:
 - a. AE - Satin Anodized Aluminum
 - 4. Height: Height as required
 - 5. Ramp Length: As required to maintain a slope not greater than on unit vertically in two units horizontally
- F. Flooring Transition, Type 6 (05 77 00.FT5)
 - 1. Basis of Design: Schluter®-DILEX-AHK
 - 2. Description: ball-and-socket hinged profile with sloped exposed surface, tapered leading edge, integrated trapezoid-perforated anchoring leg, and integrated grout joint spacer.

3. Material and Finish:
 - a. AE - Satin Anodized Aluminum
 4. Height: Height as required
 5. Ramp Length: As required to maintain a slope not greater than on unit vertically in two units horizontally
- G. Flooring Transition, Type 7 (05 77 00.FT5)
1. Basis of Design: Schluter®- DILEX-AHKA
 2. Description: ball-and-socket hinged profile with sloped exposed surface, tapered leading edge, integrated trapezoid-perforated anchoring leg, and integrated grout joint spacer.
 3. Material and Finish:
 - a. AE - Satin Anodized Aluminum
 4. Height: Height as required
 5. Ramp Length: As required to maintain a slope not greater than on unit vertically in two units horizontally

2.3 FINISHING AND EDGE-PROTECTION PROFILES FOR WALLS AND COUNTERTOPS

- A. Decorative Trim, Type 1 (05 77 00.DT1)
1. Basis of Design: Schluter®-DECO
 2. Description: Profile with 1/4" (6 mm) wide visible surface and integrated trapezoid-perforated anchoring leg.
 3. Anchoring Leg: Provide with straight anchoring leg
 4. Material and Finish:
 - a. AE - Satin Anodized Aluminum
 5. Height: Height as required
- B. Decorative Trim, Type 2 (05 77 00.DT2)
1. Basis of Design: Schluter®-JOLLY
 2. Description: L-shaped profile with 1/8" (3.2 mm) wide top section and vertical wall section that together form the visible surface, integrated trapezoid-perforated anchoring leg, and integrated grout joint spacer.
 3. Anchoring Leg: Provide with straight anchoring leg
 4. Material and Finish:
 - a. AT - Satin Nickel Anodized Aluminum
 5. Height: Height as required
- C. Decorative Trim, Type 3 (05 77 00.DT3)
1. Basis of Design: Schluter®-QUADEC
 2. Description: profile with square visible surface, integrated trapezoid-perforated anchoring leg, and integrated grout joint spacer.
 3. Corners:
 - a. Provide with matching inside corners
 - b. Provide with matching outside corners
 - c. Provide with internal connectors

4. Material and Finish:
 - a. AE - Satin Anodized Aluminum
5. Height: Height as required
- D. Decorative Trim, Type 4 (05 77 00.DT4)
 1. Basis of Design: Schluter®-SCHIENE
 2. Description: L-shaped profile with 1/8" (3.2) wide top section and vertical wall section that together form the visible surface, integrated trapezoid-perforated anchoring leg, and integrated grout joint spacer.
 3. Anchoring Leg: Provide with straight anchoring leg
 4. Material and Finish:
 - a. AE - Satin Anodized Aluminum
 5. Height: Height as required

2.4 DECORATIVE CORNER TRIM

- A. Corner Trim, Type 1 (05 77 00.CT1)
 1. Basis of Design: Fry Reglet®-DMCT-375
 2. Description: Corner trim with 3/8" exposure on each side
 3. Material: Aluminum
 - a. Finish: Satin Anodized Aluminum

2.5 DECORATIVE WALL REVEALS

- A. Decorative Reveal, Type 1 (05 77 00.DR1)
 1. Basis of Design: Fry Reglet®-DRM-625-50, Non-Vented
 2. Description: Decorative reveal
 - a. Reveal Depth: 5/8"
 - b. Reveal Width: 1/2"
 3. Material: Aluminum
 - a. Finish: Satin Anodized Aluminum
- B. Decorative Reveal, Type 2 (05 77 00.DR1)
 1. Basis of Design: Fry Reglet®-DRM-625-50, Non-Vented
 2. Description: Decorative "F" reveal
 - a. Reveal Depth: 5/8"
 - b. Reveal Width: 1/2"
 3. Material: Aluminum
 - a. Finish: Satin Anodized Aluminum

PART 3 – EXECUTION

3.1 APPLICATION

- A. Consult Schluter®-Systems' current technical literature for proper design and installation instructions.

END OF SECTION

SECTION 06 10 00
ROUGH CARPENTRY

CONDITIONS OF THE CONTRACT AND DIVISION 01, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. All rough carpentry items including, but not limited to:
 - a. Wood blocking for support of items supported on or recessed into wood framing or requiring wood blocking for support.
 - b. Wood cants, nailers, curbs, and other items associated with roofing work.
 - c. Miscellaneous framing items and plywood sheathing.
- B. Related Requirements
 - 1. All Sections of Work requiring wood blocking for support, such as wall trim, wall cabinets, handrails, lockers, toilet compartments, toilet and bath accessories, markerboards, tackboards, projection screens, fire extinguisher cabinets, etc., as applicable to the Project.

1.2 SUBMITTALS

- A. Product Data: Manufacturer's data on wood treatment materials.

1.3 STANDARDS AND GRADING

- A. All lumber used structurally shall be graded and marked with grade and trademark of a lumber grading organization approved by the Architect, except that a certification of grade from such a grading organization may be accepted in lieu of grade and trademarks when approved by Architect. Trademark of manufacturer shall also appear on each piece.
- B. Each piece of plywood used shall carry the American Plywood Association trademark.
- C. Grading Rules: Conform with all applicable requirements of American Lumber Standards "Simplified Practice Recommendations R-16" and to grading rules of manufacturer's association under whose rules the lumber is produced.
- D. Reference Standards: Conform with all requirements.
 - 1. U.S. Dept. of Commerce Product Standards (PS)
 - 2. Engineered Wood Association (APA)
 - a. Standards and Construction Guide
 - 3. American Wood Preservers Association (AWPA)
 - a. Standards, as they apply.
 - 4. Architectural Woodwork Institute (AWI)
 - a. "Quality Standards"
 - 5. National Woodwork Manufacturers' Association (NWMA)
 - a. Standards
 - 6. Western Wood Products Association (WWPA)
 - a. Manual

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Lumber:
1. Treated No. 2, S4S Southern Yellow Pine, #1 kiln dried.
 - a. Comply with NWMA Standards
 - b. Use for blocking, stripping, grounds, cants and miscellaneous wood items in contact with concrete, roofing, or exposed to the weather.
 2. No. 2, S4S Southern Yellow Pine: Use for framing, blocking, stripping and miscellaneous concealed interior lumber not exposed to concrete, roofing weather or moisture, when FRS lumber is not required by building code.
 3. Fire Retardant No. 2, S4S Southern Pine: Refer to Fire Retardant Treatment below. Use for framing, plates and blocking in all walls and partitions where required by building code or noted on drawings.
- B. Plywood:
1. General: Comply with APA Standards.
 2. Interior Plywood Sheathing (06 10 00.PSI): APA A-D, Group 1 Interior used where appearance of only one side is exposed to view for interior locations. Use for wall liner at MDF/IDF closets and telephone boards in mechanical and telephone rooms where shown or required. 3/4 inch thick unless required or shown otherwise. Paint as scheduled in Section 09 90 00 "Painting and Coating".
 3. Fire Retardant Treated Plywood (06 10 00.PFR): Refer to Fire Retardant Treatment below. Use when required by building code or noted on drawings.
- C. Rough Hardware:
1. Nails, Spikes, and Staples: Galvanized for exterior locations, high humidity locations, and treated wood; plain finish for other interior locations: Size and type to suit application. Do not use to resist "pull-out" loads.
 2. Bolts, Nuts, Washers, Lags, and Screws: Medium carbon steel; size and type to suit application. Galvanize for exterior locations, high humidity locations, and treated wood. Plain finish for other interior locations.
 3. Fasteners: Toggle bolt type for anchorage to hollow masonry. Expansion shield and lag bolt type for anchorage to solid masonry and concrete. Bolts or power activated type for anchorage to steel.
- D. Wood Treatment:
1. Preservative Treatment (Concealed Conditions):
 - a. Option 1: Borate: Pressure impregnate preservative to net retention of 0.28 lbs./cu.ft., in plant licensed by manufacturer in accordance with the following standards.

Option 2: Micronized Copper Quaternary (MCQ): Pressure impregnate preservative to net retention of 0.25 lbs./cu.ft., in plant licensed by manufacturer in accordance with the following standards.
 - b. Standards:
 - 1) Preservative Treatment Standard: AWPA P5
 - 2) Structural Lumber Treatment Standard: AWPA C31
 - 3) Plywood Treatment Standard: AWPA C9

- c. Brush two (2) coats of preservative on bored or sawn surfaces of treated lumber.
 - d. Provide Quality Mark Stamp or end tag identifying third party inspection agency on treated wood for identification.
 - e. Concealed conditions mean conditions that are interior, above ground that are not exposed to direct standing water, in contact with natural grade, or exposed to weather.
 - f. ACQ and CCA preservatives not permitted.
 - g. Acceptable Products:
 - 1) Borate: Osmose "Advance Guard", Universal Forest Products "Prowood Borate", or Architect approved equal
 - 2) MCQ: Osmose "MicroPro" Smart Sense or Architect approved equal
2. Fire Retardant Treatment:
- a. Lumber shall be pressure-impregnated with non-combustible fire retardant chemicals in accordance with U.L. FRS Fire Hazard Classification. All lumber must be dried following treatment in accordance with AWPA Standard C20.
 - b. Plywood shall be pressure-impregnated with non-combustible fire retardant chemicals in accordance with U.L. FRS Fire Hazard Classification. All plywood must be dried following treatment in accordance with AWPA Standards C27.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Wood Framing:
 - 1. Framing and blocking shall be accurately cut and fitted true to line and levels, avoiding shims and wedges.
 - 2. Spiking and nailing shall be done using largest size spikes and nail practicable.
 - 3. Unless otherwise shown, use 2 inch by 4 inch wood studs spaced 16 inches o.c. with 4 inch face perpendicular to direction of wall or partition. Provide single bottom plate and double-top plates 2 inches thick by width of studs.
 - 4. Bolt nailers and blocking to steel, masonry or concrete members with bolts or proportionate strength of members attached from each end, except as otherwise noted on plans.
 - 5. Provide blocking, bucks and framing as necessary and for other trades as required.
 - 6. Drill lumber accurately for bolts and fit all bolts with suitable washers.
 - 7. Perimeter wood blocking to be attached 2'-0" staggered with 1/2" galvanized bolts through both nailers.
 - 8. Screws are to be used for perimeter edge nailers. No nailing permitted.
- B. Plywood:
 - 1. Install plywood over framing in accordance with instruction of American Plywood Association Construction Guide Form No. E30C.
 - 2. Install underlayment plywood as shown in accordance with instructions of American Plywood Association. Space panel joints and edges 1/32 inch. Fill and

sand panel edge joints, surface roughness, and damaged or open areas. Nail with 4d ring-shank nails spaced at six (6) inches at edges and eight (8) inches in field each way.

END OF SECTION

SECTION 06 20 00
FINISH CARPENTRY

CONDITIONS OF THE CONTRACT AND DIVISION 01, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. Providing all finish carpentry items including, but not limited to:
 - a. Finish Carpentry
 - b. Plastic Laminate (06 20 00.PL#)
 - c. Casework (06 20 00.CW#)
 - d. Cabinet Hardware (06 20 00.CH#)
 - e. Miscellaneous Millwork (06 20 00.M##)
 - 2. Installation of:
 - a. Finish hardware
 - b. Plastic laminate faced wood doors
- B. Related Requirements
 - 1. Section 01 32 16 "Sustainable Design Requirements" – VOC limits for adhesives
 - 2. Section 06 10 00 "Rough Carpentry"
 - 3. Section 08 14 16 "Flush Wood Doors"
 - 4. Section 09 90 00 "Painting and Coating"
 - 5. Section 12 35 53 "Laboratory Casework"

1.2 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI A156.9 - Cabinet Hardware
 - 2. ANSI A161.1 - Woodwork Testing Standards
 - 3. ANSI A208.1 - Mat-Formed Wood Particleboard
- B. Architectural Woodwork Institute:
 - 1. AWI - Quality Standards Illustrated.
- C. National Electrical Manufacturers Association:
 - 1. NEMA LD 3 - High Pressure Decorative Laminates.

1.3 PERFORMANCE REQUIREMENTS

- A. Unless otherwise indicated, perform work in accordance with AWI "Quality Standards Illustrated", Custom Grade, except where specification exceeds those standards, the more stringent shall govern.
- B. Fabricate millwork and cabinetry in accordance with ANSI A161.1, NEMA LD3, and general static load testing performed and certified by an independent testing agency, covering the following areas of product performance, with these minimum results:
 - 1. Base cabinet construction/racking test: 800 lbs.
 - 2. Cabinet front joint loading test: 425 lbs.
 - 3. Wall cabinet static load test: 2,000 lbs.

4. Drawer front joint loading test: 600 lbs.
 5. Drawer construction/static load test: 750 lbs.
 6. Cabinet adjustable shelf support device/static load test: 300 lbs.
- C. Shelf Loading: Comply with loading/deflection standards of the Composite Panel Association.

1.4 SUBMITTALS

- A. Product Data:
1. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
 2. Manufacturer's preprinted product information for all hardware proposed on the project.
 3. Manufacturer's preprinted maintenance instructions for the casework hardware.
- B. Shop Drawings:
1. Indicate size, material and finish.
 2. Show locations and installation procedures, including hardware, sinks, service fixtures, trim and other pertinent data for each unit.
- C. Door Resurfacing Shop Drawings:
1. Schedule location, size, thickness, elevation, details of construction, location and extent of hardware blocking, and other pertinent data for each door required.
 2. Include schedule of hardware preparation required for each door.
 3. Show installation procedures.
- D. Certification: Provide manufacturer's certification that casework has been fabricated and installed according to AWI "Custom" Grade guidelines or better.
- E. Samples: Two (2) each, 6 inch by 6 inch by 3/4 inch sample of specified particleboard core with grade stamp for use as verification of installed product.
- F. Closeout:
1. Record Drawings: indicate revisions to original drawings and shop drawings
 2. Manufacturer contact names, addresses and phone numbers.
 3. Finish Material Schedule: names and color numbers of laminates and stains.
 4. Keys: Provide additional master key for each room and additional locksets totaling one percent of total project for attic stock.

1.5 QUALITY ASSURANCE

- A. Manufacturer: Minimum of five (5) years experience in providing manufactured casework systems for similar types of projects, produce evidence of financial stability, bonding capacity, and adequate facilities and personnel required to perform on this project.
- B. Delivery conference: 48 hours prior to delivery, notify Architect of delivery date and time. At the Architect's discretion, a representative of the Architect may be present at the time of delivery. Casework not conforming to the specified requirements, as reasonably determined by the Architect's representative, shall be removed and returned to manufacturer for repair or replacement at no additional cost to the Owner or increase in time.

1.6 PRE-INSTALLATION CONFERENCE

- A. Section 01 31 13 "Project Coordination"

1.7 PRODUCT HANDLING

- A. Deliver completed laminate clad casework, countertops and related products only after wet operations in building are completed. Store in ventilated place, protected from the weather, with relative humidity range of 20 to 50 percent.
- B. Protect finished surfaces from soiling and damage during handling and installation with a protective covering.

1.8 JOB CONDITIONS

- A. Environmental Requirements: do not install casework until permanent HVAC systems are operating and temperature and humidity have been stabilized for at least one (1) week.
 - 1. Manufacturer/Supplier shall advise Contractor of temperature and humidity requirements for architectural casework installation areas.
 - 2. After installation, control temperature and humidity to maintain relative humidity between 25 and 55 percent.
- B. Conditions: Do not store or install casework in building until concrete, masonry, and drywall/plaster work is dry.

1.9 COORDINATION

- A. Coordinate the Work of this with plumbing work specified in Division 22. Coordinate sink opening construction with sinks specified in Division 22.
- B. Coordinate location of blocking in walls for installation and support of wall cabinets.

1.10 WARRANTY

- A. Warranty the work specified herein for five (5) years against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship.
- B. Defects shall include, but not be limited to the following:
 - 1. Rough or difficult operation, or loose or missing parts.
 - 2. Delamination of surfaces.
 - 3. Noticeable deterioration of finish.
 - 4. Warped or misaligned surfaces or telegraphing of subsurface imperfections.

PART 2 – PRODUCTS

2.1 CASEWORK MANUFACTURERS

- A. Manufacturers listed below are certified by AWI Quality Certification Program and are listed for the Contractor's convenience only and shall not preclude the Contractor from using other manufacturers, provided they produce equivalent products of the type specified for the scope and size of the Project. Other manufacturers must have experience manufacturing products meeting or exceeding the specifications and must comply with the criteria specified in paragraph 1.6 above and with Division 1 requirements regarding substitutions.
 - 1. Casework:
 - a. Ameritek Design Inc., Houston, TX (281) 442-7767
 - b. Calmar Manufacturing Co., Inc., Calmar, IA (563)562-3261
 - c. Case Systems, Inc., Midland, MI (989) 496-9510
 - d. Global Casework Manufacturing, Inc., Sugar Land, TX; (281) 494-6181
 - e. Imperial Mill & Fixture, Inc., Corpus Christi, TX; (361) 883-4630

- f. Jericho Woodworks, Stafford, TX; (281) 969-7947
 - g. Jim R. Reynolds & Associates, Inc., Houston, TX; (281) 350-1133
 - h. MGC Millwork, LP, Stafford, TX (281) 340-1400
 - i. South Texas Woodmill, Inc., Brownsville, TX; (956) 831-3304
 - j. Stevens Industries, Inc. Teutopolis, IL (217) 540-3100
 - k. Terrill Manufacturing Co., San Angelo, TX; (915) 655-7133
 - l. TMI Systems Design Corp., Dickenson, ND; (701) 225-6716
 - m. Victoria Cabinetworks, Victoria, TX (361) 578-0263
2. Plastic Laminate:
- a. Chemetal
 - b. Wilsonart LLC

2.2 CASEWORK MATERIALS

- A. Plastic Laminate (06 20 00.PL#): High-pressure decorative laminate complying with NEMA LD3, and the following requirements:
- 1. Exterior Color Selection Available:
 - a. Laminates
 - 1) Maple: "Harvest Maple" 7953-38 as manufactured by WilsonArt
 - 2) White Magnetic Dry Erase: "Magnetic Dry Erase #152 White Gloss" as manufactured by Chemetal
 - b. Provide 5 different colors available per project.
 - c. If laminate has wood grain, direction of grain shall be vertical on door, end panels, fascia panels, and exposed backs; horizontal on drawer faces, aprons, and top rails.
 - 2. Laminate grades:
 - a. Exposed doors, finished end panels, and other vertical surfaces: GP28 (0.028 inch thick nominal)
 - b. Horizontal surfaces other than top: GP28 (0.028 inch thick nominal)
 - c. Cabinet Liner: CL20 (0.020 inch nominal), white.
 - d. Work Surfaces and Countertops: GP50 (0.050 inch thick nominal) with BK20 (0.20 inch thick) backer sheet.
 - e. Backsplash: PH42 (0.042 inch nominal) with nominally balanced backer sheet.
 - 3. Adhesive: PVA water resistant adhesive. Contact adhesives not permitted. Refer to Section 01 32 16 "Sustainable Design Requirements" for VOC limits.
 - 4. Pressure Fused Laminate:
 - a. NEMA LD3 VGL, and NEMA LD3 CLS, Melamine resin impregnated, 120 gram PSM minimum, thermofused to core under pressure.
 - b. Color:
 - 1) Closed interiors, underside of wall cabinets: White.
 - 2) Exposed and Semi-exposed open cabinets: Match exterior.
 - c. Provide balanced construction with same thermofused melamine. Unsurfaced coreboard or simple backers not allowed.

- B. Core Material:
1. Plywood: Shop sanded, exterior grade veneer cored, hardwood faced, any species, with no defects affecting strength or utility. Overlay plywood not permitted.
 2. Water resistant treated plywood: shall have 24 hour thickness swell factor of five percent or less and 24 hour water absorption factor of ten percent or less; P.S. 51, Type II or better.
 3. Cabinet components shall be of the following minimum core thicknesses:
 - a. Cabinet backs, drawer body, and drawer bottoms: 1/2 inch particleboard
 - b. Door and drawer face, base, wall, and tall cabinet tops and bottoms, cabinet sides, drawer spreaders, cabinet back rear hangstrips, structural dividers, and exposed cabinet backs: 3/4 inch particleboard
 - c. Work surfaces and countertops: minimum 1 inch particleboard or plywood, except use water resistant treated plywood core at counters with sinks.
 - d. Shelves: 3/4 inch particleboard core for 30 inches long or less, 1 inch thick particleboard core for more than 30 inches long; 14 inch deep, unless otherwise noted. Provide vertical dividers for shelves over 36 inches long.
 - e. Cabinet Toe-Base: 3/4 inch plywood. No particleboard within four (4) inches of floor.
- C. Countertops and Backsplashes:
1. Countertops: Provide countertops with PVC edge in as long as practical continuous lengths. Provide field glued splines at joints. No joints closer than 24 inches either side of sink cutout.
 2. Backsplash: Integral to countertop, 4 inch high unless otherwise shown. Fabricate with single continuous sheet of laminate from front counter to top of splash with no joints from horizontal to vertical application. No joints shall occur at sink openings.
 3. At exposed countertop end corners, provide 1 inch radius, or similar safety treatment.
- D. Countertop Support (06 20 00.CS)
1. Basis of Design: SWS1 – 18-3/8" Perforated Work Support as manufactured by Doug Mockett & Company, Inc.
- E. Sinks: Refer to Division 22. Sizes as shown on drawings. Provide sealant at sink cut-outs.
- F. Service Fixtures: Refer to Division 22.
- G. Toe Spaces: Leave toe spaces unfinished for installation of resilient base, unless otherwise shown.
- H. End Panels and Filler Strips: Match adjacent case-piece.
- I. Edging:
1. Provide the following in accordance with "Edging Locations":
 - a. Flat Edge PVC: 0.020 inch. Solid, high-impact, purified, color-thru, acid resistant, machine-applied with hot melt adhesives.
 - b. 3 mm PVC: Solid, high-impact, purified, color-thru, acid resistant, pre-lamination primed edging, machine-applied with hot melt adhesives, and machine profiled to 1/8 inch radius.

2. Edging Locations:
 - a. Cabinet body edge, including door/drawer front spacer rail: Flat Edge PVC, color matched to door/drawer face or as selected.
 - b. Forward edge of interior body components, interior dividers, shelf, and top edges of drawer body: Flat Edge PVC to match cabinet interior surface color.
 - c. Door/Drawer-Front edging: 3mm PVC, color matched to standard laminates.

2.3 CABINET HARDWARE

- A. All hardware shall meet ANSI A156.9 and shall be subject to approval by the Architect. All keying shall match existing master key system and be approved by the Owner.
 1. Acceptable Manufacturers:
 - a. Accuride
 - b. National
 - c. Knape & Vogt
 - d. Ives
 - e. Stanley
 - f. As specified herein, provide specified product, or Architect approved equal.
- B. Hinges:
 1. Heavy duty, five-knuckle 2 3/4 inch institutional type hinge shall meet ANSI/BHMA A156.9 Grade 1 requirements. Mill ground, hospital tip, Teflon coated tight pin feature with all edges eased. Hinge shall be full wrap around type of tempered steel 0.095 inch thick. Each hinge shall have minimum of 9 screws, #7, 5/8 inch FHMS to assure positive door attachment.
 2. One pair per door to 48 inch height. One and one-half pair over 48 inches in height. Hinge shall accommodate 13/16 thick laminated door and allow 270 degree swing.
 3. Finish: US26D.
- C. Casework Pulls (06 20 00.CP1):
 1. Wire design, 4 inches, Chrome, US26D finish.
- D. Sliding Door Hardware:
 1. Frameless 1/4 inch glass sliding doors: double track rolling door assembly.
 2. Framed 13/16 inch thick stile and rail sliding doors: top mounted track with dual roller hangers. Vertical adjustment for accurate alignment.
- E. Drawer Slides:
 1. Standard Drawers: 3/4 extension, self-closing, white epoxy-coated, lever disconnect, positive in-stop/out-stop, nylon rollers, minimum 100 pound dynamic load rating at full extension.
 2. File Drawers: Full extension, 3-part progressive opening slide, precision steel ball bearing, minimum 100 pound dynamic load rating at full extension, zinc plated or epoxy coated at manufacturer's option.
 3. Provide body mounted molded rails for hanging file system for legal or letter size as indicated by manufacturer's model number. Cutting or machining of drawer

- body/face not permitted.
4. Paper Storage Drawers: Full extension, self-closing, white epoxy-coated, lever disconnect, positive in-stop/out-stop, nylon rollers, minimum 150 pound dynamic load rating at full extension.
- F. Catches: Provide opening resistance in compliance with the Americans with Disabilities Act.
1. Provide top-mounted magnetic catch for base and wall cabinet door.
 2. Provide two at each tall cabinet door. Catch housing shall be molded in White.
- G. Shelf Supports, Adjustable (06 20 00.SSA):
1. Dual-pin design with anti tip-up shelf restraints for both 3/4 inch and 1 inch shelves.
 2. Include keel to retard shelf slide-off, and slot for mechanical attachment of shelf to clip.
 3. Load rating shall be minimum 300 pounds each support without failure.
 4. Basis of Design: #255 Standards and #256 Supports as manufactured by K&V.
- H. Wardrobe Rod: 1-1/6 inch diameter plated steel rod, with captive sockets.
- I. Coat Hooks: Single and double prong, wall mount - Satin Aluminum.
- J. Locks: Five-disk tumbler cam-style with strike. Locks on cabinets in same room keyed alike. Provide two (2) keys per room where doors and drawers are scheduled to receive locks. Dull chrome finish. Lock core shall be removable with a control key, permitting Owner to change lock arrangements without tools.

2.4 SPECIALTY ITEMS

- A. Grommets:
1. Size: 2-1/2 inches diameter with "Flip-Top"™ tab in cap.
 2. Colors: As selected by Architect from manufacturer's available colors.
 3. Number/Location: Where electrical, telephone, and computer data wiring need to pass through tops whether shown or not.
 4. Approved Product/Manufacturer: Model No. EDP3 manufactured by Doug Mockett & Company, Inc., Manhattan Beach, CA; (800) 523-1269, or Architect approved equal.
- B. Keyboard Drawers (At all knee spaces):
1. Approved Product/Manufacturer: No. SD-1 as manufactured by Knape & Vogt; or Architect approved equal.
- C. Molded Personal Pencil Drawer: High-impact 100 Polystyrene with in-stop, out-stop, and self-closing features. Provide under top mounted 100 lb self-closing slides. Twelve compartment drawer body, and slides, Black. Provide where indicated on plans.
- D. Mailbox Label Holder: Brass, card size 1/2" x 2-3/16". Provide one (1) at each opening.

2.5 SOLID STOCK

- A. Moisture Content: Percent of moisture in relation to over-dry weight shall be between 8 percent and 13 percent at time of installation. Natural Finish Hardwood:
1. Occasional knot permitted provided it is tight and smooth.
 2. Grain Pattern: Rift-cut
 3. Species: AWI "Premium" Grade, White Oak

- B. Paint Grade Hardwood: Any species, including Parana Pine, Except do not use Oak, Elm or similar species which have coarse grain.

2.6 MISCELLANEOUS

- A. Utility Shelving: AWI "Economy" grade.
- B. Clothes Rod: 1-1/2 inch diameter smooth wooden dowel by length required, with end supports and fasteners of type recommended to suit application.
- C. Telephone/MDF/IDF Board: Provide minimum 4 foot by 8 foot by 3/4 inch thick plywood for telephone/data punch down blocks and video equipment in accordance with Section 06 10 00 "Rough Carpentry". Paint in accordance with Section 09 90 00 "Painting and Coating".

2.7 MILLWORK FABRICATION

- A. Fabricate casework, countertops and related products to dimensions, profiles and details shown on drawings. Fabricate casework square, plumb, and true.
- B. Detailed Requirements For Cabinet Construction:
 - 1. Toe-Base:
 - a. Continuous, ladder type platform with concealed fastening to cabinet bottom, level and secured to floor
 - b. Toe-base at exposed cabinet end panels shall be recessed 1/4 inch from face of finished end, for flush installation of finished base material.
 - c. No cabinet sides-to-floor will be allowed.
 - 2. Cabinet Top and Bottom:
 - a. Solid sub-top shall be furnished for all base and tall cabinets.
 - b. At cabinets over 36 inches bottoms and tops shall be mechanically joined by a fixed divider.
 - c. Assembly devices shall be concealed on bottom side of wall cabinets.
 - 3. Cabinet Sides:
 - a. Doweled, and glued under pressure, or attached with fully concealed interlocking mechanical fasteners to sub-top and bottom.
 - b. Drill holes for adjustable shelves 1-1/4 inches on center.
 - 4. Cabinet Backs:
 - a. Side bound, captured in grooves, recessed from cabinet rear, and securely fastened at top and bottom.
 - b. Hang rails shall be located at rear of cabinet back and fastened to cabinet sides. Provide minimum of two (2) at base, two (2) at wall, and three (3) at tall cabinets as instructed by casework manufacturer.
 - c. Provide removable back panels and closure panels for plumbing access at all sink cabinets, and where shown on drawings.
 - 5. Exposed end corner and face frame attachment:
 - a. Butt joint, glued and finish nailed; or attached with fully concealed interlocked mechanical fasteners.
 - 6. Door and Drawer Fronts:
 - a. Drawer fronts and hinged doors shall overlay the cabinet body. Maintain a maximum 1/8 inch reveal between pairs of doors, between door and drawer front, or between multiple drawer fronts within the cabinet.

- b. Where indicated, provide Stile and Rail doors with full 1/4 inch plate glass, hinged or sliding. Exposed lite-opening edges shall be trimmed and glazed with extruded glazing bead.
 - c. Where indicated, frameless sliding glass doors shall be 1/4 inch thick plate glass with ground and polished edges. Fit with anodized aluminum shoes and nylon rollers.
- C. Drawers:
- 1. Drawer fronts: apply to separate drawer body component sub-front.
 - 2. Drawer sides: doweled to receive front and back, glued under pressure, machine squared.
 - 3. Drawer bottom: set into front and sides, 1/4 inch deep groove with minimum 3/8 inch standing shoulder, continuously glued. Reinforce drawer bottoms with 1/2 inch by 4 inch front-to-back intermediate underbody stiffeners, mechanically fastened. One at 24 inches, two at 36 inches, and over.
 - 4. Paper storage drawers: fitted with full width hood at back.
 - 5. Hanging file drawers shall be fabricated to accept letter size hanging folders compatible with Pendaflex system.
- D. Vertical and Horizontal Dividers: As required by manufacturer for type and style of component.
- E. Door/Drawer Front Rail: As required by manufacturer for type and style of component, and hardware placement.
- F. ADA, Americans with Disabilities Act Requirements: The following special requirements shall be met, where specifically indicated on architectural plans as "ADA", or by General Note. Shall be in compliance with Federal Register Volume 56, No. 144, Rules and Regulations:
- 1. Countertop height: With or without cabinet below, not to exceed a height of 34 inches Above Finished Floor (A.F.F.), at a surface depth of 24 inches
 - 2. Kneespace clearance: minimum 29 inches A.F.F. at apron, and 30 inches clear span width.
 - 3. 12 inch deep shelving, adjustable or fixed: Not to exceed a range from 9 inches A.F.F. to 54 inches A.F.F.
 - 4. Wardrobe cabinets: Provide with rod/shelf adjustable to 48 inches A.F.F. at a maximum 21 inch shelf depth.
 - 5. Sink cabinet clearances: In addition to above, upper kneespace frontal depth shall be no less than 8 inches, and lower toe frontal depth shall be no less than 11 inches, at a point 9 inches A.F.F., and as further described in Volume 56, Section 4.19.
- G. Typical Desk or Counter Height at Kneespace Locations: 30" above finished floor.

2.8 DOOR RESURFACING

- A. Material:
- 1. High-pressure decorative laminate complying with NEMA LD3, and the following requirements:
 - a. Specified Product: Formica Brand Laminate, Architectural Door Stocking Program, available locally through McKillican American, Houston, TX, (713) 333-1360.
 - b. Standard, precut laminate sheets, 3'-0" by 7'-0"

- c. Architect to select from 42 selections available, including wood grain patterns and solid colors.
- d. Laminate grade: Formica Grade 10, 0.048 inch (HGS)
- 2. Adhesive: Contact adhesive as instructed by laminate manufacturer. Water-based adhesives not permitted. Refer to Section 01 32 16 "Sustainable Design Requirements" for VOC limits.

PART 3 – EXECUTION

3.1 MILLWORK INSTALLATION

- A. Positioning: Place approximately level, plumb and at right angles to adjacent work.
- B. Fitting: Where field cutting or trimming is necessary, perform in a neat, accurate, professional manner without damaging the products and adjacent work.
- C. Anchorage: Attach securely so the products will perform to their maximum ability without damage from inadequate fastenings.
- D. Fasten tops to frames with concealed clips, screws and glue.

3.2 EXISTING WOOD DOOR REFINISHING

- A. Remove existing wood (veneer or solid wood) doors as indicated on Drawings as to be resurfaced.
- B. Remove hardware and store for reuse unless hardware is to be replaced.
- C. Prepare door surfaces as necessary to receive paint or stain as scheduled.
- D. Refinish door in accordance with Section 09 90 00 "Painting and Coating."
- E. Install or reinstall as scheduled.

3.3 FINISH HARDWARE INSTALLATION

- A. The supplier will mark each item of hardware for location. Protect the markings until each item is installed. If any item is delivered to the job not properly marked, return it to the supplier for marking before attempting to install it.
- B. Check markings on hardware for proper location. Install and make necessary adjustments for proper working order. Any hardware damaged by improper adjustment or careless abuse will be replaced by the Contractor at his expense.
- C. Provide clean, properly sized and accurately placed mortises and drilled holes for all mortise hardware such as locksets and for cylindrical locks where specified only.
- D. Fit all surface-applied hardware accurately.
- E. After hardware is installed, protect exposed surfaces by use of heavy paper and masking tape and maintain until job completion.
- F. Remove all finish hardware except that which is primed for painting before painter's finish is applied. Permanently replace and re-adjust for proper function after painter's finish has dried hard.
- G. Millwork contractor shall be responsible for hardware on millwork.

3.4 WOOD DOOR INSTALLATION

- A. Protect all doors during handling.
- B. Install doors in accordance with manufacturer's instructions.
- C. Install and adjust doors for smooth, quiet operation.

END OF SECTION

SECTION 07 52 19 - MODIFIED BITUMEN MEMBRANE ROOFING SYSTEM

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Providing coordination for the entire roofing assembly, including, but not limited to:
 - 1. Tapered edge strips, cant strips, and wood nailers. (Refer to this Section and Section 06 10 00)
 - 2. Modified bitumen membrane roofing
 - 3. Flashings, including sheet metal perimeter edge (fascia) (Refer this Section and Section 07 62 00).
 - 4. Work incidental to, the complete and proper installation of a watertight modified bitumen membrane roofing system as shown on the drawings or specified herein, and in accordance with all applicable requirements of the Contract Documents.

- B. It is the intent of this Section that the Work shall:
 - 1. provide a watertight facility;
 - 2. conform to all applicable building code requirements and of authorities having jurisdiction;
 - 3. include Section 07 62 00, Roof Related Sheet Metal as part of the Work of this Section; and
 - 4. be performed to obtain a single responsibility total system warranty.

- C. Work and materials hereinafter specified shall be best of kind described and, unless specified otherwise, shall be new and of best quality. All roofing materials utilized in performance of each type of work shall be the products of one (1) manufacturer or supplier.

1.2 RELATED WORK

- A. All Sections of Work relating to the roofing system, including mechanical, plumbing and electrical items penetrating the roof system.

1.3 REFERENCES

- A. American Society for Testing and Materials (ASTM)
 - 1. C920, Standard Specification for Elastomeric Joint Sealants
 - 2. D41, Standard Specification for Asphalt Primer Used in Roofing, Damproofing, and Waterproofing
 - 3. D312, Standard Specification for Asphalt Used in Roofing
 - 4. D2178, Standard Specification for Asphalt Glass Felt Used in Roofing and Waterproofing
 - 5. D4479, Standard Specification for Asphalt Roof Coatings - Asbestos-Free
 - 6. D4586, Standard Specification for Asphalt Roof Cement, Asbestos-Free
 - 7. D4601, Standard Specification for Asphalt-Coated Glass Fiber Sheet Used in Roofing
 - 8. D5147, Standard Test Methods for Sampling and Testing Modified Bituminous Sheet Material
 - 9. D4897, Standard Specification for Asphalt-Coated Glass-Fiber Venting Base Sheet Used in Roofing

10. D6163, Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Glass Fiber Reinforcements
- B. FM Global (FM)
 1. Loss Prevention Data Sheets: I-49, Perimeter Flashing
 2. 1-90 Windstorm Resistance Classification
- C. Federal Specifications (FS)
 1. SS-R-620B
 2. TT-S-00230C
- D. National Roofing Contractors Association (NRCA)
 1. Roofing and Waterproofing Manual
- E. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA)
 1. Architectural Sheet Metal Manual
- F. International Building Code
- G. Underwriters' Laboratories (UL)
 1. Fire Hazards Classifications

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's printed instructions, schedules, charts, literature, and illustrations to indicate the performance, fabrication procedures, product variations, fastener pattern layout, and accessories to be used in the Work.
- B. Certifications:
 1. Manufacturer's written certification that installer is approved and licensed to install specified roofing system.
 2. Manufacturer's affidavit that materials used in Project contain no asbestos.
 3. Installer shall submit resume and project experience list for proposed system for Project Manager and job site superintendent.
 4. Installer shall submit written certification that there are no undocumented workers being employed by them or by any subcontractor on this project and that all workers on this project are covered by workmen's compensation.
 5. Installer shall submit list of all subcontractors with evidence of subcontractor's insurance coverage in compliance with contract requirements.
 6. Manufacturer's written certification of approval / acceptance of these specifications and details.
 7. Warranty: Submit letter from manufacturer signed by agent authorized to do so, stating acceptance of warranty as specified and detailed.
- C. Referenced Standards: Two (2) copies of each referenced standard and retain approved copies at site.
- D. Shop Drawings: Furnish from copies of the manufacturer's literature or from copies of NRCA "Roofing and Waterproofing Manual", fourth edition.
 1. Furnish for approval any proposed details which differ from those included with this proposal package. All proposed details shall first be approved in writing by roofing manufacturers prior to submitting to Architect for approval.
 2. Furnish detail project sequencing, staging, material loading, manpower plans, and project construction schedule for approval.

- E. Samples:
 - 1. Submit sample copy of job specific warranty that is to be issued upon project completion.
 - 2. Submit mock-up of all fabricated sheet metal items.
 - 3. Submit 12 inch x 12 inch sample of all types of roof membranes to be installed.
- F. Temperature Charts: Bitumen heating devices 24 hour temperature charts.
- G. Test Reports: Bitumen manufacturer's test reports relative to the following for each batch of bitumen furnished:
 - 1. Softening Point: ASTM D312.
 - 2. Flashpoint: ASTM D92.
 - 3. Acceptable Bitumen Temperature: As recommended by the bitumen manufacturer and EVT label on containers.
 - 4. Thermometers: Two (2) hand held, "8F" thermometers complying with ASTM E1 to Architect for his checking kettle temperature.
- H. Upon Substantial Completion of Work, submit the following to Architect for his submission to Owner:
 - 1. Manufacturer's Warranty: Manufacturer's written warranty as specified.
 - 2. Maintenance Procedures: Three (3) copies of manufacturer's printed instructions for Owner's use regarding care and maintenance of roof.

1.5 PROJECT CONDITIONS

- A. Weather Condition Limitations: Proceed with roofing work when existing and forecasted weather conditions permit work to be performed in accordance with manufacturer's recommendations and warranty requirements. Roofing application with moisture present will not be accepted. Do not attempt construction of the roofing system when the reported or calculated dew point are within three (3) degrees of each other
- B. Do not allow waste products, petroleum, grease, oil solvents, mineral oil, and other contaminants to come into contact with the roofing system before or during installation. Advise Owner if there is a possibility of his facility emitting such contaminants in the future.

1.6 INSPECTIONS / TESTS

- A. The Architect's and Manufacturer's representative shall at all times have access to the job site and work areas. The contractor will provide proper and safe facilities for such access and inspection.
 - 1. Architect Inspections: The Architect will be providing periodic inspections throughout the duration of the project. Architect's Representative shall be required to inspect after completion of each major phase of construction for approval.
 - 2. Manufacturer Inspections:
 - a. An inspection shall be made by a representative of the material manufacturer a minimum three (3) times monthly during performance of Work to ensure that said project is installed in accordance with the manufacturer's specifications and illustrated details. Written reports by the manufacturer shall be turned over to the Architect, on each Monday following the prior week.
 - b. The authorized material manufacturer's field representative shall be responsible for:

- 1) Keeping the Architect's representative informed after periodic inspections as to the progress and quality of the work observed.
 - 2) Calling to the attention of the contractor those matters observed which are considered to be in violation of the contract requirements.
 - 3) Reporting to the Architect's representative, in writing, any failure or refusal of the contractor to correct unacceptable practices called to his attention.
 - 4) Confirming, after completion of the work and based on his observation and test, that he has observed no application procedures in conflict with these specifications.
- B. Any failure by the Architect's or Manufacturer's Representative to detect, pinpoint, or object to any defect or noncompliance of these specifications of work in progress or completed work shall not relieve the contractor, or reduce, or in any way limit, his responsibility of full performance of work required of him under these specifications.
- C. Architect may require tests and inspections as necessary to verify quality of roofing materials and workmanship. Laboratory tests will be performed in accordance with ASTM standard procedures.
1. Owner will select testing laboratory and will pay for Work required by testing laboratory.
 2. Re-tests for work which fail initial tests or inspections shall be paid by contractor.
 3. Non compliance with contractor requirements will result in the Architect/Owner to assign full time quality control and will be subject to reimbursement by the construction manager/contractor.

1.7 QUALITY ASSURANCE

- A. Applicator:
1. Applicator shall have approval by manufacturer of accepted roofing system for application and issuance of specified warranty for a minimum of three (3) years. Proof of license agreement dated at least three years prior to date of bid opening.
 2. Applicator shall be an experienced single firm specializing in the type of roofing and sheet metal work specified, with a minimum of five (5) years of previous successful experience on projects similar in size and scope.
 3. No subcontracting of sheet metal fabrication or installation will be accepted. Contractor must have a sheet metal shop on the company premises.
 4. Applicators shall have a competent Superintendent, who is not actually performing roofing work, on site at all time while work is in progress, with full authority to act on behalf of the Contractor as his agent.
 5. All workmen shall be covered by Workmen's Compensation insurance (verify upon request) and thoroughly experienced in the particular class of work upon which employed. Use of undocumented workers will not be tolerated - No Exceptions.
 6. Roofing contractor must have reached the highest level of qualifications from the manufacture they are providing material for (i.e. Master Select contractor).
- B. Regulatory Requirements:
1. Classification by Underwriters' Laboratories, Inc. as a Class A roof covering.
 2. Follow local, state, and federal regulations of safety standards and codes. Refer to applicable building code or International Building Code for roofing system installation requirements and limitations.

C. Laboratory Testing and Samples:

1. Architect may require tests and inspections as necessary to verify quality of roofing materials and workmanship. Laboratory tests will be performed in accordance with ASTM procedures.
2. Owner will select testing laboratory and will pay for Work required by testing laboratory. Contractor shall assume all costs for extraction and patch of all samples.
3. Re-tests for work which fail initial tests or contractor shall pay inspections.
4. Contractor shall correct all deficiencies in accordance with manufacturers recommended procedures at no cost to Owner.

D. Installation:

1. Unless otherwise indicated, the materials to be used in this specification are those specified and denote the type, quality, performance, etc. required. All proposals shall be based upon the use of the specified material.
2. Install materials in accordance with the manufacturer's current published application procedures and the general recommendations of the National Roofing Contractor's Association.
3. It will be the contractor's responsibility to obtain and/or verify any necessary dimensions by visiting the job site, and the contractor shall be responsible for the correctness of it. Any drawings supplied are for reference only.
4. Contractor shall plan and conduct the operations of the work so that each section started on one day is complete, details installed and thoroughly protected and in watertight condition before the close of work for that day.
5. Materials will be securely fastened in place in a watertight, neat and workmanlike manner. All workmen shall be thoroughly experienced in the particular class of work upon which employed. Work shall be performed in accordance with these specifications and shall meet the approval in the field of the Architect.
6. All waste materials, rubbish, etc., shall be removed from the Owner's premises as accumulated. Rubbish shall be carefully handled to reduce the spread of dust, and shall be deposited at an approved disposal site. At completion, all work areas shall be left broom clean and all contractors' equipment and materials removed from the site.

1.8 PERFORMANCE REQUIREMENTS

- A. Fire Resistance: Meet Underwriter's Laboratory Class "A" fire rating.
- B. Contractor shall ensure that base fastener pull out resistance tests on new lightweight insulating concrete fill were performed and approved by Architect and coordinated with Roofing Consultant prior to starting roofing application.

1.9 PRE-INSTALLATION CONFERENCE

- A. Refer to Section 01 31 13 – Project Coordination.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in manufacturer's original unopened packaging with all tags and labels intact and legible. Carton and can labels shall indicate appropriate warnings, storage conditions, lot numbers, and usage instructions. Handle and store materials and equipment in such a manner as to avoid damage. Coordinate material storage with school Principal.

- B. Manufacturer's packaging and/or roll plastic is not acceptable for exterior storage. Tarpaulin with grommets shall be minimum acceptable for exterior coverings. All materials stored as above shall be minimum of four (4) inches off the substrate, and the tarpaulin tied off with rope.
- C. Products liable to degrade as a result of being frozen shall be maintained above 40 degrees F in heated storage.
- D. Moisture sensitive products shall be maintained in dry storage areas or properly covered. Roofing insulation and felts must always be covered or stored in a dry area when not being used.
- E. The proper storage of materials is the sole responsibility of the contractor. Materials damaged in shipping or storage shall not be used. Wet or damaged roofing materials shall be discarded, removed from job site, and replaced with new materials prior to application.
- F. No storage of materials shall be permitted on roof areas other than those materials that are to be installed the same day. Any exception must be in written form. Do not place materials or equipment in such a manner as to overload structure.

1.11 PRECAUTIONS

- A. Some of the indicated materials are extremely flammable and/or toxic. Use precautions indicated on can and carton labels.
- B. Due caution should be exercised so as not to alter the structural integrity of the deck. When cutting through any deck, care should be taken so as not to damage the deck or any part of the deck, such as post tension cables, etc.
- C. If torches are used, Contractor shall maintain a three (3) hour fire watch after completion of torching of each day's work. Provide a 20 lb. fire extinguisher near torch at all times.
- D. The contractor is to verify the location of all interior ducts, electrical lines, piping, conduit, and/or similar obstructions. The contractor is to perform all work in such a manner as to avoid contact with the above mentioned items.

1.12 WARRANTY

- A. Roofing Manufacturer: Warrant the roofing and associated Work for 20 years from date of Substantial Completion as follows:
 - 1. The warranty shall be a NDL "No Dollar Limit" / no penal sum type, with total replacement cost.
 - 2. The warranty shall guarantee the entire roof system and associated work against defective materials and workmanship of installation, with NO exclusion for ponding water.
 - 3. The roof system shall include roof insulation, flashing, metal work, labor, and material shall be guaranteed against failure of workmanship and materials. Repair of the system, including materials and labor, shall be done at no cost to the Owner.
- B. Roofing Contractor: Jointly with any subcontractors employed by him, shall guarantee the work required and performed under this contract will be free from defects in workmanship and materials, and that the building will be and remain waterproof for a five (5) year

warranty period, after the Architect accepts the work as substantially complete. The warranty shall be in approved notarized written form, to obligate the Contractor, and subcontractors, to make good the requirements of the warranty. The warranty will be held jointly with the Bonding Company for the first two (2) years and the manufacturer for the remaining three (3) years.

- C. Make arrangements with the materials manufacturer to provide required inspections for issuance of warranty. Final warranty shall be submitted to Owner at time of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All materials shall be manufactured, specified, or accepted in writing by membrane manufacturer issuing the warranty. Proposed materials shall ensure full system warranty from said manufacturer.
- B. Samples of all materials used on the project, which are not supplied by the membrane manufacturer, shall be submitted to the membrane manufacturer for written approval prior to starting work.
- C. All materials used on the project shall be asbestos free.

2.2 APPROVED PRODUCTS/MANUFACTURERS

- A. Unless noted otherwise, specifications are based on products of manufacturers listed below. Manufacturers whose products meet or exceed the specifications, who have manufactured and installed roof materials and systems of the type specified for a minimum of ten (10) years, and who maintains a single source responsibility for the total roofing system, as described herein, may apply for approval as a substitution in accordance with Division 1 requirements regarding substitutions. The following are pre-approved optional manufacturers.
 - 1. GAF Wayne, NJ (800) 766-3411
 - 2. Soprema, Wadsworth, OH; (800) 356-3521
 - 3. Siplast, Inc., Irving, TX; (800) 922-8800
 - 4. JM Denver, Colorado (800) 922-5922
 - 5. Firestone Building Products Company, Carmel, IN (800) 428-4442

2.3 ROOF MEMBRANE ASSEMBLY/SYSTEM DESCRIPTION

- A. System Description: A roof membrane assembly consisting of two (2) plies of a prefabricated, reinforced, homogeneous polymer modified asphalt membrane, secured to specified insulation or substrate. The assembly shall possess waterproofing capability, such that a phased roof application, with only the modified bitumen base ply in place, can be achieved for prolonged periods of time without detriment to the watertight integrity of the entire roof system. Contractor option to install using hot asphalt "mopped", cold adhesive, torched, or any combination – confirm special membrane types with manufacturer. Provide components of the roof membrane assembly meeting the following physical and mechanical requirements.
 - 1. Modified Bitumen Base Ply: A high performance modified bitumen base ply consisting of a reinforcing mat impregnated and coated with high quality modified bitumen: (Coordinate with manufacturer for special membrane type requirements when installed over insulation.)

- a. GAF: Ruberoid 20 FR
 - b. Soprema Product: Elastophene Sanded
 - c. Siplast Product: Paradiene 20
 - d. JM Product: DynaBase
 - e. Firestone Product: SBS Base
2. Modified Bitumen Finish Ply: A high performance modified bitumen finish ply consisting of a reinforcing mat impregnated and coated with high quality modified bitumen, and surfaced with white ceramic granules:
- a. GAF: Ruberoid 30 FR
 - b. Soprema Product: Elastophene FRGR
 - c. Siplast Product: Paradiene 30 FR
 - d. JM Product: DynaGlas FR
 - e. Firestone Product: SBS FR Cap
3. STRIPPING PLY: Same as Modified Bitumen base ply.

2.4 FLASHING MEMBRANE ASSEMBLY

- A. A flashing membrane assembly consisting of two (2) plies of reinforced, polymer modified asphalt membrane (foil face flashing membrane can be used as substitute):
1. Modified Bitumen Flashing Sheet:
 - a. GAF: Ruberoid 30 FR
 - b. Soprema Product: Elastophene FRGR
 - c. Siplast Product: Paradiene 30 FR
 - d. JM Product: DynaGlas FR
 - e. Firestone Product: SBS FR Cap
 2. Modified Bitumen Foil Faced Flashing Sheet (Substitute):
 - a. GAF: Ruberoid Ultraclad
 - b. Soprema Product: Sopralast 50 TV "Alu"
 - c. Siplast Product: "Aluminum" Veral
 - d. JM Product: DynaClad AL
 - e. Firestone Product: SBS Metal Flash AL
 3. Reinforcing PLY: Same as roof system base ply.

- 2.5** All nailers, cants and wooden curbs shall be No. 2 or better treated lumber selected to meet design details and field dimensions and requirements of Section 06 10 00, Rough Carpentry. MCQ and MCA only.

2.6 ROOFING SHEET METAL

- A. Refer to Section 07 62 00, Roof Related Sheet Metal.

2.7 ROOF INSULATION (AS APPLICABLE)

- A. Roofing Insulation:
1. All insulation shall be approved in writing by the membrane manufacturer as to thickness, type, and manufacturer. All insulation must be approved for the specific application with UL and FM Global approval.
 2. Polyisocyanurate Roof Insulation: Shall comply with ASTM C1289 and Federal Specification (FS) HH-I-1972/Gen and HH-I-1972/2, with a 20 psi minimum

- compressive strength. Insulation shall be surfaced on both sides with a non-asphaltic fiberglass facers. Thickness shall be a minimum of 3.5" over all conditioned air space, see drawings for details. Approved product shall be Enrgy 3 as manufactured by Johns Manville or pre-approved equal.
3. Recover Board (Unless noted otherwise): Glass-Faced Gypsum Roof Board equal to UL rated Type X "Dens Deck Prime" as produced by Georgia-Pacific. Board sizes shall be 48" x 96" x 1/2" or as indicated on drawings for roof assembly. 1/4" SOPRABOARD is approved substitution with Soprema roofing system. Provide as required by manufacture recommendation primer for Roof System. Approved substitute, SECUROCK by USG.
 4. Tapered ISO. Insulation: Factory cut 48 inches x 48 inches polyisocyanurate board cut to 1/4 inch per foot slope; thickness varies; ASTM C1289, UL Class A, Factory Mutual Class 1. Approved product shall be Tapered E'NERG'Y 3 manufactured by Johns Manville or pre-approved equal. Provide 1/2 inch recovery board similar to that specified above over tapered polyisocyanurate board insulation if used.
 5. Tapered Edge Strip: 1-1/2 inches to 0 inches (or as required, field verify), 18 inches x 48 inches, install at all expansion joints, curbs, projections, crickets, saddles and base flashings. Approved material shall be as manufactured by Cant Products or pre-approved equal.

2.8 ROOFING ACCESSORIES

A. Roofing Adhesives:

1. Insulation Adhesive (structural concrete decks): Asphalt that has been certified for full compliance with the requirements for Low Fume Type IV asphalt listed in Table I, ASTM D312. Each container or bulk shipping ticket shall indicate the equiviscous temperature EVT, the finished blowing temperature, FBT, and the flash point, FP.
 - a. Approved Product: Trumbull Low Fume asphalt or as required by membrane.
2. Mopping Asphalt: Asphalt that has been certified for full compliance with the requirements for Low Fume Type IV asphalt listed in Table I, ASTM D312. Each container or bulk shipping ticket shall indicate the equiviscous temperature EVT, the finished blowing temperature, FBT, and the flash point, FP.
 - a. Approved Product: Trumbull Low Fume asphalt or as required by membrane.
3. Cold Adhesive (if applicable): An asphalt based adhesive formulated especially for adhering polymer modified asphalt roofing membranes and base plies. Adhere shall be UL & FM listed and approved.
 - a. GAF Product: Matrix
 - b. Soprema Product: FMA
 - c. Siplast Product: PA-311 Adhesive
 - d. Firestone Product: MB Cold Adhesive

B. Bituminous Cutback Materials:

1. Primer: A high flash, quick drying, asphalt solvent blend which meets or exceeds ASTM D41 requirements.
2. Plastic Cement: An asphalt cutback mastic, reinforced with non-asbestos fibers, used as a base for setting metal flanges and conforming to ASTM D4586 Type II requirements.
3. Flashing Cement: A heavy-bodied all-weather trowel grade mastic, used as a base for laying-up cold process flashing membrane where fast setting adhesives are required.

- C. Sealants: A single component, high performance, elastomeric sealant conforming to ASTM D232 or ASTM C920 requirements. Acceptable types are as follows:
 - 1. Sonolastic NP 1 manufactured by Sonneborn Building Products; Minneapolis, MN (612) 835-3434

- D. Ceramic Granules: No. 11 Grade Specification Ceramic granules of color scheme matching the granule surfacing of the finish ply.

- E. Walkpads / Protection Pads: Provide cut sections of granule surfaced polyester reinforced modified bitumen sheet, such as "Dyna Tred Plus".
 - 1. Walk pads shall have contrasting granule color from surfacing.
 - 2. Provide walk pads shall be installed at point of roof access, at service points of all roof mounted equipment requiring periodic maintenance.
 - 3. Protection pads shall have rounded corners and extend minimum four (4) inches beyond edge of overlying element.
 - 4. Provide new protection pads under all pipe supports, at HVAC and mechanical access points, in front of all roof top doors and openings.

- F. Fasteners:
 - 1. Shall be Factory Mutual approved and as recommended by the manufacturer for the specific application.
 - 2. Fastener for Brick: Shall be 1/4 inch x 2 inches, stainless steel nail, one piece unit, flat head, as manufactured by Rawl Zamac Nailin, or approved equal.
 - 3. Fastener for Wood and Insulation (over steel decks): Shall be a minimum #14 Factory Mutual approved fastener, fluorocarbon coated, with CR-10 coating. A minimum 0.200 inch diameter shank and 0.250 inch diameter thread. To be used with Factory Mutual approved, round pressure plates or bar, and having a fluorocarbon CR-10 coating, when subjected to 30 Kesternich cycles (DIN 50018) shows less than ten percent (10%) red rust which surpasses Factory Mutual Approval Standard 4470 as manufactured by Olympic Manufacturing Group, Inc., or pre-approved equal. Stainless Steel 304 when used with ACQ treated lumber.
 - 4. Cementitious Fiber Deck Base Sheet Fasteners: Shall be a fastener with self-locking tube nail of the correct length and 2.7 inch smooth secured galvanized disk, Twin Loc-Nail as manufactured by ES Products, or approved equal. Fasteners and washers shall be listed in the Factory Mutual Approval Guide.
 - 5. Nails: Stainless Steel ring shank, size as required to suite application, minimum 11 gauge with 3/8 inc Shall be a toggle bolt with minimum 0.215 inch diameter shank and minimum 20 threads per inch, with a 2-1/2 inch wing span, with wing activated adhesive and pressure plate, as manufactured by Olympic Manufacturing Group, Inc.

- G. Substrate Adhesive: (Over Structural Concrete) A fluid or spray applied adhesive as manufactured by and approved by roofing manufacturer;
 - 1. Olympic Fasteners "OlyBond".
 - 2. Soprema "HV II Adhesive"
 - 3. "Insta Stick"

2.10 MISCELLANEOUS MATERIALS AND ACCESSORIES

- A. Other materials shall be as shown, specified or required and be of the best grade for the proposed use as recommended by the manufacturer.
1. Expansion Joint: As detailed on drawings and outlined in NRCA and SMACNA manuals.
 2. Low Level expansion joints, as noted on the drawings, to be fabricated similar to Situra Inc. "Red Line" Low level expansion joint details. Install as per manufactures recommendations.
 - a. Approved Substitute Soprema's "Sopra Joint". Install as per manufactures recommendations.
 3. Sealant Backer Rod: Provide compressible rod stack of polyethylene foam, polyurethane foam, polyethylene jacketed polyurethane foam, butyl rubber foam, neoprene foam or other flexible, permanent, durable, non-absorptive material as recommended by sealant manufacturer for back-up of and compatibility with sealant. Where used with hot-applied sealant, provide heat-resistant type which will not be deteriorated by sealant application temperature as indicated.
 4. Pipe Hangers and Supports: Provide and install all necessary supports for gas lines, conduit, chilled water lines, duct work, condensate lines, etc.. Refer to Section 07721, Roof Accessories.
 5. Cant Strips: Shall be wood fiber where used for non-structural purposes. Shall be treated solid wood where used for structural purposes meeting NRCA, Factory Mutual and Underwriters Laboratory guidelines. If solid wood cant is used where insulation exists, cant is to be toe nailed into treated solid wood nailer the same height as insulation.
 6. Termination Bar:
 - a. Material: Extruded aluminum bar with lip profile.
 - b. Size: 0.090 inch thick by 3/4 inch wide with 3/16 inch lip width and a 45 degree lip angle, factory punched 1/4 inch x 3/8 inch oval holes spaced six (6) inches on center.
 - c. Approved Product/Manufacturer: "LIPTB 06" manufactured by Olympic Manufacturing Group, Inc., or approved equal.

PART 3 - EXECUTION

3.1 SITE CONDITIONS

- A. Environmental Requirements:
1. Apply roofing in dry weather.
 2. Do not apply roofing when ambient temperature is below 45 degrees F.
 3. Refer to manufacturers recommendations.

3.2 ROOFING AND FLASHING - GENERAL

- A. Membrane Application: Install roofing in accordance with roofing system manufacturer's current published instructions and the following requirements. Application of roofing membrane components shall immediately follow installation of insulation as a continuous operation.
- B. Aesthetic Considerations: An aesthetically pleasing overall appearance of the finished roof application is a standard requirement for this Project. Make necessary preparations, utilize recommended application techniques, apply the specified materials and exercise care in ensuring that the finished application is acceptable to the Owner.

- C. Application of materials shall be in strict accordance with the manufacturer's recommendations except where more stringent requirements are shown or specified. In the instance of a conflict between these specifications and those of the manufacturer, the more stringent specifications shall take precedence.
- D. General Installation:
1. Protect adjacent areas with tarpaulin or other durable materials.
 2. Contractor shall prevent overspray, and be responsible for parking lot areas and/or adjoining areas not part of this contract.
 3. Contractor shall be responsible for sealing, as required, all openings that may allow bitumen migration or drippage, i.e. pitch dams, envelopes, and filler strips.
 4. Prepare surfaces according to manufacturer's or applicator's published instructions. All metal that is to receive bitumen, or come in contact with bitumen or adhesive, shall be first primed with appropriate primer. All Kynar 500 or Hylar 5000 finished metal shall be buff sanded on the surface which is to be primed prior to the application.
 5. Use cleaning materials or primers necessary to render an acceptable surface/substrate.
 6. All surfaces / substrates shall be clean and dry prior to application of materials. Roof deck substrates shall be inspected for moisture in accordance with the manufacturer's recommendations. Architect's representative shall witness inspection. Roofing installed before inspection by Architect's representative shall be removed to allow inspection.
 7. Prior to application of felts and membrane, all foreign matter, gravel, etc., shall be removed from the substrate. Gravel or debris between the substrate and plies is not acceptable.
 8. Ambient temperature shall be 45 degrees F and rising.
 9. Bitumen kettles or tankers shall have a visible thermometer and thermostatic control to provide positive monitoring of the bitumen temperature when it is heated in accordance with manufacturer's instructions. Kettle shall be kept a minimum of 20 feet away from building, placed so that fumes, odors, and smoke, do not enter building through windows, doors, fresh air vents or similar entrances; are not directed towards freshly painted or anodized surfaces, glass or other glazing materials. Do not place kettle under trees or near vegetation. The assigned kettle man shall remain in close attendance, within 25 feet of ground level, while burners are lit. Kettle lids are to remain closed except for loading. Level of bitumen shall be kept within eight (8) inches from top of kettle. All kettles are to have afterburners installed to reduce fume emissions.
 10. Asphalt Bitumen Heating: Heat and apply bitumen in accordance with equiviscous temperature method ("EVT Method") as recommended by the manufacturer. Discard bitumen that has been held at temperature, exceeding finished blowing temperature (FBT) for a period exceeding three hours. Do NOT heat bitumen to a temperature higher than 25 degrees F (14 degrees C) below flash point.
 11. Asphalt Temperatures: If the EVT information is not provided, the following asphalt temperature shall be observed. Maximum heating temperature shall be 525 degrees F. Minimum application temperature shall be 400 degrees F.
 12. Asphalt Moppings: Ensure that all moppings do not exceed a maximum of 25 pounds per square. Mopping shall be total in coverage, leaving no breaks or voids.
 13. Membrane Adhesive Application: Apply cold adhesive in a smooth, even, continuous layer without breaks or voids at the rate of 1-1/2 gallons per square per ply. (The porosity of some substrates may require a heavier application to ensure full adhesion.)
 14. Bitumen Consistency: Cutting or alterations of bitumen, primer, and sealants will not be permitted.

15. Circulate bituminous materials, do not allow bituminous materials to stand in luggers for long periods. Use insulated hot transport lines and luggers.
16. Keep kettle lid closed except when adding bitumen.
17. Wrinkles, buckles, kinks, and fishmouths are not acceptable when laying felt and membrane.
18. Dry voids of felt on felt are not acceptable.
19. Primed cant strips shall be installed at the intersection of the deck and the vertical surfaces.
20. All flashings shall be mechanically top-fastened with a termination bar a minimum of six (6) inches on center at the top leading edge, and be a minimum of eight (8) inches in height above the finished membrane height.
21. On slopes greater than one (1) inch in 12 inches, refer to NRCA and/or manufacturer's guidelines for backnailing procedures and follow the more stringent guidelines for all specified materials.
22. Correct all errors in application the same work day they occur, including voids, fishmouths, dry laps or spots, wrinkles, ridges, blisters, bare spots, improper application, physical damage and all work not meeting specifications.
23. Follow manufacturer's recommendation for application of cold adhesive due to slope requirements.

3.3 NAILERS

- A. Wooden nailers shall be installed at perimeter edges or drip edges on outside perimeter of building in accordance with FM Global 1-49 securement requirements. All deck penetrations (soil stacks, mechanical curbs, etc.) shall receive wooden nailers stacked minimum 3/4 inch above designed deck thickness.
- B. All Construction: Nailers shall be the same height as the finished height of the insulation layer. Nailers shall be anchored to resist a pull-out force of 175 pounds per foot. Fasteners shall be no less than two (2) per nailer, and be spaced at three (3) feet on center maximum or as required by FM Global 1-49 requirements. Provide nailers at all penetrations. Install / raise all curbs, etc, a minimum of ten (10) inches above roof deck.

3.4 SUBSTRATE PREPARATION

- A. Existing Roof Areas (Tear-off):
 1. Tear-off existing roof system down to existing substrate to remain (See Nomenclature Schedule on Drawings). Remove all associated flashings and abandoned equipment.
 2. Repair / Patch all existing decks as required due to removal of equipment or deteriorated conditions. Sweep or vacuum all surfaces, removing all loose aggregate and foreign substances prior to commencement of roofing. Ensure dry, smooth surface with no depressions or ponding water. Notify Architect prior to roofing any areas that may result in ponding water.
 3. Trash Chutes: Roofing materials and other discarded materials shall be put into an enclosed trash chute. No material may be thrown off roof. Remove debris daily from roof and from grounds.
- B. Ensure decking to receive base sheet or insulation is clean, dry, even and properly secured.
- C. Structural concrete decks shall have existing fully adhered roof membrane removed to the greatest extent possible and without exception all loose, poorly bonded roofing plies, dirt, dust and debris shall be removed completely. Prepare roof deck as per manufacture recommendations to accept thermally activated base sheet.

3.5 APPLICATION OF BASE SHEET

- A. General:
1. Apply primer at manufactures specified rate to a clean, structural concrete deck.
 2. Manufactures approved thermally activated base sheet shall be applied directly to the existing concrete.
 3. Apply thermally activated base sheet as per manufactures recommendation to ensure proper adhesion and proper venting of any moisture releasing from the building or deck.

3.6 APPLICATION OF INSULATION

- A. General:
1. Manufacturer's Instructions: In regard to attachment, the manufacturer's instructions or specifications shall determine the suitability for an application.
 2. Precautions: The surface of the insulation must not be ruptured or damaged prior to installation of the roof membrane. Replace damaged boards.
 3. Thermal insulation boards shall be laid on the substrate in parallel rows with end joints staggered and butted as close as possible. All joints shall be tight and at the roof perimeter and roof penetrations, insulation shall be cut neatly and fitted to reduce openings to a minimum. All openings 1/4 inch or larger shall be filled with insulation.
 4. Insulation shall be tapered or feathered at drains and scuppers to provide proper drainage (if applicable).
 5. No more insulation shall be installed than can be covered by the completed roof system by the end of the day or the onset of inclement weather.
 6. Tapered insulation and crickets, when specified, shall be placed in accordance with the drawings and/or as required NRCA standards.
- B. (Structural Concrete decks); Specified rigid insulation shall be fully adhered to thermally activated base sheet over the structural concrete deck in accordance with roof manufacturer's latest published specifications in a minimum of thirty pounds (#30) per one hundred (100) square feet of surface. It is the contractor's responsibility to consult current publications, literature, and bulletins of Factory Mutual and the manufacturer that are in effect at the time of this project.
- C. For subsequent layer or layers of insulation or specified recovery board, the top surface of the underlying layer of insulation shall be coated with hot asphalt using a minimum of twenty-five pounds (25#) per one hundred (100) square feet of surface, and subsequent layers of insulation shall be applied using offset joints, so that all individual insulation layers joints are offset a minimum of six inches (6") both ways with the preceding layer, and immediately walked in place.

3.7 ROOF MEMBRANE INSTALLATION

- A. Membrane Application: Install roofing in accordance with roofing system manufacturer's current published instructions and the following requirements. Application of roofing membrane components shall immediately follow application of insulation as a continuous operation.
- B. Aesthetic Considerations: An aesthetically pleasing overall appearance of the finished roof application is a standard requirement for this Project. Make necessary preparations, utilize recommended application techniques, apply the specified materials (i.e. granules, metallic

powder, etc.) and exercise care in ensuring that the finished application is acceptable to the Owner.

- C. Adhesive Application: Apply cold adhesive with a spray equipment or squeegee in a smooth even, continuous layer without breaks or voids at the rate of 1½ to 2 gallons per square per ply. (The porosity of some substrates may require a heavier application to ensure full adhesion. Refer to manufacturer's requirements.)
- D. Bitumen Consistency: Cutting or alterations of bitumen, primer, and sealants will not be permitted.
- E. Roofing Application: Apply all layers of roofing free of wrinkles, creases or fishmouths. Exert sufficient pressure on the roll during application to ensure prevention of air pockets. Lap seams between the base ply layer and the finish ply layer shall not coincide. Stagger the courses to ensure this.
 - 1. Apply all layers of roofing so that water flows over or along lap seams, but never against laps.
 - 2. Fully bond the base ply to the insulation with cold adhesive, torch, or hot asphalt. Each sheet shall have minimum three (3) inch side laps and six (6) inch end laps. Each sheet shall be applied directly behind the adhesive applicator. Stagger end laps a minimum of three (3) feet.
 - 3. Fully bond the finish ply to the base ply with cold adhesive, torch, or hot asphalt. Each sheet shall have a minimum of three (3) inch side and six (6) end laps. Each sheet shall be applied directly behind the adhesive applicator. Stagger end laps of the finish ply a minimum of three (3) feet. Stagger side laps of the finish ply a minimum of 12 inches from side laps in the underlying base ply. Stagger end laps of the finish ply a minimum of three (3) feet from end laps in the underlying base ply.
 - 4. Maximum sheet lengths and special fastening of the specified roof membrane system may be required at various slope increments where the roof deck slope exceeds 1/2 inch per foot. The manufacturer shall provide acceptable sheet lengths and the required fastening schedule for all roofing sheet applications to applicable roof slopes.
 - 5. Lap Treatment: A 20-pound roller shall be used on all side and end laps, following immediately behind application, apply uniform pressure across lap area to achieve a continuous visible bleed out.
- F. Granule Embedment: Broadcast mineral granules over all bitumen overruns on the finish ply surface, while the bitumen is still hot, to ensure a monolithic color and adhesion.

3.8 ROOF FLASHING MEMBRANE INSTALLATION

- A. Flashing - General:
 - 1. Flashings shall be installed using the manufacturer's flashing membrane, with length of run not to exceed manufacturer's recommendations.
 - 2. Wooden nailers or curbs shall be installed at all edges and openings in the roof, mechanically fastened to the deck. The nailers should be of exterior grade wolmanized timber, and of the same thickness as any insulation to be used on the roof.
 - 3. Cant strips shall be installed at the intersection of the deck and/or all vertical surfaces. Prime all cants.
 - 4. The roofing field membrane shall extend up over and to the top of cant strips at all vertical intersections or out to the roof's edge.
 - 5. All substrates receiving flashing membrane shall be clean and primed with asphalt primer, prior to application.

6. All flashings shall be mechanically fastened with a termination bar a maximum of six (6) inches on center, be a minimum of eight (8) inches above finished roof height (seal top with three (3) coursing), extend a minimum of nine (9) inches onto the field of horizontal roof membrane, and not exceed ten (10) linear feet of run in length.
 7. Install flashing membrane in accordance with drawings and/or material manufacturer's guarantee requirements, whichever is the most stringent.
 8. Exert sufficient pressure on the flashing membrane to ensure the prevention of air pockets. This can be accomplished by using a damp, kitchen type sponge mop or a damp, heavy duty cotton nap paint roller.
 9. Prime all end laps of the flashing membrane with a uniform coating of the specified asphalt primer and allow to thoroughly dry prior to overlapping of adjoining sheets.
 10. Probe laps using a clean, heated roofing trowel and heat fuse dry laps of the flashing membrane to ensure a complete seal.
- B. Flashing Application - Masonry Surfaces: Flash masonry parapet walls and curbs using the reinforcing sheet and the metal foil flashing membrane. After the base ply has been applied to the top of the cant, fully adhere the reinforcing sheet, utilizing minimum three (3) inch side laps and extend a minimum of three (3) inches onto the base ply surface and three (3) inches up the parapet wall above the cant. After the final roofing ply has been applied to the top of the cant, prepare the surface area that is to receive flashing coverage by torch heating granular surfaces or by application of asphalt primer; allowing primer to dry thoroughly. Torch apply the metal foil-faced flashing into place using three (3) foot widths (cut off the end of roll) always lapping the factory selvage edge. Stagger the laps of the metal foil flashing layer from lap seams in the reinforcing layer. Extend the flashing sheet a minimum of four (4) inches beyond the toe of the cant onto the prepared surface of the finished roof and up the wall to the desired flashing height. Exert pressure on the flashing sheet during application to ensure complete contact with the wall/roof surfaces, preventing air pockets; this can be accomplished by using a damp sponge or shop rag. Check and seal all loose laps and edges. Nail the top edge of the flashing on nine (9) inch centers. (See manufacturer's schematic for visual interpretation.)
- C. Flashing Application - Wood Surfaces: Flash wood or plywood parapet walls and curbs using the reinforcing sheet and metal foil flashing membrane. The reinforcing sheet shall have minimum three (3) inch side laps and extend a minimum of three (3) inches onto the base ply surface and to the top of the parapet wall, curb, etc. Nail the reinforcing sheet through the field of the sheet to the vertical wood surface on 12 inch centers from the top of the cant to top of wall curb, etc. Fully adhere the remainder of flashing reinforcing sheet that extends over the cant and roof level. After the finish ply has been applied to the top of the cant, prepare the surface area that is to receive flashing coverage by torch heating granular surfaces or application of asphalt primer; allowing primer to dry thoroughly. Torch apply the metal foil-faced flashing into place using three (3) foot widths (cut off the end of roll) always lapping the factory selvage edge. Extend the flashing sheet a minimum of four (4) inches beyond the toe of the cant onto the prepared surface of the finished roof and up the wall to the desired flashing height. Exert pressure on the flashing sheet during application to ensure complete contact with the wall/roof surfaces, preventing air pockets; this can be accomplished by using a damp sponge or shop rag. Check and seal all loose laps and edges. Nail the top edge of the flashing on nine (9) inch centers. (See manufacturer's schematic for visual interpretation.)

- D. Projection Flashings:
1. Plumbing Vents: Soil vent stack pipes shall receive lead flashings installed in accordance with practices set forth in the NRCA Roofing Manual. The lead shall be carried up and over the top of the stack, and crimped down into the pipe to form a watertight seal. Projections shall be flashed as recommended by the roof membrane manufacturer. Strip-in flange with specified stripping ply and cap with finish ply. Provide flashing membrane target.
 2. Square Projections: Strip in all flanges on square projections with specified stripping ply and cap with finish ply. Provide flashing membrane target. Provide tapered edge strips around base. Cricket up-side slope.
 3. Prime all flanges prior to setting in a bed of mastic. Install to manufacturer's specifications. Provide tapered edge strips around base as required. Cricket up-side slope.
 4. Round Projections: Strip in all flanges on round projections with specified stripping ply and cap with finish ply. Provide flashing membrane target.
 5. Prime all metal prior to setting in mastic. Install to manufacturer's specifications.
- E. Wall and Curb Flashings:
1. The flashing substrate shall be free of all dirt and loose material.
 2. The underlayment ply or plies shall be brought to the top of the cant strip and adhered.
 3. Starting on the roof at least six (6) inches from the roofside edge of the cant strip, adhere two (2) plies of flashing extending over the cant and up the vertical a minimum of eight (8) inches. Each lap of the ply sheet shall be a minimum of three (3) inches.
 4. Starting two (2) inches past the flashing plies, install one (1) ply of SBS flashing membrane in hot asphalt. Laps shall not coincide with previously installed plies. The top of the SBS flashing shall be one (1) inch past the previously installed plies above the cant strip.
 5. Fasten the top edge of the flashings on six (6) inch centers using approved termination bar and fasteners.
 6. An NRCA-approved metal counterflashing shall extend down over the flashing a minimum of four (4) inches.
 7. Cricket the up-side slope at all curb projections.
- F. Perimeter Edge Flashing: Refer to Section 07 62 00.
- G. Bleed out of flashing membrane: Broadcast bulk aluminum powder over all bitumen overruns on the flashing membrane surface while the bitumen is still hot to ensure a monolithic surface color. With approval of manufacturer, a premium glossy aluminum paint may be used.

3.9 OVERNIGHT SEAL / WATER CUT-OFF

- A. Over Night Seal: Shall be performed according to accepted roofing practice as outlined in the NRCA Roofing Manual.
- B. Water Cut-Off: At the end of day's work or when precipitation is imminent, construct a water cut-off at all open edges. Cut-offs can be built using asphalt or plastic cement and roofing felts, constructed to withstand protracted periods of service. Cut-offs must be completely removed prior to resumption of roofing.

3.10 ROOF SYSTEM INTERFACE WITH RELATED COMPONENTS

- A. The following is a list of descriptions for correct installation of components integrated into the roof membrane assembly. In all cases, unless otherwise approved, incorporate flanged components into the system between the application of the base ply and finish ply. The flange must be primed with a uniform coating of approved ASTM D41 asphalt primer and allowed to dry thoroughly; all flanges must be set in approved mastic.
- B. Sealant: Caulk all exposed finish ply edges at gravel stops, waste stacks, pitch pans, vent stacks, etc., with a smooth continuous bead of approved sealant.
- C. Sheet Metal: Refer to Section 07620, ROOF RELATED SHEET METAL.

3.11 FIELD QUALITY CONTROL AND INSPECTIONS

- A. Roof cuts shall be performed and repaired at contractor's expense. Cuts shall be made in the areas as indicated by the Architect's representative. Send required roof cuts to roof membrane manufacturer for laboratory examination. Roof cuts required by the Architect's representative shall be furnished to the Architect's representative for testing.
- B. Remove not more than one (1) 12 inch x 12 inch cut per 5,000 square feet of roof area or fraction thereof.
- C. Field audit will follow criteria outlined in current roof membrane manufacturer's Reference Manual.
- D. Repair sampled areas with "feathered in" patch consisting of same number of plies as in the roof specification.
- E. Correct deficiencies in roof as prescribed in current roof membrane manufacturer's Reference Manual and as approved by Architect's Representative.

3.12 CLEANING AND PROTECTION

- A. Contractor shall keep the job clean and free from all loose materials and foreign matter. Contractor shall take necessary precautions to keep outside walls clean and shall allow no roofing materials to remain on the outside walls.
- B. Leave all areas around job site free of trash, debris, roofing materials, equipment, and related items after completion of job.
- C. All bituminous or roofing related materials shall be removed from ladders, stairs, railings, and similar parts of the building.
- D. Remove bitumen stains from walls, walkways, and driveways.

END OF SECTION

SECTION 07 62 00 -ROOF RELATED SHEET METAL

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable to this Section.

PART I - GENERAL

1.1 SECTION INCLUDES

- A. It is the intent of this Section that the Work shall:
 - 1. conform to all applicable building code requirements and of authorities having jurisdiction;
 - 2. include all shop and field formed sheet metal work shown on drawings, specified or required, including, but not limited to:
 - a. Roof penetration sleeves and hood and umbrella counterflashing
 - b. Metal counterflashing
 - c. Expansion joint
 - d. Roof drains
 - e. Scuppers
 - f. Metal perimeter edge
 - g. Gutters, Downspouts, Splash Blocks and Splash Pans
 - h. One-way roof moisture relief vents
 - i. Metal gravity vents
 - j. Metal heat exhaust vents
 - k. Sanitary vent pipes
 - l. Pipe box
 - m. Copings, trim and miscellaneous sheet metal accessories.
 - 3. be part of the Work of Section 07 52 19, Modified Bitumen Membrane Roofing System; and
 - 4. be performed by a single source contractor.

1.2 RELATED WORK

- A. Section 07 52 19 - Modified Bitumen Membrane Roofing System
- B. Section 07 72 00 – Roof Accessories
- C. All Sections of Work relating to or affecting the roofing system, including mechanical, plumbing and electrical items.

1.3 REFERENCES

- A. ASTM International (ASTM)
 - 1. A525, Standard Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
 - 2. A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
 - 3. B32, Standard Specification for Solder Metal
 - 4. C1107, Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
- B. FM Global (FM)
 - 1. Loss Prevention Data Sheets: I-49, Perimeter Flashing

- C. Federal Specifications (FS)
 - 1. QQ-L-201
- D. National Association of Architectural Metal Manufacturers (NAAMM)
- E. National Roofing Contractors Association (NRCA)
 - 1. Roofing and Waterproofing Manual
- F. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA)
 - 1. Architectural Sheet Metal Manual
- G. ANSI / SPRI ES-1:

1.4 SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
 - 2. Manufacturer's installation instructions.
- B. Shop Drawings: Indicating sizes, configurations, details of attachment to related and adjacent work, materials, and finishes.
- C. Samples:
 - 1. Full range of finish colors for Architect's selection.
 - 2. 12 inch long sample of each specified item with approved finish.
 - 3. Provide full size mockup of all shop built assemblies.

1.5 QUALITY ASSURANCE

- A. Single Source Responsibility: Fabricator and installer of roof-related flashing and accessories shall be the same as the membrane roof installer.
- B. Comply with governing codes and regulations of authorities having jurisdiction.
- C. ANSI / SPRI ES-1: Fabricate and install sheet metal edge flashings and copings to comply with requirements of ANSI / SPRI ES-1 for 120 MPH wind speed zone and wind resistance loads.

1.6 INSTALLATION CONFERENCE

- A. Refer to Section 01 31 13, Project Coordination.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Deliver, handle and store materials in accordance with manufacturer's instructions.
- B. Handle and store materials and equipment in such a manner as to avoid damage.
- C. No storage of materials shall be permitted on roof areas other than those materials that are to be installed the same day. Any exception must be in written form. Do not place materials or equipment in such a manner as to overload structure.

1.8 WARRANTIES

- A. Manufacturer's Product Warranty:
 - 1. Manufacturer's standard 20 year Kynar 500 or Hylar 5000 Finish warranty signed by the manufacturer, with guarantee covering any failure of the fluoropolymer finish during the warranty period.
 - 2. Failure is defined to include, but not be limited to:
 - a. Deterioration of finish, such as fading, discoloring, peeling, cracking, corroding, etc.
 - 3. Correction may include repair or replacement of failed product.
- B. Roofing Contractor's Warranty:
 - 1. Contractor shall warrant the sheet metal work and related work to be free from defects in workmanship and materials, and that the metal flashings will be and remain watertight, for a period of five (5) years from date of Substantial Completion.
 - 2. Defects shall include, but not be limited to:
 - a. Leaking water or bitumen within building or construction.
 - b. Becoming loose from substrate.
 - c. Loose or missing parts.
 - d. Finish failure as defined above.

PART 2 - PRODUCTS

2.1 APPROVED MANUFACTURERS

- A. Manufacturers named within specification are approved for use on the Project providing:
 - 1. their products meet or exceed the specifications;
 - 2. company has a minimum of five (5) years experience manufacturing products of the type specified;
 - 3. products have been tested in conjunction with roofing membrane system as an assembly and as such has obtained the same approval and rating as the roofing membrane system; and
 - 4. products are approved for use by the roofing membrane manufacturer.
- B. Substitutions shall be in accordance with Division 1 requirements regarding substitutions.

2.2 SHEET METAL MATERIALS

- A. General Requirements: Roofing sheet metal system shall have been tested in conjunction with roofing membrane system as an assembly and have the same approval and rating as the roofing membrane system.
- B. Prefinished Galvalume Sheet Steel:
 - 1. Commercial quality with 0.20 percent copper, conforming to ASTM A526, except ASTM A527 for lock forming, with G-90 hot-dip galvanized coating designation.
 - 2. Thickness: Except as otherwise indicated, minimum 24 gauge. SMACNA recommendations shall govern.
 - 3. Finish: Kynar 500 or Hylar 5000 in color as selected by Architect from manufacturer's standard colors.
- C. Sheet Lead:
 - 1. Comply with FS QQ-L-201, Grade B
 - a. Four (4) pound minimum for use at roof drains and soil stacks.

- D. Stainless Steel: ASTM A167, Type 302 / 304 Soft Temper, No. 2D finish. Minimum thickness 24 gauge, except as otherwise noted.

2.3 FASTENERS

- A. Same metal as flashing / sheet metal or other non-corrosive metal or as noted below.
- B. Exposed fasteners shall be self-sealing and gasketed (ZAC type) for weathertight installation.
- C. Match finish of exposed heads with material being fastened.
- D. Mechanical Fasteners:
 - 1. Nails: Ring shank, minimum 1-1/2 inches in length with 1/2 inch diameter head.
 - 2. Washers: Steel washers with bonded rubber sealing gasket.
 - 3. Screws: Self-tapping sheet metal type of stainless steel or compatible with material being fastened, with hooded integral EPDM washers (ZAC type).
 - 4. Rivets: Stainless steel and cadmium plated material, closed end type of sizes recommended by sheet metal manufacturer to suit application.
- E. Clips:
 - 1. Continuous Cleat (coping / fascia): Minimum 20 gauge, G-90 galvanized, stainless steel, or aluminum. Match material of coping / fascia and provide one (1) gauge heavier.

2.4 RELATED MATERIALS

- A. Solder: ASTM B32, alloy grade 58, 50 percent tin, 50 percent lead.
- B. Flux:
 - 1. Phosphoric acid type, manufacturer's standard.
 - a. For Use with Steel or Copper: Rosin flux
 - b. For Use with Stainless Steel: Acid-chloride type flux, except use rosin flux over tinned surfaces.
- C. Underlayment:
 - 1. 40 mil thick SBS modified bituminous product of self-adhering type with non-stick surface conforming to "TAMKO TW-Metal and Tile Underlayment" manufactured by Tamko Roofing Products, Inc., or Architect approved equal.
- D. Adhesives: Type recommended by flashing sheet manufacturer seaming and adhesive application of flashing sheet to ensure adhesion and watertightness.
- E. Metal Accessories: Sheet metal clips, straps, anchoring devices, clamps and similar accessories required for the complete installation of work, matching or compatible with material being installed, non-corrosive, size and gauge recommended by installer to suit application and performance.

- F. Sealant:
1. Type A:
 - a. Type: One-part, non-sag, moisture-curing polyurethane sealant.
 - b. Approved Products / Manufacturers: "Chem-Calk 900" manufactured by Bostik Construction Products Division, "Vulkem 921" manufactured by Mameco International, Inc., "Dynatrol I" manufactured by Pecora Corporation, "MasterSeal NP 1" manufactured by BASF, or approved equal.
 2. Type B:
 - a. Type: One-part, neutral-curing, medium-modulus silicone sealant for sealing metal to metal surfaces, i.e. metal edge, cover plates, etc.
 - b. Approved Products / Manufacturers: "Chem-Calk 1200" manufactured by Bostik Construction Products Division, "795 Silicone Building Sealant" manufactured by Dow Corning Corporation, "895 Silicone" manufactured by Pecora Corporation, "Omniseal" manufactured by Sonneborn Building Products, "Spectrem 2" manufactured by Tremco Incorporated, or approved equal.
- G. Grout - Pitch Pans:
1. Type: Quick-setting, non-shrink, non-metallic, high strength formula complying with ASTM C1107.
 2. Approved Products / Manufacturers: "Sure Grip High Performance Grout" manufactured by Dayton Superior Corporation, "Premier Quick-Trim" manufactured by L & M Construction Chemicals, Inc., "MasterFlow" manufactured by BASF, or approved equal.
- H. Pitch Pan Filler:
1. Type: Pourable polyurethane sealer, approved by roofing system manufacturer.
 2. Approved Products / Manufacturers: "Quick Pitch Sealer" manufactured by U.S. Intec, "SPM Pourable Sealer" manufactured by Johns Manville, or approved equal.
- I. Termination Bar:
1. Material: Extruded aluminum bar with flat profile.
 2. Size: 1/8 inch thick by one (1) inch wide with factory punched 1/4 inch x 3/8 inch oval holes spaced six (6) inches on center.
 3. Approved Product / Manufacturer: "TB 125" manufactured by TruFast Corp., or approved equal.
- J. Pipe Hangers and Supports: Refer to Section 07721, Roof Accessories.
- K. Splash Blocks: Concrete type, of size and profiles indicated; minimum 3,000 psi compressive strength at 28 days, with minimum five (5) percent air entrainment. Use at locations where roof drainage discharges on ground.
- L. Splash Pans: 22 gauge stainless steel, of size and profiles indicated. Use at locations where roof drainage discharges over adjoining, lower roof level(s).

2.5 FABRICATION

- A. Except as otherwise indicated, fabricate work in accordance with SMACNA Architectural Sheet Metal Manual and other recognized industry practices and reviewed shop drawings. Form all flashings, receivers and counterflashings in accordance with standards set forth in the NRCA roofing manual and SMACNA.

- B. Comply with manufacturer's installation instructions and recommendations.
- C. Unless noted otherwise, fabricate perimeter edge / fascia, scuppers, gutters, downspouts, copings, counterflashings, wind clips, and trim from pre-finished galvanized sheet steel.
- D. Shop fabricate work to greatest extent possible. Fabricate inside and outside corners for metal edges, counterflashing, and coping caps.
- E. Fabricate items to size and dimensions as indicated on the drawings. Limit single-piece lengths to ten (10) feet.
- F. Fabricate for waterproof and weather-resistant performance; with expansion provisions for running work sufficient to permanently prevent leakage, damage or deterioration of the work.
- G. Integrate flashing in a manner consistent with detailing. Form work to fit substrates.
- H. Make angle bends and folds for interlocking metal with full regard for expansion and contraction to avoid buckling or fullness in metal after installation.
- I. Fabricate items with straight lines, sharp angles, smooth curves, and true levels. Avoid tool marks, buckling, and oil canning.
- J. Fold back edges on concealed side of exposed edge to form hem.
- K. Unless noted otherwise, lap joints minimum three (3) inch. Lap joints to have sealant installed as per details, to maintain watertight condition, inside and outside corners and elevation changes to be riveted and soldered.
- L. Seams:
 - 1. Wherever possible, fabricate non-moving seams in sheet metal with flat-lock seams and end joints.
 - 2. Pre-finished Galvanized Steel: Seal pre-finished metal seams with rivets and silicone sealant.
 - 3. Metal Other than Aluminum: Tin edges to be seamed, form seams, and solder.
- M. On Kynar 500 or Hylar 5000 pre-finished metal, surface sand metal flanges prior to applying any primers. Prime all metal in contact with bituminous material.
- N. Backpaint all concealed metal surfaces with bituminous paint where expected to be in contact with cementitious materials or dissimilar metals.
- O. Expansion Provisions: Where lapped or bayonet type expansion provisions in work cannot be used or would not be sufficiently waterproof or weatherproof, form expansion joints of intermeshing hooked flanges, not less than one (1) inch deep filled with mastic sealant concealed within joints.

2.6 FABRICATED ITEMS

- A. Metal Flashings: (Minimum ten (10') foot lengths)
 - 1. Through wall Receiver Tray: Minimum 24 gauge stainless steel, through wall receivers shall not extend past the face of the exterior veneer more than $\frac{3}{4}$ ".

2. Counterflashings: Minimum 24 gauge stainless steel formed in maximum ten (10) foot lengths. Through-wall receivers shall be 24 gauge stainless steel, through wall receivers shall not extend past the face of the exterior veneer more than $\frac{3}{4}$ ".
- B. Wind Clips: Minimum 24 gauge stainless steel (or match material of counterflashing), one (1) inch wide by length to engage counterflashing a minimum of 1/2 inch.
- C. Roof Penetrations:
1. Umbrella Counterflashing: Two-piece construction of minimum 22 gauge stainless steel, fabricated in accordance with drawings or project requirements.
 2. Flashing Pans:
 - a. 24 gauge stainless steel.
 - b. Fabricate to provide installed minimum clear inside perimeter dimension of two (2) inches on each side of penetrating element.
 - c. Fabricate pans to at least six (6) inches above the finished roof membrane and with 1/4 inch hem at top edge and with four (4) inch flanges. Round all corners of flange.
 - d. Fabricate metal bonnets for all pans, NO EXCEPTIONS. Fabricate bonnets with metal compatible with metal to which bonnet is to be attached. On beams and other steel, weld in place bonnets fabricated from 1/4 inch steel plate. Draw band bonnets fabricated from 22 gauge stainless steel may be used on circular projections.
- D. Metal Edge:
1. Minimum 0.040 inch thick pre-finished sheet metal formed in maximum ten (10) foot lengths, with six (6) inch wide cover plates of same profile, four (4) inch flange, maximum seven (7) inch fascia, 3/4 inch gravel stop.
 2. Provide expansion slip joints at maximum 20 feet on center.
 3. Shop fabricate all interior and exterior corners. Fabricate exterior corners with 18 inch minimum to four (4) foot maximum legs. Lap, rivet, and seal prior to delivery to jobsite.
 4. Fabricate to sizes and dimensions as indicated on drawings with a minimum one (1) inch coverage past top of wall. Refer to SMACNA Fig. 2-5A.
 5. Provide mock-up for Architect's approval prior to fabrication.
- E. Continuous Cleats: Continuous strips, same material and profile, minimum one gauge heavier of item which cleats attach.
- F. Vent Hoods, Sleeves, Penetration Flashings, and Accessories: Minimum 24 gauge stainless steel, or as shown or directed otherwise.
- G. Angle Termination Bar: Aluminum pressure bar 1/8 inch x one (1) inch.
- H. Vent Pipe Flashing: Four (4) pound lead. Provide proper size to fold down inside of pipe a minimum of one (1) inch.
- I. Gutters / Downspouts / Collector Heads:
1. Minimum 0.040 inch thick pre-finished aluminum formed in maximum ten (10) foot lengths, with six (6) inch wide cover plates.
 2. Match dimension of existing. Verify gutter and downspout meets rainfall data as outlined in SMACNA.
 3. End Caps, Downspout Outlets, Gutter and Downspout Straps, Support Brackets and joint fasteners to be manufactured to suit profile and dimension of gutter and downspout.

4. Install all anchoring devices as outlined in SMACNA.
5. Expansion Joints: Lap or Butt type per SMACNA, locate every 50 linear feet.
6. Gutter Straps and Supports: Minimum 0.040 inch thick pre-finished (match color) aluminum hemmed around 1/8 inch galvanized bent steel bracket.
7. Downspout straps: Strap type, like metal, match color.
8. Gutter Screen: Stainless steel 1/4 inch diamond wire screen enclosed in a pre-finished steel frame.
9. Collect Heads: Minimum 0.040 inch thick pre-finished (match color) aluminum. As outlined in SMACNA; Refer to Figure 1-25F and Figure 1-28 with alternate Section A-A.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify substrates are smooth and clean to extent required to perform sheet metal work.
- B. Verify roof openings, curbs, pipes, sleeves, ducts or vents through roof are solidly set in place.
- C. Verify that reglets, nailers, cants, and blocking to receive sheet metal are in place and free of concrete and soil.
- D. Do not start work until conditions are satisfactory.

3.2 PREPARATION

- A. Field measure site conditions prior to fabrication work.
- B. Install starter and edge strips and cleats before starting installation.

3.3 INSTALLATION

- A. Install sheet metal with lines, arises, and angles sharp and true, and plane surfaces free from objectionable wave, warp, or buckle. Exposed edges of sheet metal shall be folded back to form 1/4 inch hem on concealed side from view. Finished work shall be free from water retention and leakage under all weather conditions. Pre-fabricated corners or transitions are required at changes in direction, elevation, or plane and at intersections. Locate field joints not less than 12 inches, nor more than three (3) feet from actual corner. Laps shall be one (1) inch, riveted and soldered at following locations:
 1. Pre-fabricated corners;
 2. transitions;
 3. changes in direction, elevation, and plane; and
 4. at intersections.
- B. Anchor units of work securely in place to prevent damage or distortion from wind or buckling. Provide for thermal expansion of metal units; conceal fasteners wherever possible; and set units true to line and level as indicated. Install work with laps, joints, and seams which are permanently watertight and weatherproof.
- C. Install fabricated sheet metal items in accordance with manufacturer's installation instructions and recommendations and with SMACNA Architectural Sheet Metal Manual.
- D. Separations: Provide for separation of metal from dissimilar metal or corrosive substrates by coating concealed surfaces with zinc chromate, bituminous coating, or other

permanent separation at locations of contact as recommended by manufacturer or fabricator. Do not use materials which are incompatible with roofing system.

- E. Continuous Cleat: At exposed edges of perimeter edge, fascias, cap flashings, and where required, attach continuous cleat at six (6) inches on center with appropriate fasteners. At a distance of 10 feet from each direction of all corners, install fasteners spaced at 3 inches on center. Install cleat so fascia extends a minimum of 1 inch below top of exterior wall finish.
- F. Gravel Guard / Fascia:
1. Install with expansion joints 10 feet o.c., 1/2 inch expansion leeway, with cover plate.
 2. Set in asphalt mastic and fasten into nailer at 3 inches o.c. staggered.
 3. Buff sand Kynar surface of flange and prime.
 4. Strip in flange with specified stripping plies set in hot bitumen extending 3 inches from outer edge of flange to at least 3 inches inward towards gravel stop. Provide finish stripping ply of modified bitumen base ply in hot bitumen extending 6 inches from the outer edge of the flange and butt base of gravel stop.
- G. Counterflashing:
1. Do not use surface mount counterflashing except as noted in drawings.
 2. Set in through wall with receiver and spring lock counterflashing, as detailed in drawings and to NRCA roofing manual, SMACNA standards.
 3. Coordinate installation of through-wall flashing with the masonry contractor.
 4. Seal through-wall in conjunction with masonry wall waterproofing.
 5. Install wind clips 30 inches o.c. at all counterflashing over five (5) feet in length.
- H. Pitch Pans, Metal Flanges:
1. Apply mastic under pitch pan or metal flashing flange at least 1/2 pound per linear foot.
 2. Prime all metal flanges with asphalt primer prior to flashing installation.
 3. Clean all projections enclosed in pitch pans in any manner suitable and coated with a rust inhibitive coating as approved by the Architect. Coating shall be allowed to dry prior to pitch pan fill.
 4. Fill base of pitch pans with grout or cementitious binder and allow to cure.
 5. Top Finish Fill: Self-leveling, one-part urethane; at least two (2) inches to top of pitch pan sides.
 6. Strip in pitch pan flanges with two strips of specified stripping plies set in hot bitumen extending three (3) inches from the outer edge of the flange to at least three (3) inches inward toward base of pitch pan. Provide finish stripping ply of SBS modified bitumen membrane in hot bitumen extending six (6) inches from the outer edge of the flange and butt to base of pitch pan.
- I. Sanitary Vent Stacks:
1. Prime top and bottom flanges of lead flashing sleeve. Set flange in uniform troweling of plastic roof cement. Prime top side of flange to receive strip-in membrane.
 2. Fold lead sleeve down inside of pipe a minimum of one (1) inch. Apply a continuous bead of sealant on inside of pipe prior to folding lead sleeve.
- J. Gutters / Downspouts:
1. Install gutters as detailed.
 2. Install downspouts plumb and level, attached to columns or wall with straps located at top and bottom of downspout and maximum ten (10) feet on center.

3. Install splash pad or block under discharge port of downspouts (if non exist).
Install splash pan over a protection (walkway) pad for downspouts located at roof level.

3.4 CLEANING AND PROTECTION

- A. Remove flux and residual acid immediately by neutralizing with baking soda and washing with clean water. Leave work clean of stains.
- B. Remove scraps and debris and leave work area clean.
- C. Clean exposed metal surfaces, removing substances which might cause corrosion of metal or deterioration of finishes. Paint areas where finish is damaged on pre-finished metal by painting with a compatible paint in color to match undamaged finish.
- D. Prime soldered area of phosphatized metal after cleaning to prevent rusting.
- E. Paint metal flashings that have been soiled with bitumen with aluminized paint.
- F. Clean other work damaged or soiled by Work of this Section.
- G. Protect finished work from damage.

END OF SECTION

SECTION 07 72 00 - ROOF ACCESSORIES

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 INSTALLATION RESPONSIBILITY

- A. In addition to the items normally a part of this Section, coordinate the installation of roof accessory curbs and pipe flashings and equipment supports that may be specified elsewhere.
- B. Coordinate the Work specified herein with the following Work:
 - 1. Roofing
 - 2. Roofing sheet metal
 - 3. Mechanical equipment
 - 4. Plumbing

1.2 REFERENCES

- A. Federal Specifications (FS)
 - 1. TT-S-00227E
- B. National Roofing Contractors Association (NRCA)
- C. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA)
 - 1. Architectural Sheet Metal Manual

1.3 SUBMITTALS

- A. Product Data: Submit schedules, charts, literature, and illustrations to indicate the performance, fabrication procedures, product variations, and accessories.
- B. Shop Drawings: Indicate size, material, and finish. Show locations and installation procedures. Include details of joints, attachments, and clearances.

1.4 PRE-INSTALLATION CONFERENCE

- A. Refer to Section 01 31 13 – Project Coordination.

1.5 WARRANTY

- A. Warranty the Work specified herein for one (1) year against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship.
- B. Defects shall include, but not be limited to, the following:
 - 1. Noticeable deterioration of finish
 - 2. Leakage of water into the building or within the construction.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Specifications are based on products of named manufacturers. Other manufacturers must have a minimum of five (5) years experience manufacturing products meeting or exceeding the specifications and comply with Division 1 requirements regarding substitutions to be considered.

2.2 PREFABRICATED ROOF CURBS

- A. Frames:
1. Material: ASTM A 653 G90 hot-dipped galvanized steel.
 - a. Minimum 18 gauge, and as engineered by manufacturer.
 - b. Minimum 18 gauge for curbs supporting HVAC units
 - c. Minimum 20 gauge for expansion joint curbs.
 2. Corners: Mitered and welded (welds are micro sealed and prime painted after fabrication). Bolted connections not accepted.
 3. Base Plates: Integral to frame and welded.
 4. Internally reinforced with galvanized 1 inch by 1 inch by 12 gauge angles for curbs exceeding 3 foot length. Reinforce internal bulkhead at equipment curbs to support lateral loads.
 5. Wood Nailers: Factory installed, pressure treated. Size and width as suitable for support of items installed on curbs.
- B. Insulation: Factory installed 1-1/2 inch thick three-pound density fiberglass insulation.
- C. Curb Height: Minimum 8 inch above finished roof.
- D. Construct curbs to match roof slope with plumb and level top surface for mounting mechanical equipment.
- E. Gasketing: 1/4 inch thick, one (1) inch wide at roof top units.
- F. Counterflashing: 24 gauge stainless steel
- G. Counterflashing Cap: Stainless steel.
- H. Cants:
1. Non-canted curb style installs either under or on top of metal decks with insulation.
 2. Cants shall be provided under Section 07 52 19 - Roofing
- I. All insulated roof curbs shall be structural and shall include calculations signed and sealed by a registered Structural Engineer. Refer to installation drawings for any additional structural requirements. If curbs do not span a minimum of two bar joists, only two angles will be required. Coordination mechanical equipment weight loading on the roof with Structural Engineer.
- J. Approved Manufacturers:
1. Custom Curb, Inc.
 2. Roof Products, Inc.

2.3 PIPE SUPPORTS (Cannot be contractor built supports)

- A. Gas Pipe Supports:
 - 1. Provide strut and hanger type support with recycled plastics and carbon black for UV protection bases (10 inches x 16 inches x 3 inches; 6 lbs. each); Model Type PP-10 with strut & hanger for lines 2-1/2 inches and smaller, Model Type PS-1-2 with hanger for lines 3 inches and larger.
 - 2. As manufactured by PHP Systems Design; Miro Industries Inc.; MAPA Products; Advanced Support Products or Architect approved equal.

- B. Electrical Conduit / Condensate Lines:
 - 1. Provide strut type support with recycled plastics and carbon black for UV protection bases (10 inches x 16 inches x 3 inches; 6 lbs. each), install with hold clips ordered as an accessory; Model Type PP-10 with strut. Model Type PS-1-2 with hanger for lines 3 inches and larger.
 - 2. As manufactured by PHP Systems Design; Miro Industries Inc.; MAPA Products; Advanced Support Products or Architect approved equal.

- C. Chill Water Lines:
 - 1. Provide strut and hanger type support with recycled plastics and carbon black for UV protection bases (size as required); Model Type PS-1-2 and Model Type PSE-2-2 as required.
 - 2. As manufactured by PHP Systems Design, Inc.; Miro Industries Inc.; MAPA Products; Advanced Support Products or Architect approved equal.

- D. Installation:
 - 1. Locate as indicated by Drawing at no greater than 8 feet-0 inches o.c.
 - 2. Provide protective traffic pads below each support, tacked in place with approved mastic or adhesive.
 - 3. Install hold down clips if indicated on the drawings or required.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install roof accessories in accordance with manufacturer's printed instructions and approved shop drawings. Installation of Portable Pipe Hangers shall not exceed six (6) feet on center.

- B. Coordinate with roofing operation for watertight integrity.

- C. Finished installation shall be water and air tight. Install sealant conforming to FS TT-S-00227E, Type II, Class A.

END OF SECTION

SECTION 07 81 23

INTUMESCENT FIREPROOFING

CONDITIONS OF THE CONTRACT AND DIVISION 01, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes

1. Spray application of water based, intumescent, fireproofing on interior, exposed structural steel, and related exposed structural steel to provide rated fireproofing.

1.2 REFERENCES

A. ASTM International (ASTM)

1. D256, Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics
2. D638, Standard Test Method for Tensile Properties of Plastics
3. D695, Standard Test Method for Compressive Properties of Rigid Plastics
4. D790, Standard Test Method for Flexural Properties for Unreinforced and Reinforced Plastics and Electrical Insulating Materials
5. D1002, Standard Test Method for Apparent Shear Strength of Single-Lap Joint Adhesively Bonded Material Specimens by Tension Loading (Metal-to-Metal)
6. D1044, Standard Test Method for Resistance of Transparent Plastics to Surface Abrasion
7. D4541, Standard Test Method for Pull off Strength of Coatings Using Portable Adhesion Testers
8. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
9. E119, Standard Test Methods for Fire Tests of Building Construction and Materials.

B. U.L., Inc. - Fire Resistance Directory.

1.3 PERFORMANCE REQUIREMENTS

- ###### A.
- Intumescent fireproofing system to provide a fire rating as scheduled in accordance with ULC.

1.4 SUBMITTALS

- ###### A.
- Submit product data under provisions of Section 01 33 00 "Submittal Procedures"

1. Indicate product characteristics, performance, and limitation criteria.

- ###### B.
- Submit manufacturer's installation instructions under provisions of Section 01 33 00 "Submittal Procedures".

- ###### C.
- Submit manufacturer's certificate under provisions of Section 01 33 00 "Submittal Procedures" that products meet or exceed specified requirements.

- ###### D.
- Submit independent testing agency test reports under provisions of Section 01 45 23 "Testing and Inspecting Services".

- ###### E.
- Submit manufacturers certified test reports indicating the following:

1. Fire test reports of fireproofing application to substrate materials similar to project conditions.

2. U.L. Design Listings from U.L., Inc.

- F. Submit applicator's current certification, by product manufacturer, as a factory trained and manufacturer approved installer of this product.
- G. Certification: Manufacturer's affidavits that materials used in Project contain no asbestos.

1.5 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum five years documented experience.
- B. Applicator: Company specializing in applying the work of this Section with minimum 3 years documented experience and approved by manufacturer.

1.6 TESTS AND INSPECTIONS

- A. Architect may require tests and inspections as necessary to verify quality, strength, and thickness of intumescent fireproofing. Laboratory tests of materials for resistance to damage, bond strength, air erosion and mold resistance will be made in accordance with referenced ASTM standard procedures. Inspections shall be carried out prior to application of final color top coat.
- B. Owner will select Testing Laboratory and Owner will pay for initial tests of Testing Laboratory. Work which fails initial testing shall be replaced with new materials. Retesting shall be at Contractor's expense until test results are satisfactory to Architect.

1.7 REGULATORY REQUIREMENTS

- A. Conform to applicable code for fire resistance ratings.
- B. Submit certification of acceptability of fireproofing materials to authority having jurisdiction and to Architect.

1.8 ENVIRONMENTAL REQUIREMENTS

- A. Provide ventilation in areas to receive fireproofing during and 72 hours, minimum, after application, to dry materials and dissipate solvent odors.
- B. Maintain non-toxic, unpolluted working area. Provide temporary enclosure to prevent spray from contaminating air.
- C. Relative humidity must not exceed 75 percent throughout the total period of application and drying, and must not exceed 65 percent throughout the total period of application and drying of the top coat. Relative humidity of 40 percent to 60 percent is recommended in work areas.
- D. Do not apply fireproofing until concrete toppings and roofing applications have been installed.

1.9 WARRANTY

- A. Provide one year manufacturer's warranty under provisions of Section 01 77 00 "Closeout Procedures".
- B. Provide one year applicator's warranty under provisions of Section 01 77 00 "Closeout Procedures".
- C. Warranty: Fireproofing to remain free from cracking, checking, dusting, flaking, spalling, separation, and blistering. Reinstall or repair such defects or failures.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Specifications are based on any of the manufacturers listed below. Other manufacturers not listed must have a minimum of five (5) years experience manufacturing products

meeting or exceeding the specifications and comply with Division 1 regarding substitutions to be considered.

1. A/D Fire Protection Systems, St. Louis, MO; "A/D FIREFILM®II"
2. Albi Manufacturing, East Berlin, CT (860) 828-0571; "ALBI CLAD TF." (Basis of Specifications)
3. Carboline Co., St. Louis, MO (800) 848-4645; "Thermosorb".
4. Isolatek International, Stanhope, NJ (800) 631-9600; "CAFECO SprayFilm WB3"

2.2 MATERIALS

- A. Intumescent Fireproofing: Single component, water based, factory mixed, asbestos free, intumescent material blended for uniform texture; conforming to the minimum following requirements:
 1. Bond Strength: ANSI/ASTM E 736, minimum 40 psi when set and dry.
 2. Bond Impact: ASTM E 760, ASTM D2794, no cracking, flaking, or delamination.
 3. Dry Density: ASTM E 605, minimum average density of 85 lb/cu ft.
 4. Surface Burning Characteristics, ASTM E84: Class "A"
 5. Compressive Strength :ASTM E 761, Minimum: 300 psi
 6. Comply with V.O.C. Air Quality Standards.
- B. Primer: Select primer from manufacturer's list of approved compatible primers of type recommended or approved by fireproofing manufacturer. If the steel has previously been coated with another primer, consult fireproofing manufacturer for recommendation for treating surface.
- C. Color top coat: Select from compatible type recommended or approved by fireproofing manufacturer.
- D. Glass fiber mesh: If required by manufacturer or when required to meet total coating thickness for UL rating, use approved glass fiber mesh, square pattern 3/16" x 3/16" at mid depth of coating.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Verify that surfaces are ready to receive work. Beginning of installation means applicator accepts existing substrate.
- B. Verify that clips, hangers, supports, sleeves, and other items required to penetrate fireproofing are in place.

3.2 PREPARATION

- A. Clean substrate of dirt, dust, grease, oil, loose material, or other matter which may effect bond of fireproofing.

3.3 PROTECTION

- A. Protect floor areas from this Work by completely covering with tarps or 4 mil polyethylene sheets.
- B. Protect adjacent surfaces, equipment, and floor areas from damage by overspray, fall-out, and dusting.
- C. Close off and seal ductwork in areas where fireproofing is being applied.

3.4 APPLICATION

- A. Apply primer and fireproofing in accordance with manufacturer's instructions. Do not apply to surfaces which would prohibit proper adhesions.
- B. Apply primer according to primer manufacturer's recommendations. Provide primer "cut-back" three inches for bolted connections and 12 inches for welded connections.
- C. Apply fireproofing in sufficient thickness to achieve rating, with as many passes necessary to cover with monolithic blanket of uniform hardness, density and texture. Spray and roll smooth the finished surface.
- D. Apply color top coat according to manufacturer's recommendations.

3.5 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed using manufacturer's guidelines under provisions of Section 01 45 00 "Quality Control".
- B. Inspections will be performed to verify compliance with requirements.
- C. Patch fireproofing, which has been cut away to facilitate work of other trades, so as to maintain complete coverage of full thickness on appropriate substrate.
- D. Correct unacceptable Work and provide further inspection to verify compliance with requirements, at no cost.

3.6 CLEANING

- A. Remove excess material, overspray, droppings, and debris. Remove fireproofing from materials and surfaces not specifically required to be fireproofed.

3.7 SCHEDULE OF FIREPROOFING

- A. Wood in Plenum Spaces:
 - 1. U.L. Rating: 2 hours
 - 2. U.L. Listing: X638 (Albi), X633 (Carboline), X642 (A/D), X649 & X650 (Isolatek).

END OF SECTION

SECTION 07 84 00

FIRESTOPPING

CONDITIONS OF THE CONTRACT AND DIVISION 01, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. Non-combustible firestopping and fire safing materials, and accessories as shown on drawings, or if not shown, as required, including, but not limited to the following:
 - a. Intumescent Caulks, Elastomerics, Sealants, Compounds, Putties, Joint Sprays, Wrap Strips, and Coatings
 - b. Silicone Sealants
 - c. Mortar Materials (Cementitious)
 - d. Firestopping Foam Materials
 - e. Fire Block Materials
 - f. Pillow Materials
 - g. Mat Materials
 - h. Cast-in-place Devices, Collars, and other materials, including fire/smoke stop systems, which meet the specified requirements.
 - 2. General description of the work in this section:
 - a. Only tested firestop systems shall be used in specific locations as follows:
 - 1) Penetrations for the passage of duct, cable, cable tray, conduit, piping, electrical busways and raceways through fire-rated vertical barriers (walls and partitions), horizontal barriers (floor/ceiling assemblies), and vertical service shaft walls and partitions.
 - 2) Blank openings through fire-rated vertical barriers (walls and partitions), horizontal barriers (floor/ceiling assemblies), and vertical service shaft walls and partitions.
 - 3) Openings and penetrations in fire-rated partitions or walls containing fire doors. Openings around structural members which penetrate floors or walls.
- B. Related Requirements
 - 1. Section 07 92 00 "Joint Sealants"
 - 2. Section 09 21 16 "Gypsum Board Assemblies": Wallboard used for fire rated construction.
 - 3. Division 23 – Mechanical: Requirements for penetrations through fire rated construction.
 - 4. Division 26 – Electrical: Requirements for penetrations through fire rated construction.

1.2 REFERENCES

- A. ASTM International (ASTM)
 - 1. C665, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing

2. E84, standard Test Method for Surface Burning Characteristics of Building Materials
 3. E119, Standard Test Methods for Fire Tests of Building Construction and Materials
 4. E814, Standard Test Method for Fire Tests of Through-Penetration Fire Stops
 5. E2174, Standard Practice for On-Site Inspection of Installed Fire stops
- B. National Fire Protection Association (NFPA)
1. 70, National Electric Code
 2. 101, Life Safety Code
- C. Underwriters Laboratories (UL)
1. 263, Fire Tests of Building Construction and Materials
 2. 1479, Fire Test of Through-Penetration Firestops
 3. 2079, Tests for Fire Resistance of Building Joint Systems
 4. UL Fire Resistance Directory:
 - a. Firestop Devices (XHJI)
 - b. Fire Resistance Ratings (BXRH)
 - c. Through-Penetration Firestop Systems (XHEZ)
 - d. Fill, Voids, or Cavity Material (XHHW)
 - e. Forming Materials (XHKU)
 - f. Joint Systems (XHBN)
- D. International Firestop Council Guidelines for Evaluating Firestop Systems Engineering Judgments

1.3 PERFORMANCE AND QUALITY ASSURANCE REQUIREMENTS

- A. Firestopping Materials:
1. Shall be rated as non-combustible when tested in accordance with ASTM E119 to achieve fire rating noted on the drawings and provide a fire rating equal to that of construction being penetrated. If no such fire rating is noted on the drawings, the fire rating shall be required by the authorities having jurisdiction.
 2. If such materials are used in a through-penetration seal condition, they shall be approved for such use, with all required devices and accessories forming an assembly or included in the test, when tested in accordance with ASTM E814 or UL 1479.
 3. Tests shall be performed by an approved testing agency to indicate compliance with specified requirements and the resulting approval number shall be the latest or current test approved by authorities having jurisdiction. For those firestop applications that exist for which no UL tested system is available through a manufacturer, an engineering judgment derived from similar UL system designs or other tests will be submitted to local authorities having jurisdiction for their review and approval prior to installation. Engineering judgment drawings must follow requirements set forth by the International Firestop Council.
- B. Fire-Safing Materials:
1. Shall be tested and rated non-combustible to achieve fire rating noted on the drawings, or if not noted, as required by authorities having jurisdiction.
 2. If such materials are used in an assembly, they shall be approved for such use,

- with all required devices and accessories forming an assembly or included in the test.
3. Tests shall be performed by an approved testing agency to indicate compliance with specified requirements and the resulting approval number shall be the latest or current test approved by authorities having jurisdiction.
 4. Proposed fire safing materials and methods shall conform to applicable governing codes having local jurisdiction.
- C. Definitions: As they appear in this Section:
1. Combustible: Penetrations composed of any material which will burn or melt in a fire, including, but not limited to the following:
 - a. Nonmetallic pipes made of glass or plastic.
 - b. Metallic pipes made of lead or aluminum.
 - c. Electrical, data, communication, security, and telephone cables.
 2. Non-combustible: Penetrations composed of any material which will not burn or melt in a fire, including, but not limited to the following:
 - a. Metallic pipes made of steel, iron or copper.
 3. Approved Testing Agencies: UL or other testing agency licensed and equipped to conduct the required fire tests and approved by authorities having jurisdiction.
 4. Authorities Having Jurisdiction: Shall be the person or entity responsible for applicable governing code enforcement.
- D. Manufacturer Qualifications: Those listed in Paragraph 2.1, A, or company specializing in manufacturing the products specified in this Section with minimum of five (5) years experience. Refer Division 1 for substitutions.
- E. Installer Qualifications: Company specializing in performing the Work of this Section with minimum three (3) years experience installing tested and classified firestop and fire safing systems or manufacturer certification and approval.
- F. Standards: All firestop and fire safing systems shall have a flame (F) rating and temperature (T) rating conforming to applicable building codes and in accordance with Drawings and Specifications.
- G. Single Source Responsibility: Obtain firestopping and fire safing materials from a single manufacturer for each different product required.
- H. No firestopping or fire safing materials shall be concealed or covered until they have been observed and approved for use by the Architect and/or authorities having jurisdiction.

1.4 CONTRACTOR'S RESPONSIBILITIES

- A. As scope and performance documents, the Drawings and Specifications do not necessarily indicate or describe all the Work required for the performance and completion of the Work. Contracts will be let on the basis of such documents with the understanding that the Contractor shall furnish and install the items required for proper completion of the Work without adjustment to price or schedule. Work shall be of sound, quality construction and the Contractor shall be solely responsible for the inclusions of adequate labor and materials to cover the proper and timely furnishing and installation of the firestopping and fire safing indicated, described, or implied.
- B. As a performance specification, the criteria for the solution of the firestopping and fire safing indicated on the Drawings or specified herein are for the sole purpose of defining the design intent and performance requirements. The details shown, if any, are intended to emphasize the acceptable performance requirements for this Project. To avoid any misunderstanding or lack of interpretation, the Contractor is hereby advised that the

responsibility for all firestopping and fire safing are totally his and that designs and resolutions proposed by the Contractor through his submittals and related documentation shall be demonstrated throughout the Work and warranty period specified herein.

- C. Design proposal submissions which follow exactly the details indicated on the Drawings, will not relieve the Contractor of his responsibility for the design, furnishing, installation, or performance of the Work of this Section.
- D. In the event of a controversy over any requirements of this Section, the decision of the Architect will take precedence.

1.5 SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's technical data on product characteristics, performance, and limitation criteria for each material including UL firestop systems to be used.
 - 2. Manufacturer's installation instructions.
 - 3. Manufacturer's Material Data Sheets (MSDS)
- B. Shop Drawings: Manufacturer's shop drawings or detail sheets indicating each condition that requires a penetration or joint seal. Details must be in accordance with the proposed approved system. Include materials to be used, anchorage, methods of installation and relationship to all adjacent construction.
- C. Manufacturer's engineering judgment identification number and drawing details when no UL system is available for an application. Engineering judgment must include both project name and contractor's name who will install firestop system as described in drawing.
- D. Certifications:
 - 1. Manufacturer's certification of compliance indicating approval of authorities having jurisdiction for combustibility and use of materials, and that their installation conforms to shown or required fire rating.
 - 2. Manufacturers' affidavit that materials used in Project contain no asbestos.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver and store materials undamaged in manufacturer's clearly labeled, unopened containers, identified with brand, type, and UL label where applicable.
- B. Coordinate delivery of materials with scheduled installation date to allow minimum storage time at job-site.
- C. Store materials under cover and protect from weather and damage in compliance with manufacturer's requirements, including temperature restrictions.
- D. Comply with recommended procedures, precautions or remedies described in material safety data sheets as applicable.
- E. Do not use damaged or expired materials.

1.7 INSTALLER QUALIFICATIONS

- A. Engage an experienced Installer who is certified, licensed, or otherwise qualified by the firestopping manufacturer as having been provided the necessary training to install manufacturer's products per specified requirements. A manufacturer's willingness to sell its firestopping products to the Contractor or to an Installer engaged by the Contractor does not in itself confer qualification on the buyer.
- B. Installer Training: A manufacturer's direct representative (not distributor or agent) to be on-site during initial installation of firestop systems to train appropriate contractor personnel in proper selection and installation procedures. This will be done per manufacturer's written recommendations published in their literature and drawing details.

1.8 REGULATORY REQUIREMENTS

- A. Conform fire resistance ratings and surface burning characteristics of authorities having jurisdiction.
- B. Provide certificate of compliance from manufacturer indicating approval of authorities having jurisdiction for combustibility and use of materials, and that their installation conforms to shown or required fire rating.

1.9 ENVIRONMENTAL REQUIREMENTS

- A. Do not use materials that contain flammable solvents.
- B. Verify existing conditions and substrates before starting work. Correct unsatisfactory conditions before proceeding.
- C. Weather conditions: Do not proceed with installation of firestop materials when temperatures exceed the manufacturer's recommended limitations for installation printed on product label and product data sheet.
- D. During installation, provide masking and drop cloths to prevent firestopping materials from contaminating any adjacent surfaces.
- E. Provide ventilation in areas to receive solvent cured materials.

1.10 PRE-INSTALLATION CONFERENCE

- A. Refer to Section 01 31 13 "Project Coordination"

1.11 SEQUENCING

- A. Sequence Work to permit firestopping and fire safing materials to be installed after adjacent and surrounding work is complete.

1.12 WARRANTY

- A. Warrant the work specified herein for two (2) years against becoming unserviceable or causing an objectionable appearance resulting from either defective or non-conforming materials and workmanship.
- B. Defects shall include, but not be limited to:
 - 1. Use of incorrect material within the installation
 - 2. No mineral wool insulation within a system that requires it.
 - 3. Use of mineral wool insulation when ceramic fiber insulation is required.
 - 4. Incorrect amount of material is installed within system.
 - 5. No use of an accessory seal within a system that requires one.
 - 6. Use of an incorrect system with a firestop or fire safing installation
 - 7. Failure to meet specified performance or quality assurance requirements.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS / PRODUCTS

- A. Subject to compliance with through penetration firestop systems listed in Volume II of the UL Fire Resistance Directory (XHEZ), manufacturers specified are approved for use in the Project. Other manufacturers must have a minimum of five (5) years experience manufacturing products meeting or exceeding the specifications and comply with Division 01.
 - 1. Hilti, Inc.
 - 2. Nelson Firestop Products
 - 3. Specified Technologies, Inc.

4. Tremco Inc.
 5. 3M Fire Protection Products
- B. To maintain clarity of products, specifications are based on specified products manufactured by Hilti, Inc.; Tulsa, OK. Listed manufacturers providing equivalent products are acceptable for use on this project.
- C. It is recognized that the manufacturers listed may not produce all of the specified types of products, therefore, products from several manufacturers may be used throughout the project as long as consistent use of each individual product is maintained throughout the project, they meet the requirements specified herein for the intended use, and are approved for that use by authorities having jurisdiction. Products which are combined to form a UL listed assembly must be provided as tested and approved as shown in the Fire Resistance Directory.

2.2 MATERIALS AND COMPONENTS

- A. General:
1. Any of the following materials, either by itself or in combination with other materials may be used on the Project provided they:
 - a. Satisfy the firestopping and fire safing requirements for use in the required application on the Project.
 - b. Meet the performance and quality assurance requirements specified herein.
 - c. Are approved for use in that application by the authorities having jurisdiction.
 2. Materials shall comply with ASTM E814 (UL 1479) or ASTM E119 (UL 263), and shall be manufactured of non-toxic, non-hazardous, asbestos free materials. Product shall bear proper independent test laboratory label/logo and shall conform to construction assembly type, penetrating item type, annular space requirements, and fire rating involved for each separate instance.
- B. Primers: Conform to firestop manufacturer's recommendations for primers required for various substrates and conditions.
- C. Back-Up (Damming) Materials: Conform to firestop manufacturer's recommendations for back-up (damming) materials. Material may be removable or permanent as recommended by manufacturer to suit application and as required by UL testing or other testing agency approved by authorities having jurisdiction.
- D. Retainers: Steel angles, clips, sheet metal, and impaling fasteners to support damming material and fire safing material and where required by UL testing or other testing agency approved by authorities having jurisdiction.
- E. Adhesives and Fasteners: Conform to firestop manufacturer's recommendations for adhesives and fasteners required for various substrates and conditions and to suit intended use. Materials must conform to those required by UL testing or other testing agency approved by authorities having jurisdiction.
- F. Firestopping Fill, Void, and Cavity Materials: Shall conform to those required by UL testing or other testing agency approved by authorities having jurisdiction, including, but not be limited to the following. Refer to list of approved manufacturers:
1. Cast-in place firestop devices for use with combustible and non-combustible pipes (closed and open piping systems) and cable bundles penetrating concrete floors, the following products are acceptable:
 - a. "CP 680 Cast-In Place Firestop Device" manufactured by Hilti, Inc
 - 1) Add Aerator adaptor when used in conjunction with aerator

- ("sovent") system.
- b. "CP 681 Tub Box Kit" for use with tub installations manufactured by Hilti, Inc
 - c. "CP 682 Cast-In Place Firestop Device" for use with noncombustible penetrants manufactured by Hilti, Inc
2. Sealants, caulking materials, or foams for use with non-combustible items including steel pipe, copper pipe, rigid steel conduit and electrical metallic tubing (EMT), the following products are acceptable:
 - a. "FS-ONE Intumescent Firestop Sealant" manufactured by Hilti, Inc.
 - b. "CP 604 Self-leveling Firestop Sealant" manufactured by Hilti, Inc.
 - c. "CP 620 Fire Foam" manufactured by Hilti, Inc.
 - d. "CP 606 Flexible Firestop Sealant" manufactured by Hilti, Inc.
 - e. "CP 601s Elastomeric Firestop Sealant" manufactured by Hilti, Inc.
 3. Sealants or caulking materials for use with sheet metal ducts, the following products are acceptable:
 - a. "CP 601s Elastomeric Firestop Sealant" manufactured by Hilti, Inc.
 - b. "CP 606 Flexible Firestop Sealant" manufactured by Hilti, Inc.
 - c. "FS-ONE Intumescent Firestop Sealant" manufactured by Hilti, Inc.
 4. Intumescent sealants, caulking materials for use with combustible items (penetrants consumed by high heat and flame) including insulated metal pipe, PVC jacketed, flexible cable or cable bundles and plastic pipe, the following products are acceptable:
 - a. "FS-ONE Intumescent Firestop Sealant" manufactured by Hilti, Inc
 5. Foams, Intumescent sealants, or caulking materials for use with flexible cable or cable bundles, the following products are acceptable:
 - a. "FS-ONE Intumescent Firestop Sealant" manufactured by Hilti, Inc
 - b. "CP 620 Fire Foam" manufactured by Hilti, Inc
 - c. "CP 601s Elastomeric Firestop Sealant" manufactured by Hilti, Inc
 - d. "CP 606 Flexible Firestop Sealant" manufactured by Hilti, Inc
 6. Non curing, re-penetrable, intumescent putty or foam materials for use with flexible cable or cable bundles, the following products are acceptable:
 - a. "CP 618 Firestop Putty Stick" manufactured by Hilti, Inc
 - b. "CP 658T Firestop Plug" manufactured by Hilti, Inc
 7. Wall opening protective materials for use with U.L. listed metallic and specified nonmetallic outlet boxes, the following products are acceptable:
 - a. "CP 617 Firestop Putty Pad" manufactured by Hilti, Inc.
 8. Firestop collar or wrap devices attached to assembly around combustible plastic pipe (closed and open piping systems), the following products are acceptable:
 - a. "CP 643N Firestop Collar" manufactured by Hilti, Inc
 - b. "CP 644 Firestop Collar" manufactured by Hilti, Inc
 - c. "CP 645/648 Wrap Strips" manufactured by Hilti, Inc.
 9. Materials used for large openings and complex penetrations made to accommodate cable trays and bundles, multiple steel and copper pipes, electrical busways in

- raceways, the following products are acceptable:
- a. "CP 637 Firestop Mortar" manufactured by Hilti, Inc
 - b. "FS 657 FIRE BLOCK" manufactured by Hilti, Inc
 - c. "CP 620 Fire Foam" manufactured by Hilti, Inc
 - d. "CP 675T Firestop Board" manufactured by Hilti, Inc.
10. Non-curing, re-penetrable materials used for large openings and complex penetrations made to accommodate cable trays and bundles, multiple steel and copper pipes, electrical busways in raceways, the following products are acceptable:
- a. "FS 657 FIRE BLOCK" manufactured by Hilti, Inc
 - b. "CP 675T Firestop Board" manufactured by Hilti, Inc.
11. For blank openings made in fire-rated wall or floor assemblies, where future penetration of pipes, conduits, or cables is expected, the following products are acceptable:
- a. "FS 657 FIRE BLOCK" manufactured by Hilti, Inc
 - b. "CP 658T Firestop Plug" manufactured by Hilti, Inc
- G. Fire Related Construction Joints and Other Gaps:
1. "CP 601S" Elastomeric Firestop Sealant" manufactured by Hilti, Inc.
 2. "CP 606" Flexible Firestop Sealant" manufactured by Hilti, Inc.
 3. "CP 672" Firestop Joint Speed Spray" manufactured by Hilti, Inc.
- H. Fire-Safing Materials: Comply with ASTM C665, Type I, high-melt mineral-fiber insulation with minimum nominal density of 4.0 lbs. per cubic foot and having a maximum flame spread rating of 15 and smoke developed rating of 0. Size shall be 4 inches thick by 24 inches wide by 48 inches long, unless noted otherwise. Products containing asbestos strictly prohibited.
1. "Thermafiber Safing Insulation" manufactured by Thermafiber, Inc.
 2. "Fibrex Safing Insulation" manufactured by Fibrex Insulations, Inc.
 3. "Delta Safing Board" manufactured by Rock Wool Manufacturing Company.
- I. Jacketing (For use with fire protection board): 0.016 inch aluminum or 0.010 inch stainless steel roll jacketing as shown, or if not shown, as required where high traffic requires high durability and good appearance, and as directed by Architect.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine joints and openings indicated or required to receive firestop and fire safing materials, for compliance with requirements for proper configuration, installation tolerances and other conditions affecting firestop and fire safing performance.
- B. Do not proceed with installation until unsatisfactory conditions are corrected.
- C. Beginning installation shall indicate acceptance of existing conditions. Work found to be defective or deficient due to uncorrected existing conditions prior to installation should be repaired or replaced at no additional expense to Owner.

3.2 PREPARATION

- A. Verification of Conditions: Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.
 - 1. Verify penetrations are properly sized and in suitable condition for application of materials.
 - 2. Surfaces to which firestop materials will be applied shall be free of dirt, grease, oil, rust, laitance, release agents, water repellents, and any other substances that may affect proper adhesion.
 - 3. Provide masking and temporary covering to prevent soiling of adjacent surfaces by firestopping materials.
 - 4. Install back-up (damming) materials to arrest liquid material leakage.
 - 5. Comply with manufacturer's recommendations for temperature and humidity conditions before, during and after installation of firestopping.

3.3 COORDINATION

- A. Coordinate location and proper selection of cast-in-place Firestop Devices with trade responsible for the work. Ensure device is installed before placement of concrete.
- B. Responsible trades to provide adequate spacing of field run pipes to allow for installation of cast-in-place firestop devices without interferences.

3.4 INSTALLATION

- A. General:
 - 1. Install firestop and fire safing materials in accordance with manufacturer's recommendations to provide F and T ratings as required by authorities having jurisdiction.
 - 2. Install firestop materials in accordance with UL Fire Resistance Directory.
 - 3. Install firestop and fire safing materials with sufficient pressure to properly fill and seal openings, then tool or trowel exposed surfaces.
- B. Firestopping Materials:
 - 1. Install primer and firestopping material in sufficient thickness, with required accessories to achieve rating, to uniform density and texture, in accordance with manufacturer's instructions and authorities having jurisdiction.
 - 2. Install material at walls or partition openings which contain penetrating sleeves, piping, ductwork, conduit and other items requiring firestopping.
 - 3. Consult with mechanical engineer, and damper manufacturer prior to installation of UL firestop systems that might hamper the performance of fire dampers as it pertains to duct work.
 - 4. Remove dam material after firestopping material has cured or allow dam material to remain if required to maintain fire rating integrity or required by authorities having jurisdiction.
 - 5. Do not conceal or enclose any firestopping materials until they have been examined and approved for use by the Architect and authorities having jurisdiction.
- C. Fire-Safing Materials:
 - 1. Install fire-safing in sufficient thickness, with retainer materials where shown or required to achieve fire rating in accordance with manufacturer's instructions and authorities having jurisdiction.

2. Do not conceal or enclose any fire safing materials until they have been examined and approved for use by the Architect and authorities having jurisdiction.
- D. Fire Protection Board Materials:
1. Install fire protection board in proper type, size, and density, with adhesives, fasteners, and jacketing materials where shown or required to achieve fire rating in accordance with manufacturer's instructions and authorities having jurisdiction.
 2. Do not conceal or enclose any fire protection board materials until they have been examined and approved for use by the Architect and authorities having jurisdiction.

3.5 PROTECTION OF FINISHED WORK

- A. Protect adjacent surfaces from damage by material installation.

3.6 CLEANING

- A. Remove equipment, materials and debris, leaving area in undamaged, clean condition.
- B. Clean all surfaces adjacent to sealed holes and joints to be free of excess firestop materials and soiling as work progresses.

3.7 FIELD QUALITY CONTROL

- A. Examine sealed penetration areas to ensure proper installation before concealing or enclosing areas.
- B. Keep areas of work accessible until inspection by applicable code authorities.
- C. Inspection of through-penetration firestopping shall be performed in accordance with ASTM E 2174, "Standard Practice for On-Site Inspection of Installed Fire Stops".
- D. Perform under this section patching and repairing of firestopping caused by cutting or penetrating of existing firestop systems already installed by other trades.

END OF SECTION

SECTION 08 80 00

GLAZING

CONDITIONS OF THE CONTRACT AND DIVISION 01, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Float Glass
 - 2. Tempered Glass
 - 3. Insulated Glass
 - 4. Glazing Sealants
 - 5. Accessories necessary for a complete installation
- B. Related Requirements:
 - 1. Section 07 92 00 "Joint Sealants"

1.2 DEFINITIONS

- A. ASTM C 1036 includes traditional thickness designations in IP units, but the actual thickness is based on the equivalent IP designation in millimeters.
- B. Glass Thickness: Indicated by thickness designations in millimeters according to ASTM C 1036.
- C. Interspace: Space between lites of an insulating glass unit.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design glass panels including comprehensive engineering analysis by a qualified professional engineer lawfully licensed in the State of Texas, using performance requirements and design criteria indicated.
- B. Installed Glazing: Design glazing systems to withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- C. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined according to the IBC and ASTM E 1300.
- D. Design Wind Pressures: Indicated on Drawings.
- E. Deflection requirements are examples and apply only to glass supported on all four edges. The IBC does not address deflection limits for glass. ASTM E 1300 requires the deflection not result in loss of edge support. Revise to suit.
- F. Maximum Lateral Deflection: For glass supported on all four edges, limit center of glass deflection at design wind pressure to not more than 1/50 times the short side length or 1 inch (25 mm), whichever is less.
- G. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.
- H. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

- I. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
 1. For monolithic glass lites, properties are based on units with lites 6 mm thick.
 2. For insulating glass units, properties are based on units of thickness indicated for overall unit and for each lite.
 3. U-Factors: Center of glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F (W/sq. m x K).
 4. Solar Heat Gain Coefficient and Visible Transmittance: Center of glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
 5. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

1.4 SUBMITTALS

- A. Product Data: Technical data for each type of product including recommended installation and cleaning procedures.
- B. Glass Samples: Submit samples, 12 inches (300 mm) square for each of the following types:
 1. Tinted Glass
 2. Insulating Glazing Units
- C. Glazing Schedule: List glass types and thickness for each size opening and location. Use same designations indicated on Drawings.
- D. Delegated Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- E. Product Certificates: Submit glass product certificates required by Code.
- F. Glass Manufacturer Certificate: The glass manufacturer shall submit a letter certifying it has reviewed the glazing details proposed for the project, including the use of gaskets and sealants, and that each product furnished is recommended for the application shown and compliance with the Code.
- G. Thermal Stress and Wind Load Analyses: Submit the following from the glass manufacturer:
 - H. Thermal stress analysis for each exterior glass unit type, each building elevation. The analysis shall clearly indicate the expected service temperature ranges and the effects of partial and full shading on the glass.
 - I. Attach to the thermal stress analysis a statement from the glass manufacturer that based upon this analysis that the resulting thermal stresses will not reduce the specified statistical probability of breakage.
 - J. Wind load analysis for each glass unit type, each building elevation. The analysis shall indicate the statistical probability of breakage at the design wind pressure does not exceed the specified statistical probability of breakage.
- K. Product Test Reports: Submit test reports for insulating glass and glazing sealants, for tests performed by a qualified testing agency.
- L. Glazing Sealants: Provide test reports based on testing current sealant formulations within previous 36 month period.
- M. Glazing Sealants: Preconstruction adhesion and compatibility test report.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements:
- B. Building Code: Comply with applicable requirements of the IBC for glazing.
- C. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- D. As a minimum provide Category II materials complying with testing requirements in 16 CFR 1201 (Consumer Product Safety Commission Safety Standard for Architectural Glazing Materials, published in the Code of Federal Regulations) and ANSI Z97.1.
- E. Permanently mark safety glass with certification label of Safety Glazing Certification Council.
- F. Insulating Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.
- G. Glazing Publications: Comply with published recommendations of glass product organizations.
 - 1. GANA: Glazing Manual.
 - 2. IGMA: SIGMA TM-3000 Vertical Glazing Guidelines.
 - 3. GANA: Laminated Glazing Reference Manual.
 - 4. AAMA: AAMA GDSG-1 Glass Design for Sloped Glazing.
 - 5. AAMA: TIR A7 Sloped Glazing Guidelines.
 - 6. IGMA for Sloped Glazing: IGMA TB-3001 Guidelines for Sloped Glazing.
 - 7. IGMA for Insulating Glass: SIGMA TM-3000 North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use.
- H. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than the thickness indicated.
 - 1. Minimum Glass Thickness for Exterior Lites: 6 mm.
 - 2. Thickness of Tinted Glass: Provide same thickness for each tint color indicated.
- I. Strength: Where annealed float glass is indicated, provide annealed float glass, heat strengthened float glass, or fully tempered float glass necessary to comply with performance requirements.
- J. Where heat strengthened float glass is indicated, provide heat strengthened float glass or fully tempered float glass necessary to comply with performance requirements.
- K. Where fully tempered float glass is indicated, provide fully tempered float glass.
- L. Manufacturer Qualifications for Insulating Glass Units with Sputter Coated, Low E Coatings: Insulating glass manufacturer who is approved and certified by coated glass manufacturer.
- M. Installer Qualifications, Glazer: Experience entity having minimum 5 years documented experience and who employs glass installers certified under the National Glass Association's Certified Glass Installer Program.
- N. Installer Qualifications, Decorative Film: Experience entity having minimum 5 years documented experience in the installation of glass films.
- O. Source Limitations for Glass and Glass Accessories: Obtain each type of glass and glass accessories from a single source.

- P. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.
- Q. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.
- R. Subject to compliance with requirements, approved mockups may become part of the completed work if undisturbed at time of Substantial Completion.
- S. Preconstruction Adhesion and Compatibility Testing: Test each glass product, tape sealant, gasket, glazing accessory, and glass framing member for adhesion to and compatibility with elastomeric glazing sealants.
- T. Testing is not required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.
- U. Use ASTM C 1087 to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.
- V. Test no fewer than eight Samples of each type of material, including joint substrates, shims, sealant backings, secondary seals, and miscellaneous materials.
- W. Schedule enough time for testing and analyzing results to prevent delaying the Work.
- X. For materials failing tests, submit sealant manufacturer's written instructions for corrective measures including the use of specially formulated primers.
- Y. Pre-installation Conference: Conduct conference at site

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
- B. Comply with insulating glass manufacturer's written instructions for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
- B. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below 40 degrees F (4.4 degrees C).
- C. Field Measurements: Verify actual dimensions of openings and construction contiguous with decorative glass by field measurements before fabrication.

1.8 COORDINATION

- A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.9 WARRANTY

- A. Glass manufacturers write warranties to commence the day of manufacturer rather than date of substantial completion. In this case, contractor must pick up the additional warranty time. Owner could lose substantial warranty time between date of manufacture and date of substantial completion.

- B. Coated Glass Products: Written warranty signed by manufacturer in which glass manufacturer agrees to replace coated glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.
- C. Warranty Period: 10 years from date of Substantial Completion.
- D. Laminated Glass: Written warranty signed by manufacturer in which manufacturer agrees to replace laminated glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.
- E. Warranty Period: Ten years from date of Substantial Completion.
- F. Insulating Glass: Written warranty signed by manufacturer in which manufacturer agrees to replace insulating glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.
- G. Warranty Period: 10 years from date of Substantial Completion.
- H. Glass Film: Written warranty signed by glass film manufacturer and installer in which manufacturer and installer agree to replace glass film that crack, peel, delaminate, discolor, change appearance, or failure to meet solar criteria within specified warranty period.
- I. Warranty Period: 5 years from date of Substantial Completion.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Manufacturers: Specifications are based on the products identified as Basis of Design. Listed manufacturers who produce products equivalent to those specified are acceptable for use on the Project. Other manufacturers must have a minimum of five (5) years experience manufacturing equivalent to those specified and comply with Division 01 requirements regarding substitutions to be considered.
 - 1. Float and Tempered Glazing:
 - a. AGC Glass North America, Alpharetta, GA; (800) 251-0441
 - b. Cardinal Glass Industries, Edan Prarie, MN; (952) 229-2600
 - c. Guardian Industries Corp., Corsicana, TX; (800) 527-2511
 - d. Oldcastle BuildingEnvelope, Houston, TX; (866) 653-2278
 - e. Pilkington North America, Austin, TX; (512) 832-7867
 - f. PPG Industries, Inc., Pittsburgh, PA; (412) 434-2858
 - g. Vetrotech Saint-Gobain, Auburn, WA (888) 803-9533
 - 2. Glass Insulation:
 - a. Technoform Glass Insulation North America, Inc., Twinsburg, OH; (330) 487-6600

2.2 PERFORMANCE SPECIFICATIONS

- A. Requirements apply simultaneously through the most adverse conditions of each exterior application.
1. Windloads: Design system to comply with structural requirements defined in Paragraph 1.3 "Structural Performance Requirements".
 2. Thermal Movement: Provide for noiseless expansion and contraction of all materials and assemblies due to temperature changes in a range between 10 degrees F and 180 degrees F without detriment to appearance or performance.
 3. Water Infiltration: Drain water entering at joints and condensation occurring within the wall construction to the exterior face of the wall. Allow no uncontrolled water other than condensation on the interior face of the wall.
 4. Air Infiltration: Limit air leakage to maximum 0.04 cfm per square foot of wall projected area.
- B. Aluminum Window Requirements Conformance to specifications in AAMA/NWWDA 101/I.S.2 when tests are performed on the prescribed 8'0" x 5'0" minimum test size with the following test results:
1. Air Infiltration: maximum 0.04 cfm/square foot when tested per ASTM E 283 at a static air pressure difference of 1.57 psf.
 2. Water Penetration: no uncontrolled water leakage when tested per ASTM E 547 and ASTM E 331 at a static air pressure difference of 10 psf
 3. Uniform Structural: window to be operable, and maximum .4% permanent deformation per member when tested per ASTM E 330 at a static air pressure difference of 67.5 psf.

2.3 MATERIALS

- A. Glazing Materials at Hollow Metal Frames:
1. General: Use glazing compounds and preformed glazing sealants approved for the application and, except as otherwise specified, conforming to Glazing Materials portion of FGMA Glazing Manual.
 2. Sealant:
 - a. One (1) part acrylic polymer sealant conforming to FS TT-S-00230 or silicone, FS TT-S-0023-C. Use for glazing of all fixed glass. Include primer as recommended by manufacturer.
 - b. Color: To match frame.
 - c. All sealants shall be compatible with adjacent material per manufacturer's instruction.
 3. Setting Blocks: Hard rubber or clean grain softwood.
 4. Back-up material: Foamed polyethylene or polystyrene rodstock, sizes as required by joint condition, and compatible with sealant.
 5. Glazing Tape: DAP #1202 or as approved.
 6. Glazing Gaskets: Extruded neoprene, free of porosity, surface defects, dimensional irregularities and conforming to physical properties of ASTM C509.
 7. Use of metal sash putty will not be permitted, but compound conforming to FS T-G-410 will be permitted. The use of non-skinning compounds, non-resilient type preformed sealers, and preformed impregnated type gasket will not be permitted.

- B. Glazing Materials at Aluminum Framing:
1. Glazing Gaskets: Extruded neoprene (Color: Black) sized to fit the frame.
 2. Sealant: Comply with Federal Spec. TT-S-00230
- C. Glass:
1. General:
 - a. Glass shall meet the requirements of ASTM C1036.
 - b. Float Glass: Care shall be taken to minimize the tong marks and, unless indicated otherwise on the drawings, the tong marks shall occur at the bottom of the glass (after installation).
 - c. All glass shall be heat strengthened unless noted otherwise.
 - d. Color of tinted glass shall be as selected by Architect.
 - e. Safety Glazing: Subject to compliance with requirements, obtain safety glazing products permanently marked on each individual glass lite with certification label of manufacturer acceptable to authorities having jurisdiction. Safety glazing shall conform to ANSI Z97.1, Safety Performance Specification, and ANSI Z97.1, Safety Glass Code., and IBC 2406.1 as applicable.

Coating is available only on clear float glass and is applied pyrolytically on the float line. Consequently, if a reflective or low E coating is required (on second surface, which was exposed to the molten tin bath on the float line), it is considered a sputtered coating.
 - f. Pyrolytic Coated, Low Maintenance Glass: Clear float glass with a coating on first surface having both photocatalytic and hydrophilic properties that act to loosen dirt and to cause water to sheet evenly over the glass instead of beading.
 - g. Reflective Coated Vision Glass: ASTM C 1376.
- D. Glazing Types:
1. Thermally-Insulating Glazing Units:
 - a. Performance Requirements:
 - 1) Insulating Glass Units: Factory assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190.
 - 2) Sealing System: Dual seal, with polyisobutylene and silicone primary and secondary sealants
 - 3) Spacer: Match existing
 - 4) Desiccant: Molecular sieve or silica gel, or a blend of both
 - b. Material Properties:
 - 1) Overall Unit Thickness: 1 inch, Unless Noted Otherwise
 - 2) Minimum Thickness of Each Glass Lite: 1/4 inch, Unless Noted Otherwise
 - 3) Outdoor Lite: Fully-Tempered Float Glass
 - 4) Interspace Content: Air
 - 5) Indoor Lite: Fully-Tempered Float Glass
 - 6) Safety glazing as required

- c. Type(s):
- 1) Type GI1 (08 80 00.GI1): 1 inch thick insulating glazing unit comprised of a 1/4 inch thick glazing quality Low-e, tinted, tempered, float glass exterior lite with a 1/4 inch thick glazing quality clear tempered float glass interior lite, separated by a 1/2 inch air space and having the following properties:
 - a) Basis of Design: "SunGuard SNX 51/23" as manufactured by Guardian Advanced Architectural Glass.
 - i. Color: Match existing
 - ii. Visible Transmittance (%): 51
 - iii. Winter Night-time U-value: 0.29 (air)
 - iv. Shading Coefficient: 0.27
 - v. Solar Heat Gain Coefficient: 0.23
 - vi. Light to Solar Gain Ratio (LSG): 2.18
2. Float Glass:
- a. Performance Requirements:

Clear float glass is the basis of glass products. Always retain.

 - 1) Clear Annealed Float Glass: ASTM C 1036, Type I, Class 1 (clear), Quality-Q3.

Retain option if required for passive solar design.
 - 2) Ultraclear Float Glass: ASTM C 1036, Type I, Class I (clear), Quality-Q3; and with visible light transmission of not less than 91 percent [and solar heat gain coefficient of not less than 0.87].
 - 3) Tinted Annealed Float Glass: ASTM C 1036, Type I, Class 2 (tinted), Quality-Q3.
 - b. Type(s):
 - 1) Type GG1 (08 80 00.GG1): 1/4 inch thick glazing quality, float glass to match existing
3. Heat Strengthened Float Glass:
- a. Performance Requirements:
 - 1) Heat Strengthened Float Glass: ASTM C 1048, Kind HS (heat strengthened), Type I, Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
 - 2) Fabrication Process: By horizontal (roller hearth) process with roll wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
4. Fully-Tempered Float Glass:
- a. Performance Requirements:
 - 1) Fully-Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

2) Fabrication Process: By horizontal (roller hearth) process with roll wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

b. Type(s):

1) Type GT1 (08 80 00.GT1): 1/4 inch thick glazing quality, tempered float glass to match existing.

E. Glazing Accessories

1. Compatibility: Provide glazing sealants compatible with one another and with other materials in contact, including glass products, seals of insulating glass units, and glazing channel substrates, under conditions of service and application, demonstrated by sealant manufacturer based on testing and field experience.
2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
3. Colors of Exposed Glazing Sealants: Selected by Architect.
[Silicone Sealants: Superior weathering characteristics, longest life expectancy; greatest cyclic movement capability; slow curing.](#)
[High and Medium Modulus: Strong adhesive and tensile properties \(structural glazing\)](#)
[Low and Medium Modulus: Used where sealing is primary concern such as cap beads.](#)
4. Glazing Sealant: Neutral curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - b. Dow Corning Corporation.
 - c. GE Construction Sealants; Momentive Performance Materials Inc.
 - d. May National Associates, Inc.; a subsidiary of Sika Corporation.
 - e. Pecora Corporation.
 - f. Sika Corporation.
 - g. Applications:
5. Glazing Sealant: Neutral curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 50, Use NT.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - b. BASF Corporation; Construction Systems
 - c. Dow Corning Corporation
 - d. GE Construction Sealants; Momentive Performance Materials Inc.
 - e. May National Associates, Inc.; a subsidiary of Sika Corporation
 - f. Pecora Corporation
 - g. Polymeric Systems, Inc.
 - h. Sika Corporation

- i. Applications:
6. Glazing Sealant: Neutral curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use NT.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - b. Bostik, Inc.
 - c. Dow Corning Corporation
 - d. GE Construction Sealants; Momentive Performance Materials Inc.
 - e. May National Associates, Inc.; a subsidiary of Sika Corporation
 - f. Polymeric Systems, Inc.
 - g. Schnee-Morehead, Inc., an ITW company
 - h. Sika Corporation
 - i. Applications:
7. Glazing Sealant: Acid curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use NT.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - b. BASF Corporation; Construction Systems
 - c. Bostik, Inc.
 - d. Dow Corning Corporation
 - e. GE Construction Sealants; Momentive Performance Materials Inc.
 - f. May National Associates, Inc.; a subsidiary of Sika Corporation
 - g. Pecora Corporation
 - h. Polymeric Systems, Inc.
 - i. Schnee-Morehead, Inc., an ITW company
 - j. Sika Corporation
 - k. Applications:
8. Glazing Sealants for Fire rated Glazing Products: Neutral curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 50, Use NT. Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - b. Dow Corning Corporation
 - c. GE Construction Sealants; Momentive Performance Materials Inc.
 - d. Colors of Exposed Glazing Sealants: Selected by Architect.
9. Back Bedding Mastic Glazing Tapes: Preformed, butyl based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:

Retain one or more tapes. AAMA 804.3 tape is for less severe back bedding and

drop in, residential and light commercial glazing applications. AAMA 806.3 tape is for high performance commercial glazing applications involving continuous pressure from gaskets or pressure generating stop designs. AAMA 807.3 tape is for commercial glazing applications not involving continuous pressure from gaskets and stop designs.

- a. AAMA 804.3 tape, where indicated.
 - b. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
 - c. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.
 - d. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:
 - e. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
 - f. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.
10. Miscellaneous Glazing Accessories: Provide products of material, size, and shape complying with referenced glazing standard, with requirements of manufacturers of glass and other glazing materials for application indicated, and with proven record of compatibility with surfaces contacted in installation.
 11. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
 12. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
 13. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
 14. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
[Retain if applicable for glazing channels.](#)
 15. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.
 16. Perimeter Insulation for Fire Resistive Glazing: Product approved by testing agency listed and labeled fire resistant glazing product with which it is used for application and fire protection rating indicated.

2.4 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
- B. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
- C. Temperature Change: 120 degrees F (67 degrees C), ambient; 180 degrees F (100 degrees C), material surfaces.
- D. Edge and Surface Conditions: Comply with the recommendations of AAMA Structural Properties of Glass for clean cut edges, except comply with manufacturer's

recommendations.

- E. Exposed Glass Edges and Surface Condition: Finish edges flat with an arrissed edge profile (small bevel of uniform width not exceeding 1.5 mm at an angle of approximately 45 degrees to the surface of the glass) with polished (surface is reflective in appearance similar to the major surface of the glass) surface.
- F. Cutting: Wheel cut or sawed edges and seamed at manufacturer's option. For site cut glass, provide glass 2 inches (50.8 mm) larger than required in both dimensions to facilitate cutting of clean cut edges without the necessity of seaming or nipping. Do not cut, seam, nip or abrade heat treated glass.
- G. Edges: Grind smooth and polish exposed glass edges and corners.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
 - 1. Manufacturing and installation tolerances, including size, squareness, and offsets at corners.
 - 2. Presence and functioning of weep systems.
 - 3. Minimum required face and edge clearances.
 - 4. Effective sealing between joints of glass-framing members.
- B. Proceed with installation after correcting unsatisfactory conditions.

3.2 PREPARATION

- A. Clean glazing channels and framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
- B. Comply with manufacturer instructions for wiping of surfaces immediately before application of primers.
- C. Wipe metal surfaces with IPA (isopropyl alcohol) unless otherwise required by compatibility and adhesion testing results.
- D. Inspect each piece of glass immediately before installation. Do not install pieces improperly sized or with damaged edges, scratches, abrasion, or evidence damage. Remove labels from glass immediately after installation.
- E. Examine glazing units to locate exterior and interior surfaces. Label or mark units so exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.
- F. Seal vent (breather or capillary) tubes in insulating glass units in accordance with insulating glass manufacturer written recommendations.
- G. Glass Film Preparation:
 - 1. Remove particulate matter on the glass surface using a scraping blade.
 - 2. Place an absorbent towel on window sill or sash to absorb moisture generated by the film application.

3.3 GLAZING

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes

- glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.
- C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
 - D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
 - E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
 - F. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).
 - 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
 - 2. Provide 1/8 inch (3 mm) minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
 - G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
 - H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
 - I. Set glass lites with proper orientation so that coatings face exterior or interior as specified.
 - J. Retain below if glazing with wedge shaped gaskets is required.
 - K. Where wedge shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
 - 1. Square cut wedge shaped gaskets at corners and install gaskets as recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.
 - L. Tape Glazing:
 - 1. Position tapes on fixed stops so that, when compressed by glass, the exposed edges are flush with or protrude slightly above sightline of stops.
 - 2. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make tapes fit opening.
 - 3. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.
 - 4. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
 - 5. Do not remove release paper from tape until right before each glazing unit is installed.
 - 6. Apply heel bead of elastomeric sealant.

7. Center glass lites in openings on setting blocks, and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
 8. Apply cap bead of elastomeric sealant over exposed edge of tape.
- M. Gasket Glazing (Dry):
1. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
 2. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
 3. Installation with Drive in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
 4. Installation with Pressure Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
 5. Install gaskets to protrude past face of glazing stops.
- N. Sealant Glazing (Wet):
1. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
 2. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
 3. Tool exposed surfaces of sealants to provide a substantial wash away from glass.
- O. Structurally Glazed Units:
1. Set full height continuous structural gaskets/spacers to vertical mullions. Set glass units with void between edge of units and head/sill channel, but with units fully within head/sill rebate so as to provide a proper bite.
 2. Align glass unit edges over vertical mullion continuous structural gasket/spacers and secure with manufacturers recommended temporary cleats.
 3. Structurally seal glass unit to vertical mullions with specified one part structural silicone sealant. Tool structural silicone flush in alignment to mullion face and perpendicular to face of interior glass light; remove excess structural silicone from glass and metal substrates.
 4. After full cure of structural silicone sealant remove temporary cleats. Immediately seal holes left in the vertical mullions caused by temporary cleats.

5. Insert and shape weatherseal joint backer rods, or gaskets, into vertical void between glass units and at a proper depth to receive silicone weatherseal sealant.
 6. Place silicone weatherseal sealant into void and tool flush with adjacent exterior glass light faces; remove excess sealant from glass and metal substrates.
- P. Glass Film Overlay:
1. Apply squarely aligned to glass edges, uniformly smooth, and free from tears, air bubbles, wrinkles, and rough edges, [in single sheet completely overlaying] [in pattern indicated on Drawings to] [with graphic image as indicated on Drawings to] the interior face of clean glass, according to manufacturer's written instructions, using the squeegee technique to remove moisture.
 2. Cut film edges neatly and square at a uniform distance of 1/16 inch (1.5 mm) to 1/32 inch (0.75 mm) of the window sealing device. Avoid scoring glass when cutting film.
 3. Clean film and leave free of soap residue and squeegee marks.
- Q. Erection Tolerances:
1. Maximum Deviation from Vertical: 1/8 inch in any story and 1/4 inch in any 45 foot run
 2. Maximum Deviation from Horizontal: 1/8 inch in any 30 foot run
 3. Maximum Deviation from True Alignment: 1/32 inch for any two (2) abutting units. Allow no edge projections
 4. Maximum Joint Gap: 1/32 inch

3.4 CLEANING AND PROTECTION

- A. Immediately after installation remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.
 1. If contaminating substances come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.
- C. Remove and replace glass that is damaged during construction period.
- D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION

SECTION 09 21 16
GYPSUM BOARD ASSEMBLIES

CONDITIONS OF THE CONTRACT AND DIVISION 01, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Metal wall and ceiling framing for gypsum board construction.
 - 2. Gypsum Board
 - 3. Taped, filled and sanded joint treatment
- B. Related Requirements:
 - 1. Section 05 77 00 "Decorative Extruded Metal"
 - 2. Section 07 84 00 "Firestopping"
 - 3. Section 07 92 00 "Joint Sealants"
 - 4. Section 09 90 00 "Painting and Coating"

1.2 SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
 - 2. Manufacturer's installation instructions.
- B. Shop Drawings
 - 1. Coordinate with Architect to provide shop drawings, prepared by metal framing manufacturer, for areas requiring structural support, to include, but not limited to, load-bearing mezzanines and openings spanning more than 6'-0". Indicate size, material, and finish. Show locations and installation procedures along with load criteria (refer to Structural Drawings). Include details of joints, attachments, and clearances.
- C. Supplementary Design Details
 - 1. The general design is presumed adequate to permit compliance with the specified performance. Provide engineering calculations to supplement the general design. Calculations shall bear the seal of a Registered Professional Engineer, licensed in the State of Texas.
- D. Certification: Manufacturer's affidavit that materials used contains no asbestos.

1.3 PRE-INSTALLATION CONFERENCE

- A. Refer to Section 01 31 13 "Project Coordination"

1.4 REFERENCES

- A. ASTM International (ASTM)
 - 1. C1396/C1396M, Standard Specification for Gypsum Board
 - 2. C645-08, Standard Specification for Nonstructural Steel Framing Members
 - 3. C754-07, Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products
 - 4. C840, Standard Specification for Application and Finishing of Gypsum Board

5. C954, Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. to 0.112 in. in Thickness
 6. 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
 7. C1047, Standard Specification for Accessories for Gypsum Board and Gypsum Veneer Base
 8. C1177, Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing
 9. C1280, Standard Specification for Application of Gypsum Sheathing
 10. D3273, Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber
- B. Gypsum Association (GA)
1. 216, "Recommended Specification for the Application and Finishing of Gypsum board"
- C. Federal Specifications (FS)
1. SS-L-30
- D. Underwriter's Laboratory (UL)
1. Fire Resistance Directory
- E. US Gypsum (USG)
1. US Gypsum Standards for control joints

1.5 WARRANTY

- A. Warrant the work specified for one (1) year against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials or workmanship.
- B. In addition, provide warranty from the manufacturer for the following products:
1. Exterior sheathing weathering warranty covering in-place exposure damage to exterior sheathing for twelve (12) months.
 2. Exterior sheathing warranty against manufacturing defects for five (5) years.
 3. Abuse Resistant Panel weathering warranty covering in-place exposure damage to sheathing for six (6) months.
 4. Abuse Resistant Panel warranty against manufacturing defects for three (3) years.
 5. Glass-mat sheathing weathering warranty covering in-place exposure damage to sheathing for three (3) months.
 6. Glass-mat sheathing warranty against manufacturing defects for three (3) years.
 7. Tile backer board warranty against manufacturing defects for 20 years.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturers listed whose products meet or exceed the specifications are approved for use on the Project. Where products are named in the specifications, they are considered basis of specification. Other manufacturers must have a minimum of five (5) years experience manufacturing products meeting or exceeding the specifications and comply

with Division 01 requirements regarding substitutions to be considered. All gypsum Board must be U.S. produced.

1. Gypsum Board and related products and materials:
 - a. CertainTeed
 - b. G-P Gypsum Corporation (Georgia Pacific)
 - c. James Hardie Building Products, Inc.
 - d. National Gypsum Company (Gold Bond)
 - e. United States Gypsum Company (USG)
 - f. ClarkDietrich Metal Framing
2. Aluminum Moldings:
 - a. Refer to Section 05 77 00 "Decorative Extruded Metal"
3. Deflection Track and related products and materials:
 - a. Fire Trak Corp.
 - b. The STEEL Network, Inc.
 - c. ClarkDietrich Metal Framing
4. Extruded Mullion Closures:
 - a. Gordon Interiors, Interior Specialties Division

2.2 MATERIALS

- A. Asbestos: Under no circumstances are asbestos containing materials to be used.
- B. Light-Gauge Metal Framing System:
 1. Studs (09 21 16.FS#):
 - a. Meeting requirements of ASTM C645-08; C-channel, roll-formed from hot-dipped galvanized steel; complying with ASTM A1003 and ASTM A653 G40 or equivalent corrosion resistant coating. Channel type screw studs roll formed from 25 gauge galvanized steel, unless otherwise shown on drawings. Provide channel type screw studs roll formed from 20 gauge (1/360) galvanized steel at walls to receive tile.
 - b. Widths shall be as indicated on drawings.
 - c. Section modules for studs shall be $S = 0.135$ for 3-5/8 inch studs, and $S = 0.082$ for 2-1/2 inch studs.
 2. Shaft Wall Studs (09 21 16.FSW):
 - a. Meeting requirements of ASTM C 645-08; CT-stud, roll-formed from hot-dipped galvanized steel; complying with ASTM A1003 and ASTM A653 G40 or equivalent corrosion resistant coating. System shall be Shaftwall System as manufactured by ClarkDietrich West Chester, OH; (800) 543-7140, or Architect approved equal.Tracks:
 3. Tracks:
 - a. Cold-Formed Tracks (09 21 16.FT#)
 - 1) Meeting requirements of ASTM C645-08; C-channel, roll-formed from hot-dipped galvanized steel; complying with ASTM A1003 and ASTM A653 G40 or equivalent corrosion resistant coating
 - 2) Widths shall be as indicated on drawings.
 - b. Deflection Track at Non-Rated Partitions (09 21 16.FTD): Use deflection

- track at walls extending to structure to allow for movement. Deflection track shall allow for 3/4 inch movement in either direction. Do not fasten studs directly to Deflection Track.
- c. Channel Bridging and Bracing: U-Channel Assembly; Base metal thickness of 0.0538 inch (1.37mm) and minimum ½ inch wide flanges.
 - d. Flat Strap and Backing Plate: Sheet for blocking and bracing in length and width indicated:
 - 1) Subject to compliance with requirements, provide ClarkDietrich Metal Framing: Danback™ Fire Treated Wood Backing Plate
 - 2) Galvanized Sheet Steel.
- 4. Channels: 16 gauge cold formed steel channels with hot dip galvanized finish. Sizes as indicated on drawings. Use for suspended ceilings and elsewhere as indicated.
 - 5. Furring Channels:
 - a. 09 21 16.FC1: Standard 2-3/4 inches wide, 7/8 inch deep galvanized sheet metal furring channel.
 - b. 09 21 16.FC2: Standard 2-3/4 inches wide, 1-1/2 inch deep galvanized sheet metal furring channel.
 - 6. Comply with applicable reference standards.
 - 7. Refer to Section 05 40 00 "Cold-Formed Metal Framing" for structural light-gauge steel framing for 18 gauge and heavier runners and other framing as shown or required.
- C. Wall and Ceiling Materials:
- 1. Gypsum Board (09 21 16.GBD) 5/8 inch thick, tapered-edged, conforming to ASTM C1396, Type X. Sizes shall be 4 feet-0 inches wide by longest practical length to minimize joints.
- D. Accessories and Related Materials
- 1. Corner Bead (09 21 16.CBD): No. 28 gauge galvanized steel, 1-1/4 inch legs. Use at all exterior corners.
 - 2. Joint Compound: Standard types manufactured by gypsum Board manufacturer for intended use. Fire rated type must be used on fireproof systems. Perlite and other additives not permitted.
 - 3. Laminating Adhesives: Standard type manufactured or recommended by manufacturer of product to be laminated.
 - 4. Acoustic Sealant (09 21 16.AS): Single component, non-skinning, non-hardening synthetic rubber for use in the acoustical sealing of gypsum board partitions. STC rating as required by drawings in accordance with manufacturers instructions to achieve rating. Acceptable Products and Manufacturers: Tremco Acoustical Sealant manufactured by Tremco Sealant/Weatherproofing Division, Beachwood, OH; (800) 321-7906, or Architect approved equal.
 - 5. Ceiling Hanger and Tie Wire: 9-gauge galvanized hanger wire and 16 gauge tie wire.
 - 6. Screws: One (1) inch and 1-5/8 inch long self drilling, self tapping cadmium plated bugle head type. Comply with applicable reference standards.
 - 7. Control Joint (09 21 16.CJ): Metal (USG #093 / Dietrich 093 Control Joint) type with 1/4 inch open joint, perforated flanges for floating in place.

8. Wall Fixture Reinforcement (09 21 16.WFR): 6 inches, 14 gauge cold formed steel galvanized channels.
9. Glass-Fiber Mesh Tape: minimum 2 inch wide self-adhering glass-fiber type, 10X10 threads per inch.
10. Silicone Joint Sealant: ASTM C920, Type S, grade NS, compatible with exterior sheathing tape and sheathing, instructed by tape and sheathing manufacturers for use with glass-fiber mesh sheathing tape and for covering exposed fasteners.
11. Wood Blocking (09 21 16.WDB): 2x10 at all locations to have a wall-mounted door stop
12. Decorative Trim and Reveals: Refer to Section 05 77 00 "Decorative Extruded Metal"

PART 3 - EXECUTION

3.1 INTERIOR METAL FRAMING INSTALLATION

- A. Steel Framing Installation Standard: Comply with ASTM C754.
- B. Floor Track: Attach to floor at 24 inches maximum centers with shoot-in pins or concrete nails.
- C. Ceiling Track: Fasten at 24 inch intervals, staggered. Where shown or required to extend above ceiling, brace to the structure at intervals not exceeding 4 feet-0 inches.
- D. Deflection Track (DT): Deflection track shall allow for 3/4 inch movement in either direction. Do not fasten studs directly to Deflection Track. At fire rated walls, Contractor's shall use the specified deflection track with firestop systems.
- E. Drywall Suspension System: Use at gypsum drywall suspended ceilings, where shown or required.
- F. Metal Studs:
 1. Single lengths positioned vertically straight and plumb in the runners, spaced 16 inches on center, unless shown otherwise on drawings.
 2. Anchor all studs located adjacent to door and window frames, partitions intersections and corners to runner flanges by positive screw engagement through each stud flange and runner flange.
 3. Position all studs vertically with the open side facing in the same direction, engaging the floor and ceiling runners.
 4. Use positive screw attachments with 3/8 inch or 1/2 inch Type "S" or "S-12" pan head screws through each stud flange and runner flange.
- G. Wall Fixture Reinforcement: Provide solid bridging spanning between wall studs at all wall mounted fixtures, finish hardware, toilet partitions, accessories and equipment.

3.2 GYPSUM BOARD INSTALLATION

- A. Apply all ceiling boards first as described below. Cut boards so that they slip easily into place. Butt all joints loosely. Never force panels into position. Place tapered or wrapped edges next to one another.
- B. Select the maximum practical length to minimize end joints. All end joints shall be neatly fitted and staggered. Joints on opposite sides of partition shall be so arranged as to occur on different studs.
- C. Never place a butt end or a cut edge next to a tapered or rounded edge. Wherever possible, apply boards perpendicular to framing and in lengths that will span ceilings and walls without creating end (butt) joints. If butt joints do occur, stagger and locate them as far from the center of walls and ceilings as possible.

- D. Support all ends and edges of gypsum board on framing, except long edges at right angles to framing and where end joints are to be floated between frame members and back-blocked.
- E. When fastening, apply hand pressure on panel next to fastener being driven to insure panel is in tight contact with framing member.
- F. Install metal corner bead at external corners. Where length of the corner does not exceed standard stock lengths, use a single length.
- G. Install gypsum board 1/2 inch above surface of slab to prevent wicking of moisture.
- H. Install metal trim where indicated.
- I. To insure level surfaces at joints, arrange board application so that the leading edge of each board is attached to the open or unsupported edge of a steel stud flange. To do this, all studs must be placed so that their flanges point in the same direction. Board application is then planned to advance in the direction opposite to flange direction.
- J. The leading edge of gypsum board shall not be attached to the web edge of a flange.
- K. Fasten Board at 12 inches on center except at the edges/joints which shall be at 8 inches on center
- L. Edge-Grip Clips: Position clips on the back of the panels and drive prongs into panel edges. Space clips 16 inches on center Screw-attach clip to framing, furring or wall surface.
- M. Finishing:
 - 1. Apply at least two (2) coats of joint compound over beads, screw heads and trim, and each coat shall be feathered out onto panel faces.
 - 2. Float out and sand joints to make joints invisible when painted with non-texture paint.
 - 3. Provide Level Four finish, typical, or Level Five finish at walls to receive applied graphics.
 - 4. Texture: Refer to Section 09 90 00 "Painting and Coating"
- N. Caulk around pipes, ducts, structure or similar items which penetrate drywall systems.
- O. Provide acoustical sealant at walls in accordance with manufacturer's instructions.
- P. Control joints shall be located at each jamb of doors and windows and 30 feet-0 inches on center maximum and along building expansion joints, unless noted otherwise on drawings. Locations shall be reviewed with Architect prior to final placement.

3.3 WORKMANSHIP TOLERANCES

- A. Visual: Correct any nicks, bumps, out-of-level or out - of-plumb areas detectable to the naked eye.
- B. Walls: 3/8 inch maximum deviation from vertical.
- C. Bumps in Boards: Maximum 1/8 inch in 24 inches.
- D. Corners: Maximum out-of-square 1/8 inch in 16 inches.
- E. Float solid between corner beads less than 36 inches apart. Surfaces that appear concave are not acceptable.
- F. Provide "J" mold and continuous 1/4 inch reveal wherever gypsum board directly abutts other material or when end is exposed.
- G. Float Control Joints flush with wall surface so that ceiling wall mold specified separately will align with wall surface flat and straight.

3.4 COMMENCEMENT RESTRICTIONS

- A. Interior gypsum board and ceiling board installation may not commence until all exterior dampproofing and roofing are completed and roof top equipment is fully installed and flashed and exterior wall openings are protected.

END OF SECTION

SECTION 09 51 00
ACOUSTICAL CEILINGS

CONDITIONS OF THE CONTRACT AND DIVISION 01, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. Suspension system (Grid) and accessories required to complete work.
 - 2. Acoustical lay-in panels: standard, fire rated, and sag resistant.
 - 3. Vinyl faced, sag resistant, scrubbable lay-in panels.
 - 4. Hold down clips, spacing clips, moldings, and accessories required to complete work.
- B. Related Requirements
 - 1. Section 09 21 16 "Gypsum Board Assemblies": Wallboard used as fire protection over light fixtures.
 - 2. Division 23 - Mechanical: Air diffusers and mechanical items penetrating ceiling.
 - 3. Division 26 - Electrical: Lighting and electrical items penetrating ceiling.

1.2 SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
 - 2. Manufacturer's installation instructions.
- B. Samples:
 - 1. 6 inch by 12 inch sample of each ceiling panel.
 - 2. 12 inch long sample of each type grid and actual accessories.

1.3 PRE-INSTALLATION CONFERENCE

- A. Refer to Section 01 31 13 "Project Coordination".

1.4 REFERENCES

- A. ASTM International (ASTM)
 - 1. A641, Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
 - 2. B117, Standard Practice for Operating Salt Spray (Fog) Apparatus
 - 3. C423, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
 - 4. C635, Standard Specification for the Manufacture, Performance and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings
 - 5. C636, Standard Practice for Installation of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings
 - 6. D3273, Standard Test Method for Resistance to growth of Mold on the surface of Interior ceilings in an Environmental Chamber
 - 7. E84, Test Method for Surface Burning Characteristics of Building Materials
 - 8. E413, Classification for Rating Sound Insulation
 - 9. E1264, Standard Classification for Acoustical Ceiling Products

- 10. E1414, Standard Test Method for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum
- B. Federal Specification (FS)
 - 1. SS-S-118B, Sound Controlling (Acoustical) Tiles and Panels
- C. Underwriters Laboratories (UL)
 - 1. Assembly as specified or noted on drawings

1.5 COORDINATION

- A. Coordinate Work of this Section with work under Division 23, Mechanical for location of dampers in diffusers and other mechanical items penetrating ceiling and Division 26, Electrical for location of light fixtures and other electrical items penetrating ceiling.

1.6 WARRANTY

- A. Standard ceiling Panels: warrant ceiling panels to be free from sagging, warping, shrinking, buckling, or delaminating as a result of manufacturing defects for a period of one (1) year from the date of Substantial Completion.
- B. Sag Resistant ceiling Panels: warrant products to be free from sagging, warping, shrinking, buckling, or delaminating as a result of manufacturing defects for a period of ten (10) years from the date of Substantial Completion.
- C. Standard Suspension System: Suspension systems shall be warranted to be free from defects in material or factory workmanship and shall not incur 50 percent red rust as defined by ASTM B117 test procedures for a period of ten (10) years from the date of Substantial Completion.
- D. Suspension System / Ceiling Panels: Provide manufacturers standard 15 year warranty for suspension systems when used in combination with same manufacturers sag resistant ceiling panels. Ceiling panels to be free from sagging, warping, shrinking, buckling, or delaminating as a result of manufacturing defects. Suspension systems shall not incur 50 percent red rust as defined by ASTM B117 test during the period of the warranty.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Specifications are based on products of named manufacturers. Manufacturers listed whose product meets or exceeds the specifications may be used on the Project. Other manufacturers must have a minimum of five (5) years experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
 - 1. Suspension System (Grid):
 - a. Armstrong World Industries, Inc. (Basis of Specification)
 - b. Certainteed
 - c. Chicago Metallic
 - d. USG Interiors, Inc.(Donn)
 - 2. Acoustical Lay-in Panels:
 - a. Armstrong World Industries, Inc. (Basis of Specification)
 - b. Certainteed
 - c. USG Interiors, Inc.

2.2 MATERIALS

- A. Suspension System (Grid) (09 51 00.SS#):
 - 1. General Requirements:
 - a. Type: ASTM C635, intermediate duty; components die cut and interlocking.
 - b. Materials: Commercial quality cold rolled steel with galvanized coating.
 - c. Accessories:
 - 1) Perimeter moldings
 - 2) Hold down clips
 - 3) Hanger Wire: Galvanized carbon steel in accordance with ASTM A641, soft temper, pre-stretched, with a yield stress load of at least three (3) times the design load, but not less than 12 gauge in diameter.
 - 2. Standard, Non-Rated (09 51 00.SSN):
 - a. Shape: "T"
 - b. Module: As indicated on Drawings
 - c. Exposed Grid Surface Width: 15/16 inch.
 - d. Grid Finish: White
 - e. Basis of Design: "Prelude XL" as manufactured by Armstrong World Industries, Inc.
- B. Lay-in Panels (09 51 00.ACT-#):
 - 1. Type ACT-1: Standard 24" x 24" (09 51 00.ACT-1)
 - a. Material: Wet-formed mineral fiber.
 - b. Size: 24 inches by 24 inches by 5/8 inch thick.
 - c. Edge Detail: Square lay-in, trim edge
 - d. NRC: 0.55 - 0.65 in accordance with ASTM C423
 - e. CAC: 30 - 35 in accordance with ASTM E1414.
 - f. Surface Finish: Factory applied white latex typical.
 - g. Flame Spread: Class A
 - h. Fire Rating: Where indicated, provide UL Labeled for use in fire resistive assemblies in hourly rating required.
 - i. Pattern: Perforated medium texture, non-directional.
 - j. Accessories: Hold down clips as required for U.L. assembly.
 - k. Acceptable Product/Manufacturer: "Cortega Square Lay-In Panels" No. 770 or fire-rated No. 824 FireGuard as manufactured by Armstrong World Industries, Inc.; "Baroque Trim Edge" No. BET-157 or fire-rated No. PBY-157 with Protectone as manufactured by Certainteed; "Radar" no. 2210 or fire-rated no 2115 manufactured by USG; or Architect approved equal by listed manufacturer.
 - 2. Type ACT-2: Kitchens, Break Rooms, and Wet Areas
 - a. Material: Vinyl-faced, Wet-formed mineral fiber.
 - b. Size: 24 inches by 24 inches by 5/8 inch thick.

- c. Edge Detail: Square lay-in, trim edge.
 - d. NRC: 0.10 - 0.15 minimum in accordance with ASTM C423
 - e. CAC: 40 minimum in accordance with ASTM E1414.
 - f. Surface Finish: Scrubbable factory applied white vinyl plastic paint.
 - g. Fire Resistance: Class A, UL labeled for use in fire resistive assemblies, where scheduled on drawings. One (1) hour fire rated roof/ceiling assembly.
 - h. Pattern: Non-perforated for use in commercial food service areas.
 - i. Mold / Mildew inhibitor: Manufactures anti-microbial treatment in accordance with ASTM D3273.
 - j. Acceptable Product/Manufacturer: "Clean Room VL" No. 868 as manufactured by Armstrong World Industries, Inc.; "Vinylshield A" No. 1102-CRF-1 as manufactured by Certainteed; "Clean Room Clima Plus" no. 56099 manufactured by USG; or Architect approved equal by listed manufacturer.
- C. Accessories:
- 1. Shadow Molding: At all locations (whether detailed or not) where an acoustical lay-in ceiling abuts a gypsum board ceiling in the same plane, provide a "W" shaped reveal or "shadow" molding similar to USG No. MS 174.
 - 2. Fixture Protection (option in lieu of gypsum board assembly):
 - a. Manufacturer/Type: "Thermafiber" Light Protection Kit as manufactured by USG; or Armstrong Type 5/8 or 3/4 P(S) as manufactured by Armstrong World Industries; or equivalent.
 - b. Fire Resistance Rating: to provide required ceiling assembly rating as scheduled.
 - c. Locations: at fixtures being reinstalled in new fire rated ceiling assemblies.

2.3 EXTRA STOCK

- A. At completion of work, deliver and store at site as directed not less than three (3) unopened cartons of each type of acoustical ceiling material. One (1) unopened box of suspension system material.

PART 3 – EXECUTION

3.1 PREPARATION

- A. Insure that walls are flat and wall corners square. Commencing work shall be construed as acceptance of preceding work performed by others as suitable to receive Work of this Section.
- B. Insure that wall control joints are flat and will not cause wall mould to misalign at those locations.
- C. Coordinate all locations of cut panels with Architect in field prior to commencing work.
- D. Do not install any ceiling panel until all above plumbing work, ceiling inspections and corrections have been completed.

3.2 SUSPENDED CEILING SYSTEMS

- A. General: Install acoustical ceiling systems to comply with installation standard referenced below, per manufacturer's instructions and CISCA "Ceiling Systems Handbook."
 - 1. Standard for Installation of Ceiling Suspension Systems: Comply with ASTM C636.
- B. Install ceiling systems by skilled workmen in accordance with manufacturer's printed instructions, the approved shop drawings and reflected ceiling plans. Exposed surfaces of acoustical units shall be level and flush, with all joints straight and true. Cutting and fitting around all items protruding through acoustical ceiling shall be done neatly. Edge moldings and runners shall have flush hairline joints, with all corners mitered. Pop rivets for joining members are not permitted.
- C. Typically, unless indicated on the drawings, install system so that panels are centered in the space in both directions to limit small cut pieces to minimum of three (3) inches on any side, or so that light fixtures are centered above work areas. If conflicts arise, notify architect immediately for determination and proper locations.
- D. Install main beam and cross tees in accordance with reflected ceiling plans. Suspend main beams from structure (but not bridging) above by means of 12 gauge galvanized wire, spaced at 4 feet-0 inches on center, both directions, wrapped tightly at least three (3) full turns. Do not hang wire supports from metal deck unless directed to do so by Architect and/or Structural Engineer. Powder actuated devices in metal deck are not permitted. Join cross tees to main beam with a positive interlock. Pop rivets will not be permitted for field splices.
- E. Align beams or tees with angle molding at corners unless authorized by Architect.
- F. At perimeter areas, secure angle molding to vertical surfaces, ends of tees to rest on bottom flange of molding. Attachment of cross tees to wall angles with pop rivets will not be permitted. Hanger wire at 45 degree approximately ten (10) inches long may be used to tie the grid to the wall above the ceiling to prevent eventual disengagement of the two (2) components.
- G. Install lay-in panels with accessories and hold down clips as shown or required.

END OF SECTION

SECTION 09 65 13

RESILIENT BASE AND ACCESSORIES

CONDITIONS OF THE CONTRACT AND DIVISION 01, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. Resilient base, adhesive attached, in locations shown on drawings.
- B. Related Requirements
 - 1. Section 01 32 16 "Sustainable Design Requirements": VOC limits for adhesives

1.2 REFERENCES

- A. ASTM International (ASTM)
 - 1. F1861, Standard Specification for Resilient Wall Base

1.3 SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's specifications and other data needed to demonstrate compliance with specified requirements.
 - 2. Manufacturer's installation instructions.
- B. Samples:
 - 1. Actual samples or color charts showing manufacturer's full range of colors, for Architect's selection (if selections are not already scheduled or otherwise indicated on the drawings).
 - 2. Actual 12-inch-long piece of base material in each color selected for approval.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturers listed, whose product meets or exceeds the specifications are approved for use on the Project with Architect's approval. Other manufacturers must have a minimum of five (5) years experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.

2.2 MATERIALS

- A. Standard Rubber Base (typical except where extended toe or other type of base is specifically indicated on drawings, e.g., at athletic flooring or elsewhere) (09 65 13.RB-1):
 - 1. Quality Standard: ASTM F1861
 - 2. Material: Rubber, vulcanized, Type TS, Group I, Styles A and B. Vinyl base and Type TP are not acceptable.
 - 3. Type: Topset cove; 48 inch lengths. No rolls permitted.
 - 4. Thickness: Full 0.125 (1/8) inch
 - 5. Color(s): As scheduled or otherwise indicated on the drawings, or if not so indicated, as selected by Architect.
 - 6. Height: Four (4) inches, unless indicated otherwise.
 - 7. Acceptable Products/Manufacturers: Burke Flooring, Flexco, Johnsonite, Nora Rubber Products, Roppe Corp., or Architect approved equal.

- B. Extended (Sanitary) Toe Rubber Base (at athletic flooring or elsewhere, if and where indicated) (09 65 13.RB-2):
 - 1. Quality Standard: Same as above
 - 2. Material: Rubber
 - 3. Type: Sanitary Cove with two (2) inch toe; 48 inch lengths
 - 4. Thickness: 1/8 inch thick with a 0.125 inch thick toe
 - 5. Color: Black
 - 6. Height: Four (4) inches
 - 7. Acceptable Product/Manufacturer: Extruded Rubber Cove Base with Sanitary Toe manufactured by Roppe Corp., or Architect approved equal.
- C. Joining and Edge Finish Moldings (09 65 13.FM-#):
 - 1. Usage: For use at flooring terminations with other flooring
 - 2. Type: Tapered or bullnose edge, as required to provide juncture at edge of adjacent floor surfaces
 - 3. Size: One (1) inch wide by 1/8 inch thick or as applicable to the type of flooring and condition
 - 4. Material: Rubber or vinyl as recommended by manufacturer to suit application
 - 5. Color(s): As selected by Architect from manufacturer's available colors
 - 6. Acceptable Manufacturers: Burke Flooring, Flexco, Johnsonite, Roppe, Tarkett, or Architect approved equal.
 - 7. Basis of Design:
 - a. 09 65 13.FM-1: Mannington "Transitional Moldings" 930
 - b. 09 65 13.FM-2: Mannington "Transitional Moldings" 150
 - c. 09 65 13.FM-3: Mannington "Transitional Moldings" 735
- D. Stair Treads (09 65 13.RS-#):
 - 1. Usage: For use at interior stairs, as indicated on Drawings
 - 2. Type: As indicated on Drawings
 - 3. Thickness: 1/8 inch
 - 4. Size: Largest sizes available as required for installation
 - 5. Material: Rubber or vinyl as recommended by manufacturer to suit application
 - 6. Color(s): As indicated on Drawings
 - 7. Acceptable Manufacturers: Burke Flooring, Flexco, Johnsonite, Mohawk, Roppe, Tarkett, or Architect approved equal.
 - 8. Basis of Design: Mohawk "TRUE" Stair Treads
- E. Resilient Nosing (09 65 13.RN-#):
 - 1. Usage: For use at interior stairs, as indicated on Drawings
 - 2. Type: Linear Stair Nosing
 - 3. Thickness: 1/8 inch at tread
 - 4. Material: Rubber or vinyl as recommended by manufacturer to suit application
 - 5. Color(s): As selected by Architect

6. Acceptable Manufacturers: Burke Flooring, Flexco, Johnsonite, Mannington Commercial, Mohawk, Roppe, Tarkett, or Architect approved equal.
 7. Basis of Design: Model 565 "Double Undercut Carpet Stair" as manufactured by Mannington Commercial
- F. Adhesive: Rubber-based type; same brand as base or as recommended and approved by base manufacturer to suit application.
- G. Other Materials: Provide other materials, not specifically described but required for a complete and proper installation.

2.3 EXTRA STOCK

- A. Deliver to the Owner:
1. 1.5 percent, or one (1) unopened carton of each color, type and size of base selected, whichever is greater.
 2. One (1) gallon container of each type adhesive used for base.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions under which Work of this Section will be performed. Report unsatisfactory conditions to the Architect in writing. Do not proceed until unsatisfactory conditions are corrected.

3.2 PREPARATION

- A. Prepare substrates to receive base as recommended by base manufacturer.
- B. Verify substrates are smooth and ready to receive resilient base. Grind high spots and fill low spots with latex cementitious filler as required.
- C. Starting Work indicates acceptance of existing conditions.

3.3 INSTALLATION

- A. General:
1. Install materials only after finishing operations, including painting, have been completed and after permanent heating and cooling system is operating.
 2. Verify that moisture content of concrete slabs, building air temperature, and relative humidity are within the limits recommended by the manufacturers of the materials used.
- B. Installing Base:
1. Install base where shown on the Drawings in accordance with manufacturer's instructions.
 2. Use factory-preformed exterior corners, and factory preformed or job-mitered interior corners, as indicated on the drawings or directed by Architect.

3.4 CLEANING AND PROTECTING

- A. Remove excess adhesive and other blemishes from exposed surfaces, using neutral cleaner recommended by the manufacturer of the resilient materials.

END OF SECTION

SECTION 09 65 16
RESILIENT SHEET FLOORING

CONDITIONS OF THE CONTRACT AND DIVISION 01, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Resilient vinyl sheet flooring and adhesive attached with accessories in locations shown on drawings.
 - 2. Resilient base and adhesive attached in locations shown on drawings.

1.2 RELATED REQUIREMENTS

- A. Section 09 21 16 "Gypsum Board Assemblies"
- B. Division 9 - All flooring Sections abutting resilient tile flooring and requiring installation of resilient base.

1.3 REFERENCES

- A. ASTM International (ASTM)
 - 1. F710, Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring
 - 2. F1303, Standard Specification for Sheet Vinyl Floor Covering with Backing
 - 3. F1861, Standard Specification for Resilient Wall Base
 - 4. F1869, Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride

1.4 SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
 - 2. Manufacturer's installation instructions.
- B. Samples:
 - 1. Actual samples or color charts showing manufacturer's full range of colors for Architect's selection.
 - 2. 12 inch by 12 inch tile in each color selected and 12 inch long piece of base material in each color selected for approval.
- C. Certification: Manufacturer's affidavit that materials used in the Project contain no asbestos.

1.5 WARRANTY

- A. Warrant the work specified herein for five (5) year against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship.
- B. Defects shall include, but not be limited to:
 - 1. Delamination from substrate.
 - 2. Deterioration or fading.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Specifications are based on products of manufacturers named as the Basis of Design. Manufacturers listed whose product meet or exceed the specifications are approved for use on the Project. Other manufacturers must have a minimum of five (5) years experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
1. Gerflor, Bensenville, IL; (877) 437-3567
 2. <Name, City, ST; (###) ###-####>
 3. <Name, City, ST; (###) ###-####>

2.2 MATERIALS - ALL MATERIALS SHALL BE ASBESTOS FREE

- A. Vinyl Sheet:
1. Quality Standard: ASTM F1303
 2. Thickness: 0.08 inch
 3. Roll Width: 6 feet
 4. Patterns and Colors: As selected by Architect from manufacturers full line of colors
 5. Approved Products/Manufacturers:
- B. Rubber Base: Refer to Section 09 65 13 “Resilient Base and Accessories”
- C. Trowelable Leveling and Patching Compounds: Refer to Section 03 54 00 “Cast Underlayment”
- D. Joining and Edge Finish Moldings: Refer to Section 09 65 13 “Resilient Base and Accessories”
- E. Adhesive:
1. Flooring: Clear set type adhesive; same brand as flooring or as instructed by manufacturer to suit application.
 2. Base: Rubber-based type; same brand as base or as instructed by base manufacturer to suit application.
- F. Other Materials: Provide other materials, not specifically described but required for a complete and proper installation.

2.3 EXTRA STOCK

- A. Deliver to the Owner:
1. Four (4) percent or one (1) unopened carton of each color and pattern of flooring selected, whichever is greater.
 2. Four (4) percent or one (1) unopened carton of each color, type, and size base selected, whichever is greater.
 3. One (1) gallon container of each type adhesive used for flooring and base.

PART 3 – EXECUTION

3.1 SURFACE CONDITIONS

- A. Examine the areas and conditions under which Work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.2 PREPARATION

- A. Prepare concrete floors to receive flooring in accordance with ASTM F710.
- B. Verify substrates are smooth, level, at required finish elevation, and without more than 1/8 inch in 10 feet-0 inch variation from level or slopes shown on the drawings.
- C. Level substrates by grinding high spots or filling low spots with latex cementitious subfloor filler as required.
- D. Broom clean or vacuum the surfaces to be covered, and inspect the substrates.
- E. Verify substrates are smooth, level, at required finish elevation, and are ready to receive resilient tile flooring and base.
- F. Bring discrepancies to the attention of the Architect and do not proceed until such discrepancies are corrected.
- G. Conduct moisture test in accordance with ASTM F1869 - maximum allowable amount of moisture emission from floor is 3.0 pounds per 1,000 square feet in 24 hour period, and shall not exceed maximum allowable moisture content as allowed by flooring manufacturer.
- H. Starting Work indicates acceptance of existing conditions.

3.3 INSTALLATION

- A. General:
 - 1. Install materials only after finishing operations, including painting, have been completed and after permanent heating and cooling system is operating.
 - 2. Verify that moisture content of concrete slabs, building air temperature, and relative humidity are within the limits recommended by the manufacturers of the materials used.
- B. Installing Resilient Flooring:
 - 1. Place units with adhesive cement in compliance with the manufacturer's recommendations.
 - a. Butt units tightly to vertical surfaces, nosings, edgings, and thresholds.
 - b. Scribe as necessary around obstructions and to produce neat joints.
 - c. Place rolls tightly laid, even, and in straight parallel lines.
 - d. Extend units into toe spaces, door reveals, and in closets and similar spaces.
 - 2. Lay units from center marks established with principal walls, discounting minor offsets, so that units at opposite edges of the room are of equal width.
 - a. Adjust as necessary to avoid use of cut widths less than 3 inches wide at edge of space.
 - b. Lay units square to axes of the room or space.
 - 3. Match units for color and pattern by using materials from cartons in the same sequence as manufactured and packaged.
 - 4. Place joining and edge finish mouldings, including reducer strips tightly butted to units and secured with adhesive, providing at all unprotected edges unless otherwise shown.

3.4 CLEANING AND PROTECTING

- A. Remove excess adhesive and other blemishes from exposed surfaces, using neutral cleaner recommended by the manufacturer of the resilient materials.

END OF SECTION

SECTION 09 65 19.23
VINYL TILE FLOORING

CONDITIONS OF THE CONTRACT AND DIVISION 01, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. Luxury vinyl flooring (LVT)
 - 2. Adhesive

1.2 REFERENCES

- A. ASTM International (ASTM)
 - 1. F2710, Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring
 - 2. F1861, Standard Specification for Resilient Wall Base
 - 3. F1869, Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride

1.3 SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
 - 2. Manufacturer's installation instructions.
- B. Samples:
 - 1. Actual samples or color charts showing manufacturer's full range of colors for Architect's selection.
 - 2. 3-7 inch width by 48 inch plank and/or 18 inch by 18 inch tile in each color selected and 12 inch long piece of base material in each color selected for approval.
- C. Certification: Manufacturer's affidavits that materials used in the Project contain no asbestos.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturers listed whose product meets or exceeds the specifications are approved for use on the Project with Architect's approval. Other manufacturers must have a minimum of five (5) years experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
 - 1. Johnsonite – Tarkett Group, Solon, OH; (800) 899-8916
 - 2. Shaw Industries, Inc., Dalton, GA; (800) 441-7429

2.2 MATERIALS – ALL MATERIALS MUST BE ASBESTOS FREE

- A. Luxury Vinyl Tile/Plank (LVT) (09 65 19.23.LVT-1#):
 - 1. Quality Standard: ASTM F1700.
 - 2. Size: As shown in drawings and/or selected by architect
 - 3. Minimum of 30 mil wear layer
 - 4. Patterns and Colors: As selected by Architect or as shown on drawings. Provide

- moderate complexity patterns as selected by Architect. Allow for angles and cutting of tiles.
5. Acceptable Products/Manufacturers: "Natural Creations" by Armstrong World Industries, Inc., or "Art Select, Da Vinci, Opus" by Karndean, "Centiva" by Tandus, and/or Architect approved equal.
- B. Luxury Vinyl Tile/Plank (LVT), Type 2 (09 65 19.23.LVT-2):
1. Basis of Design: "I.D. Freedom" as manufactured by Johnsonite – Tarkett Group
 2. Complies with requirements for ASTM F 1700 Standard Specification for Solid Vinyl Floor Tile, Class III, Type B.
 3. Heterogeneous printed vinyl floor covering with a non-woven glass fiber
 4. Polyurethane reinforced wear layer
 5. Tile sizes: As indicated on Drawings
 6. Plank size: As indicated on Drawings
 7. Wear Layer Thickness: 20 mil
 8. Overall thickness: 0.125"
 9. ASTM D 2047, Standard Test Method for Static Coefficient of Friction of Polish-Coated Flooring of 0.6 or greater.
 10. ASTM E 648, Standard Test method for Critical Radiant Flux of 0.45 watts/cm² or greater, Class I.
 11. 100% Recyclable.
 12. Patterns and Colors: As selected by Architect or as shown on drawings. Provide moderate complexity patterns as selected by Architect. Allow for angles and cutting of tiles.
- C. Trowelable Leveling and Patching Compounds: Refer to Section 03 54 00 "Cast Underlayment"
- D. Cement-based Floor Leveling Material: Refer to Section 03 54 00 "Cast Underlayment"
- E. Joining and Edge Finish Moldings: Refer to Section 05 77 00 "Decorative Extruded Metal"
- F. Adhesive:
1. Tile: Clear set type adhesive; same brand as tile or as instructed and approved by tile manufacturer to suit application.
 2. Base: Rubber-based type; same brand as base or as recommended and approved by base manufacturer to suit application.
- G. Other Materials: Provide other materials, not specifically described but required for a complete and proper installation.

2.3 EXTRA STOCK

- A. Deliver to the Owner:
1. Four (4) percent or one (1) unopened carton of each color and pattern of tile selected, whichever is greater.
 2. Four (4) percent or one (1) unopened carton of each color, type, and size base selected, whichever is greater.
 3. One (1) gallon container of each type adhesive used for flooring and base.

PART 3 – EXECUTION

3.1 SURFACE CONDITIONS

- A. Examine the areas and conditions under which Work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.2 PREPARATION

- A. Prepare concrete floors to receive flooring in accordance with ASTM F1869.
- B. Verify substrates are smooth, level, at required finish elevation, and without more than 1/8 inch in 10 feet-0 inch variation from level or slopes shown on the drawings.
- C. Level substrates by grinding high spots or filling low spots with latex cementitious subfloor filler as required.
- D. Broom clean or vacuum the surfaces to be covered, and inspect the substrates.
- E. Verify substrates are smooth, level, at required finish elevation, and are ready to receive resilient tile flooring and base.
- F. Bring discrepancies to the attention of the Architect and do not proceed until such discrepancies are corrected.
- G. Conduct moisture test in accordance with ASTM F1869 - maximum allowable amount of moisture emission from floor is 3.0 pounds per 1,000 square feet in 24 hour period, and shall not exceed maximum allowable moisture content as allowed by flooring manufacturer.
- H. Starting Work indicates acceptance of existing conditions.

3.3 INSTALLATION

- A. General:
 - 1. Install materials only after finishing operations, including painting, have been completed and after permanent heating and cooling system is operating.
 - 2. Verify that moisture content of concrete slabs, building air temperature, and relative humidity are within the limits recommended by the manufacturers of the materials used.
- B. Installing Tiles/Planks:
 - 1. Place units with adhesive cement in compliance with the manufacturer's recommendations.
 - a. Butt units tightly to vertical surfaces, nosings, edgings, and thresholds.
 - b. Scribe as necessary around obstructions and to produce neat joints.
 - c. Place tiles tightly laid, even, and in straight parallel lines.
 - d. Place planks tightly laid, random placement with parallel lines.
 - e. Extend units into toe spaces, door reveals, and in closets and similar spaces.
 - 2. Lay units from center marks established with principal walls, discounting minor offsets, so that units at opposite edges of the room are of equal width.
 - a. Adjust as necessary to avoid use of cut widths less than 3 inches wide at edge of space.
 - b. Lay units square to axis of the room or space.
 - 3. Match units for color and pattern by using materials from cartons in the same sequence as manufactured and packaged.

4. Place joining and edge finish moldings, including reducer strips tightly butted to units and secured with adhesive, providing at all unprotected edges unless otherwise shown.
- C. Installing Base:
1. Install base where shown on the Drawings in accordance with manufacturer's instructions.
 2. Use factory-preformed exterior corners, and factory preformed or job-mitered interior corners.

3.4 CLEANING AND PROTECTING

- A. Remove excess adhesive and other blemishes from exposed surfaces, using neutral cleaner recommended by the manufacturer of the resilient materials.

END OF SECTION

SECTION 09 90 00
PAINTING AND COATING

CONDITIONS OF THE CONTRACT AND DIVISION 01, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes
1. Surface preparation and field application of paints and stains on interior substrates where shown or required.
 2. Surface preparation and field application of paints and stains on exterior substrates where shown or required.
 3. Surfaces not included, as applicable to the project, include, but are not limited to the following:
 - a. Areas above finished ceiling or scheduled "unpainted" on the Finish Schedule of the drawings, except for those items within those spaces scheduled to painted.
 - b. Exposed concrete, unless noted otherwise.
 - c. Shop coat of paint on metal, except for damaged shop primer touch-up (unless noted otherwise.
 - d. Structural steel and related items scheduled to receive sprayed fireproofing or encased in concrete.
 - e. Face brick, unless otherwise noted.
 - f. Natural stone.
 - g. Aluminum and copper items, unless noted otherwise. (Painting of exposed pipe, including copper, brass, galvanized and black iron pipe and fittings, *is* included.)
 - h. Factory finished items other than prime painted to be field paint finished.
 - i. Glass and glass masonry.
 - j. Sealants of types which should not be painted and to which paint will not adhere.
 - k. Plastic laminate items, such as doors, countertops, casework, etc.
 - l. Acoustical ceiling and grid work, unless noted otherwise.
 - m. Acoustical panels
 - n. Aluminum, stainless steel, nickel and chrome plated piping and fittings.
 - o. Stainless steel items.
 - p. Ceramic or tile of any kind.
 - q. Valves and controls.
 - r. Sprinkler heads.
 - s. Name plates on equipment.
 - t. Fire rating labels, including those on fire rated doors and frames.
 - u. Door hardware, except that which is factory primed and designated as "BHMA 600", if any, in Door Hardware Section.
 - v. Existing construction, unless noted otherwise.

- w. Materials not noted to be refinished or to receive a finish, except as noted, including, but not limited to the following:
 - 1) Roofing
 - 2) Asphalt paving, except for parking and lane striping, fire lane, and "wheel chair" handicapped access parking spaces.
 - 3) Concrete paving and curbs, except for parking and lane striping, fire lane, and "wheel chair" accessible parking spaces.
 - 4) Flooring, except those to receive game striping, or as noted
- x. Color coding of Mechanical Room pipes whether insulated or not: (Unless noted or directed otherwise)

B. Related Requirements

- 1. Section 01 32 16 "Sustainable Design Requirements" – VOC limits

1.2 REFERENCES

- A. American Society for Testing and Materials (ASTM)
 - 1. D16, Standard Terminology for Paint, Related Coatings, Materials and Applications.

1.3 DEFINITIONS

- A. Conform to definitions of terms in ASTM D16 in interpreting requirements of this Section.

1.4 SUBMITTALS

- A. Material lists. Give the supplier's name, product name, number and generic description of each proposed product and its use. Provide product data sheets if so requested.
- B. Samples. Submit full range of colors, patterns, textures and finishes available for selection, including the following:
 - 1. Color Chips: Provide complete duplicate sets of color chips for color selection.
 - 2. Small Applied Samples: Provide pieces of actual material on which paint will occur with minimum dry mil thickness of specified paint. Provide painted 12 inch x 12 inch actual gypsum wallboard samples with approved textures for Architect's approval. Approved samples will become standard for which all work will be judged.
 - 3. Sheen Samples: Provide full range of varying sheens when sheens are controllable by intermixing.
- C. Installed Samples. Provide large size samples for approval. Approved samples may be left in place as part of the work.
- D. One room and/or area, as selected by the Architect, shall be painted with materials specified or accepted and applied directly from container, unthinned. After acceptance by Architect, room and/or area shall be standard of quality of entire project.
- E. Certification. Furnish a letter certifying that materials submitted are truly equivalent or better than those called out in the finish schedule.

1.5 RESPONSIBILITY OF COORDINATION

- A. Coordinate the work specified herein with the following work:
 - 1. Provide information to preceding trades for proper preparation of substrate.
 - 2. Inspect substrate before proceeding to verify proper preparation.
 - 3. Notify Architect of any item to receive paint which may not be covered by a scheduled finish type. Architect will furnish appropriate specification.

1.6 QUALITY ASSURANCE

A. Materials:

1. Delivery and Storage: Products shall be delivered to jobsite in unopened containers bearing manufacturer's labels intact and legible at time of use. Storage shall be in designated areas away from excessive heat and open flames and in accordance with manufacturer's recommendations.
2. Quality or Grade:
 - a. Paints and coatings shall be the manufacturer's highest professional quality material of types specified and shall be applied directly from containers in which material is purchased, except where thinning is recommended by manufacturer and approved by Architect to suit intended use, i.e. painting acoustical tile or panels without destroying their acoustical properties.
 - b. Primers and other undercoat paints shall be those produced by same manufacturer as finish coats.
 - c. Thinners shall be those recommended by paint manufacturer's printed instructions.
3. Equipment:
 - a. Spray Equipment: Shall be the type recommended for the application and shall be maintained clean and in proper working order.
 - b. Brushes, Rollers, etc.:
 - 1) Shall be new of the various sizes and types recommended for each application.
 - 2) Shall be properly cleaned and stored in accordance with manufacturer's instructions at the end of each days' use.
 - 3) Shall be replaced as often as necessary to attain the best finish quality in the Work.
4. Application:
 - a. Applicator:
 - 1) Shall be person(s) or entity specializing in application of paints and coatings of types specified with minimum five (5) years experience.
 - 2) Shall provide Owner and Architect a notarized certification that paint used is as specified.
 - b. Application:
 - 1) Shall not proceed on surfaces which are not suitable to be painted, until such surfaces have been corrected. Notify Architect in writing of which surfaces need to be corrected and their locations. Surfaces shall be corrected by the responsible trades. Surfaces not suitable for painting shall include, but not be limited to:
 - a) Oily, greasy, dusty or excessively soiled surfaces.
 - b) Non-dressed welds which will be exposed to view.
 - c) Lack of touch-up where specified.
 - d) Rusted or excessively deteriorated shop-prime painted surfaces.
 - 2) Damaged surfaces.

- 3) Number of coats of each of several finishes shall be in accordance with detailed specifications, which will produce first quality finish if properly applied. If number of coats specified fails to produce a finish acceptable to Architect, this Contractor shall apply additional coat or coats at his own expense until acceptable finish is achieved

1.7 PRODUCT HANDLING

- A. Store only approved materials at the jobsite, and store only in a suitable and designated area restricted to the storage of paint materials and related equipment.
- B. Temperature in the storage area shall be between 40 degrees F and 110 degrees F. Open and mix all materials in the storage area.
- C. Use all means necessary to protect materials before, during, and after application and to protect the installed work and materials of all other trades.
- D. Apply water-base paints only when temperature of surfaces to be painted and surrounding air temperatures are between 50 degrees F and 90 degrees F, unless otherwise permitted by paint manufacturer's printed instructions.
- E. Apply solvent-thinned paints only when temperature of surfaces to be painted and surrounding air temperatures are between 45 degrees F and 95 F, unless otherwise permitted by paint manufacturer's printed instructions.
- F. Do not paint in snow, rain, fog or mist, or when relative humidity exceeds 85 percent, or to damp or wet surfaces, unless otherwise permitted by paint manufacturer's printed instructions. Painting may be continued during inclement weather if areas and surfaces to be painted are enclosed and heated within temperature limits specified by paint manufacturer during application and drying periods.

1.8 EXTRA STOCK

- A. Upon completion of the work of this section, deliver to the Owner, an extra stock equaling ten (10) percent or a minimum of one (1) gallon, whichever is greater, of each color, type, and gloss of paint used in the work, tightly sealing each container and clearly labeling contents and location where used.

1.9 WARRANTY

- A. The undertaking of a painting subcontract will indicate that the subcontractor will warrant the work specified herein for two (2) years against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship.
- B. Defects shall include by not be limited to the following:
 1. Discoloring noticeably by yellowing, streaking, blooming, changing color or darkening
 2. Mildewing
 3. Peeling, cracking, blistering, alligating or releasing from the substrate
 4. Chalking or dusting excessively
 5. Changing sheen in irregular fashion
 6. Softening or becoming tacky
 7. Bubbling
- C. In the event of damage, immediately make all repairs and replacements necessary for approval of the Architect and at no additional cost to the Owner.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. All paint materials selected for coating systems for each type of surface shall be the product of a single manufacturer and shall, as a system, have flame spread, fuel contribution, and smoke density test results less than 25.
- B. Paint materials listed herein, unless otherwise designated in the "Painting Schedule", are the products of The Sherwin-Williams Company, 101 Prospect Avenue N.W., Cleveland, OH 44115, (800) 321-8194 and require no further approval as to manufacturer or catalogue number.
- C. Similar firstline material of the following manufacturers may be used subject to approval by the Architect for items indicated to be coated:
 - 1. Paints:
 - a. Benjamin Moore & Co.
 - b. Devoe Paint Company
 - c. Fuller O'Brien Paints
 - d. Martin-Senour Paints (Div. of Sherwin Williams)
 - e. Monarch Paint Company
 - f. Glidden Professional™ paints (formerly ICI Dulux Paints)
 - g. Pittsburgh Paints, PPG Industries, Inc., Professional & High Performance Coatings
 - h. Porter Paints
 - i. Pratt & Lambert Paints (Div. of Sherwin Williams)
 - j. Kelly-Moore Paint Co.
 - k. Kwal Paint
 - l. Tnemec Company Inc.
 - 2. Stains:
 - a. Olympic Stains, PPG Industries, Inc., Professional & High Performance Coatings
 - b. Samuel Cabot, Inc.
 - c. The Sherwin-Williams Co.

2.2 MATERIALS

- A. Paint and Coatings: Ready mixed, except for field catalyzed coatings; having good flow and brushing properties and consistent drying or curing behavior, free of sags and streaks.
- B. Accessory Materials: Linseed oil, turpentine, paint thinners and other materials recommended by paint and coatings manufacturer as necessary to achieve finishes specified.
- C. Patching and Surface Preparation: Latex fillers as recommended by paint and coatings manufacturer.

2.3 COLORS

- A. Colors shall be as scheduled.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Verify that site environmental conditions are appropriate and substrates are in proper condition to receive Work of this Section.
- B. Verify that shop applied primers are compatible with specified finish coats.
- C. Measure moisture content of surfaces using an electronic moisture meter. Do not begin application of coatings unless moisture content of surfaces is below the following maximum values:
 - 1. Gypsum soffits: 12 percent.
 - 2. Plaster: 12 percent.
 - 3. Masonry surfaces: 12 percent.
 - 4. Wood surfaces: 15 percent.
 - 5. Vertical concrete surfaces: 12 percent.
 - 6. Horizontal concrete surfaces: 8 percent.

3.2 ITEMS TO RECEIVE PAINT

- A. Generally, all new items that are normally painted in any typical building, including but not limited to the following list:
 - 1. All ferrous metal
 - 2. All exterior galvanized metal
 - 3. All exterior wood
 - 4. All interior wood
 - 5. All prime coated hardware
 - 6. All exposed conduit, outlet boxes and electrical cabinets, excluding those located in mechanical rooms.
 - 7. All exposed pipe, plumbing, and ductwork, including those located in mechanical rooms.
 - 8. All metal grilles, except aluminum, unless otherwise indicated.
 - 9. All exposed gypsum board surfaces, including all mechanical rooms.
 - 10. All exposed concrete masonry units (CMU), including all mechanical rooms.
 - 11. Miscellaneous other items which normally require painting or are scheduled to be painted.
 - 12. Consult plans, finish schedule, details and specifications for other trades as all items usually field painted or finish will be considered as part of the Contract.
 - 13. All exposed mechanical equipment and electrical equipment.
 - 14. Mechanical Room piping whether insulated or not insulated.
 - 15. All spray applied fireproofing in Mechanical Rooms.
 - 16. All cementitious wood fiber decks and exposed structure scheduled or noted to receive paint. Protect exposed wood structure from overspray.
- B. All work where a coat of material has been applied must be inspected and approved by Architect before application of succeeding specified coat, otherwise no credit for coat applied will be given. Notify Architect when a particular coat has been completed for inspection and approval. Apply coats of material in strict accordance with manufacturer's specifications except where requirements of these specifications are in excess of

manufacturer's requirements. Paint all sight exposed pipe and plumbing only after all mechanical work and tests have been completed.

3.3 PREPARATION

- A. General: Surface must be clean to insure adhesion. Remove oil and grease with paint thinner. Wash off dirt with warm soapy water and rinse with clean water. Remove rust by wire brushing or sanding.
- B. Wall surfaces must be dry before painting. Verify with moisture meter.
- C. Unfinished Surfaces
 - 1. Wood: Sand smooth and apply one (1) coat of Primer Undercoat. After primer has dried overnight, putty nail holes and cracks, then spot-prime putty with primer. Again, allow the primer to dry over- night, sand lightly and topcoat.
 - 2. Masonry and Concrete: Remove efflorescence or cement dust on masonry and concrete by etching with a 10 percent solution of muriatic (Hydrochloric) acid. Flush off surface after etching with clean water, and paint while still damp. On surface where muriatic acid cannot be used to neutralize the efflorescence, remove the efflorescence by sanding, scraping or wire brushing and apply a coat of Masonry Conditioner before painting. If efflorescence is not present, no primer is necessary on concrete and masonry surfaces. Fill voids and pores in concrete and haydite blocks with Latex Block Filler and allow to dry overnight before topcoating.
 - 3. Iron and Steel: Prime with Metal Primer and allow to dry overnight before topcoating.
 - 4. Galvanized Metal: Prime with galvanized metal primer and allow to dry overnight before topcoating.

3.4 APPLICATION

- A. General: Surfaces to be finished must be clean, dry and free of dirt, oils, loose paint or any other contamination that would adversely affect adhesion, protective properties or appearance of the coating.
- B. Paint Thickness: Provide the following minimum dry film thickness per coat unless noted otherwise:
 - 1. Enamels on Metal: 1 mil
 - 2. Latex Paints: 1 mil
 - 3. Metal Primers: 1.5 mils
 - 4. Undercoats: 1.5 mils
 - 5. Oil Paints: 1.5 mils
 - 6. Epoxy Coating: 2.0 mils
 - 7. Thickness test: Use observation gauge that measures "V" shape scratch.
- C. Allow exterior paints to dry 72 hours between coats and interior paint to dry 24 hours between coats. Allow all enamels and varnishes to dry 24 hours between coats. If enamel and varnishes are tacky after 24 hours, allow additional time until finish is dry.
- D. Leveling: Apply with proper consistency and quality so paint flows out to a level surface free of brush and roller marks, bubbles, dust, runs, sags, and holidays. Spread evenly.
- E. Appearance: Uniform color, texture and sheen.
- F. Neatness: Paint shall not be smeared, spattered or run over adjoining colors or materials. Cut-on lines shall be straight.
- G. First coat shall be white, unless otherwise specified.

3.5 CLEANING AND PROTECTION

- A. Keep project premises free of painting-related debris. Collect material that may constitute a fire hazard, place in closed metal containers, and remove daily from site.
- B. Protect work adjacent to painting operations from paint spatters and spills. Immediately remove paint that falls on finished surfaces not scheduled to receive paint, using materials and techniques that will not damage affected surfaces.

3.6 SCHEDULE

- A. The following is a schedule of typical painted items and does not specifically include every item that is to receive paint but should establish type and quality of finish for all items normally included in a complete paint job.
- B. Exterior Surfaces: Note: Exterior surfaces are divided into two (2) different categories, based upon color and level of graffiti resistance required. System 1 will be used when standard earthtone colors or neutral colors are specified, and System 2 will be used when bright colors (primary reds, yellows, and oranges) are specified and/or when a graffiti resistant coating is required.
 - 1. Galvanized Metal:
 - a. Surface Preparation: Acid etch galvanized surfaces that have not weathered at least six (6) months prior to beginning painting operations.
 - b. Primer: One (1) coat Pro-Cryl Pro Industrial Universal Primer (B66W310)
 - c. Finish: Two (2) coats Sher-Cryl HPA High Performance Acrylic (B66W300)
 - 2. Un-galvanized Metal:
 - a. Primer: One (1) coat Pro-Cryl Pro Industrial Universal Primer (B66W310)
 - b. Finish: Two (2) coats Sher-Cryl HPA High Performance Acrylic (B66W300)
 - 3. Concrete and CMU:
 - a. Primer/Finish: (2) coats Loxon XP Exterior Waterproofing System, 14-18 mils wet, 6.4 – 8.3 mils dry per coat
 - 4. Wood (Includes plywood siding and wooden trim):
 - a. Primer: One (1) coat A-100 Latex Wood Primer (B42W41)
 - b. Finish: Two (2) coats A-100 Acrylic Gloss (A8 ser.)
 - 5. Fiber-Cement Materials:
 - a. Primer: One (1) coat Loxon Masonry Primer (A24W300)
 - b. Finish: Two (2) coats A-100 Acrylic Gloss (A8 Series)
 - 6. Parking Line and Driveway Paint: Setfast Waterborne Yellow (TM225) (meets Federal Specification (FS) TTP-1952-B)

7. All piping in mechanical rooms shall be painted in their entirety, in the following colors:
 - a. Gas lines: Orange
 - b. Domestic cold water: White
 - c. Domestic hot water: Pink
 - d. Heating hot water: Red
 - e. Condenser water: Green
 - f. Chilled water: Blue
- C. Interior Surfaces:
 1. Galvanized Metal:
 - a. Primer: One (1) coat Pro-Cryl Pro Industrial Universal Primer (B66W310)
 - b. Finish: Two (2) coats Pro Industrial 0 VOC Acrylic Semi-Gloss
 2. Shop-Primed Ferrous Metals (Use for metal doors and frames and miscellaneous metal items):
 - a. Shop coat by others.
 - b. One (1) coat over Steel Kem Kromik Primer B50series.
 - c. One (1) coat over Aluminum Metal Procryl Primer B60series
 - d. Two (2) coats PM200 Alkyd Semi Gloss B34series
 3. Gypsum Board:
 - a. Primer: One (1) coat ProGreen 200 Latex Primer (B28W600)
 - b. Finish: Two (2) coats ProGreen 200 Latex Egg-Shell (B20W200 Series)
 4. Concrete and CMU: (Enamel)
 - a. Primer: One (1) coat ProMar Block Filler (AB25W25)
 - b. Finish: Two (2) coats ProGreen 200 Latex Semi-Gloss (B31-600 Series)
 5. Wood: (Painted)
 - a. Primer: ProMar Classic Latex Primer (B28W101)
 - b. Finish: ProClassic Waterborne Semi-Gloss (B31 Series)
 6. Wood: (Stained)
 - a. Stain: SherWood BAC Wiping Stain (S64 Series)
 - b. Finish (First Coat): Wood Classics Polyurethane Varnish (A67 Series)
 - c. Finish (Second Coat): Wood Classics Polyurethane Varnish (A67 Series)
 7. Gypsum Wallboard: (Epoxy) – Kitchens, bathrooms, laboratories, etc.
 - a. Primer: One (1) coat ProMar 200 Latex Primer (B28W200)
 - b. Finish: Two (2) coats Water-Based Catalyzed Epoxy (B70/B60)
 8. CMU: (Epoxy) - Kitchens, bathrooms, laboratories, etc.
 - a. Primer: Two (2) coats Heavy Duty Block Filler (B42W46)
 - b. Finish: Two (2) coats Water-Based Catalyzed Epoxy (B70/B60)

9. Pipe and fittings, including but not limited to copper and brass, at kitchen areas (but excluding aluminum, stainless steel, nickel and chrome plated pipe and fittings):
 - a. Primer: One (1) coat; product recommended for the substrate by the finish coat manufacturer.
 - b. Finish: Two (2) coats bright aluminum paint.

END OF SECTION

SECTION 10 11 00
VISUAL DISPLAY UNITS

CONDITIONS OF THE CONTRACT AND DIVISION 01, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Markerboards
 - 2. Tackboards

1.2 DEFINITIONS

- A. Visual Display Board Assembly: Visual display surface that is factory fabricated into composite panel form, either with or without a perimeter frame; includes chalkboards, markerboards, and tackboards.
- B. Visual Display Surface: Surfaces that are used to convey information visually, including surfaces of chalkboards, markerboards, tackboards, and surfacing materials that are not fabricated into composite panel form but are applied directly to walls.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for visual display surfaces.
 - 1. Include individual panel weights for sliding visual display units.
 - 2. Include computer system requirements for electronic markerboards.
- B. Shop Drawings: For visual display surfaces, provide Shop Drawings that include the following:
 - 1. Plans, elevations, sections, details, and attachments to other work.
 - 2. Locations of panel joints.
 - 3. Sections of typical trim members.
- C. Samples for Verification: For each type of visual display surface indicated.
 - 1. Visual Display Surface: Not less than 8-1/2 by 11 inches, mounted on substrate indicated for final Work. Include one panel for each type, color, and texture required.
 - 2. Trim: 6-inch-long sections of each trim profile
 - 3. Accessories: Full-size Sample of each type of accessory.
- D. Product Schedule: For visual display surfaces. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for surface-burning characteristics of fabrics.
- C. Warranties: Sample of special warranties.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For visual display surfaces to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of motor-operated, sliding visual display units required for this Project.
- B. Source Limitations: Obtain visual display surfaces from single source from single manufacturer.
- C. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: 25 or less.
 - 2. Smoke-Developed Index: 450 or less.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver factory-built visual display surfaces, including factory-applied trim where indicated, completely assembled in one piece without joints, where possible. If dimensions exceed maximum manufactured panel size, provide two or more pieces of equal length as acceptable to Architect. When overall dimensions require delivery in separate units, prefit components at the factory, disassemble for delivery, and make final joints at the site.
- B. Store visual display surfaces vertically with packing materials between each unit.
- C. Store visual display wallcoverings in accordance with manufacturer's recommendations.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install visual display surfaces until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
- B. Field Measurements: Verify actual dimensions of construction contiguous with visual display surfaces by field measurements before fabrication.
 - 1. Allow for trimming and fitting where taking field measurements before fabrication might delay the Work.

1.9 WARRANTY

- A. Standard Warranty: Manufacturer's standard warranty
- B. Special Warranty for Porcelain-Enamel Face Sheets: Manufacturer's standard form in which manufacturer agrees to repair or replace porcelain-enamel face sheets that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Surfaces lose original writing and erasing qualities
 - b. Surfaces exhibit crazing, cracking, or flaking
 - 2. Warranty Period: Life of the building

PART 2 – PRODUCTS

2.1 MATERIALS, GENERAL

- A. Porcelain-Enamel Face Sheet: Manufacturer's standard steel sheet with porcelain-enamel coating fused to steel; uncoated thickness indicated.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Claridge Products and Equipment, Inc.
 - b. PolyVision Corporation; a Steelcase Company
 - 2. Gloss Finish: Gloss as indicated; dry-erase markers wipe clean with dry cloth or standard eraser.
- B. Plastic-Impregnated Cork Sheet: Seamless, homogeneous, self-sealing sheet consisting of granulated cork, linseed oil, resin binders, and dry pigments that are mixed and calendared onto fabric backing; with washable vinyl finish and integral color throughout with surface-burning characteristics indicated.
- C. Hardboard: ANSI A135.4, tempered.
- D. Particleboard: ANSI A208.1, Grade M-1, made with binder containing no urea formaldehyde.
- E. Fiberboard: ASTM C 208.
- F. Extruded Aluminum: ASTM B 221, Alloy 6063.

2.2 MARKERBOARD ASSEMBLIES

- A. Porcelain-Enamel Markerboards (10 11 00.MP#): Balanced, high-pressure, factory-laminated markerboard assembly of three-ply construction consisting of backing sheet, core material, and 0.021-inch-thick, porcelain-enamel face sheet with high-gloss finish.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. AARCO Products, Inc.
 - b. ADP Lemco, Inc.
 - c. Aywon
 - d. Bangor Cork Company, Inc.
 - e. Best-Rite Manufacturing
 - f. Claridge Products and Equipment, Inc.
 - g. Egan Visual Inc.
 - h. Ghent Manufacturing, Inc.
 - i. Marsh Industries, Inc.; Visual Products Group
 - j. Platinum Visual Systems; a division of ABC School Equipment, Inc.
 - k. PolyVision Corporation; a Steelcase company
 - l. Tri-Best Visual Display Products
 - 2. Manufacturer's Standard Core: Minimum 1/4 inch thick, with manufacturer's standard moisture-barrier backing.
 - 3. Laminating Adhesive: Manufacturer's standard, moisture-resistant thermoplastic type.

4. Porcelain-Enamel Visual Display Board (10 11 00.MP#): Factory-Assembled.
 - a. Markerboard: Porcelain-enamel markerboard assembly.
 - 1) Color: White
 - b. Corners: Square
 - c. Width: As indicated on Drawings
 - d. Height: As indicated on Drawings
 - e. Mounting: Wall
 - f. Mounting Height: 34 inches as measured from finish floor to bottom of visual display board writing surface
 - g. Factory-Applied Aluminum Trim: Manufacturer's standard with clear anodic finish
 - h. Accessories:
 - 1) Chalktray: Solid type
 - 2) Map rail with display rail, end stops, and map hooks and clips

2.3 MARKERBOARD ACCESSORIES

- A. Aluminum Frames and Trim: Fabricated from not less than 0.062-inch-thick, extruded aluminum; standard size and shape.
 1. Factory-Applied Trim: Manufacturer's standard.
- B. Chalktray: Manufacturer's standard, continuous
 1. Box Type: Extruded aluminum with slanted front, grooved tray, and cast-aluminum end closures.
- C. Map Rail: Provide the following accessories:
 1. Display Rail: Continuous and integral with map rail; fabricated from cork approximately 1 to 2 inches wide.
 2. End Stops: Located at each end of map rail.
 3. Map Hooks and Clips: Two map hooks with flexible metal clips for every 48 inches of map rail or fraction thereof.
 4. Paper Holder: Extruded aluminum; designed to hold paper by clamping action.

2.4 TACKBOARD ASSEMBLIES (10 11 00.TB#)

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. A-1 Visual Systems
 2. AARCO Products, Inc.
 3. ADP Lemco, Inc.
 4. Aywon
 5. Bangor Cork Company, Inc.
 6. Best-Rite Manufacturing
 7. Claridge Products and Equipment, Inc.
 8. Egan Visual Inc.
 9. EverProducts by Glenroy Inc.

10. Ghent Manufacturing, Inc.
 11. Marsh Industries, Inc.; Visual Products Group
 12. Platinum Visual Systems; a division of ABC School Equipment, Inc.
 13. PolyVision Corporation; a Steelcase company
 14. Tri-Best Visual Display Products
- B. Plastic-Impregnated-Cork Tackboard (10 11 00.TPC): 1/4-inch-thick, plastic-impregnated cork sheet factory laminated to 1/4-inch-thick hardboard backing.
- C. Tackboard (10 11 00.TB#): Factory-Assembled
1. Tack Surface: Plastic-impregnated-cork tackboard assembly
 2. Corners: Square
 3. Width: As indicated on Drawings
 4. Height: As indicated on Drawings
 5. Mounting: Wall
 6. Mounting Height: As indicated on Drawings
 7. Edges: Concealed by trim
 - a. Factory-Applied Aluminum Trim: Manufacturer's standard style, with clear anodic finish.

2.5 FABRICATION

- A. Porcelain-Enamel Visual Display Assemblies: Laminate porcelain-enamel face sheet and backing sheet to core material under heat and pressure with manufacturer's standard flexible, waterproof adhesive.
- B. Visual Display Boards: Factory-assemble visual display boards unless otherwise indicated.
1. Where factory-applied trim is indicated, trim shall be assembled and attached to visual display boards at manufacturer's factory before shipment.
- C. Factory-Assembled Visual Display Units: Coordinate factory-assembled units with trim and accessories indicated. Join parts with a neat, precision fit.
1. Make joints only where total length exceeds maximum manufactured length. Fabricate with minimum number of joints, balanced around center of board, as acceptable to Architect.
 2. Provide manufacturer's standard vertical-joint spline system between abutting sections of markerboards.
 3. Provide manufacturer's standard mullion trim at joints between markerboards of combination units.
 4. Where size of visual display boards or other conditions require support in addition to normal trim, provide structural supports or modify trim as indicated or as selected by Architect from manufacturer's standard structural support accessories to suit conditions indicated.
- D. Modular Visual Display Boards: Fabricated with integral panel clips attached to core material.
- E. Aluminum Frames and Trim: Fabricate units straight and of single lengths, keeping joints to a minimum. Miter corners to a neat, hairline closure.
1. Where factory-applied trim is indicated, trim shall be assembled and attached to visual display units at manufacturer's factory before shipment.

2.6 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.7 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, surface conditions of wall, and other conditions affecting performance of the Work.
- B. Examine roughing-in for electrical power systems to verify actual locations of connections before installation of motor-operated, sliding visual display units.
- C. Examine walls and partitions for proper preparation and backing for visual display surfaces.
- D. Examine walls and partitions for suitable framing depth where sliding visual display units will be installed.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions for surface preparation.
- B. Clean substrates of substances that could impair the performance of and affect the smooth, finished surfaces of visual display boards, including dirt, mold, and mildew.
- C. Prepare recesses for sliding visual display units as required by type and size of unit.

3.3 INSTALLATION, GENERAL

- A. General: Install visual display surfaces in locations and at mounting heights indicated on Drawings, or if not indicated, at heights indicated below. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.
 - 1. Mounting Height: 36 inches above finished floor to top of chalktray.

3.4 INSTALLATION OF FACTORY-FABRICATED VISUAL DISPLAY BOARDS AND ASSEMBLIES

- A. Visual Display Boards: Attach concealed clips, hangers, and grounds to wall surfaces and to visual display boards with fasteners at not more than 16 inches o.c. Secure both top and bottom of boards to walls.
 - 1. Field-Applied Aluminum Trim: Attach trim over edges of visual display boards and conceal grounds and clips. Attach trim to boards with fasteners at not more than 24 inches o.c.
 - a. Attach chalktrays to boards with fasteners at not more than 12 inches o.c.

3.5 CLEANING AND PROTECTION

- A. Clean visual display surfaces according to manufacturer's written instructions. Attach one cleaning label to visual display surface in each room.
- B. Touch up factory-applied finishes to restore damaged or soiled areas.
- C. Cover and protect visual display surfaces after installation and cleaning.

END OF SECTION

SECTION 10 44 00
FIRE PROTECTION SPECIALTIES

CONDITIONS OF THE CONTRACT AND DIVISION 01, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 REFERENCES

- A. Uniform General Conditions for Construction Contracts, State of Texas, 2010 (UGC)
- B. National Fire Protection Association (NFPA) 10
- C. National Fire Protection Association (NFPA) 10R
- D. National Fire Protection Association (NFPA) Fire Protection Handbook
- E. State of Texas Fire Marshal requirements

1.2 SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's specifications and technical data to indicate specification compliance.
 - 2. Manufacturer's installation instructions.
 - 3. 6" x 6" sample demonstrating finish
- B. Shop Drawings

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Specifications are based on the products of named manufacturers. Other listed manufacturers who produce products equivalent to those specified are approved for use on the Project. Other manufacturers must have a minimum of five (5) years experience manufacturing equivalent to those specified and comply with Division 1 requirements regarding substitutions to be considered.
 - 1. J. L. Industries, Inc
 - 2. Larsen's Manufacturing Co.
 - 3. Modern Metal Products, Division of Technico Inc.

2.2 MATERIALS

- A. Fire Extinguisher Cabinets (FEC-):
 - 1. Basis of Design: J.L. Industries Cosmopolitan Fire-FX2 Series
 - 2. Acceptable Manufacturers:
 - a. J. L. Industries, Inc
 - b. Larsen's Manufacturing Co.
 - c. Modern Metal Products, Division of Technico Inc.
 - 3. Size: As required to accommodate specified Fire Extinguisher
 - 4. Type: ADA Compliant; Fully-Recessed (-F), Partially-Recessed (-P), or Surface-Mounted (-S) as indicated on Drawings
 - 5. Tub Construction: 22 gauge min. steel with standard baked acrylic enamel interior finish.
 - 6. Trim: Flat for Fully-Recessed cabinets; square edge for Partially-Recessed, and Surface-Mounted cabinets

7. Door and Frame: 18 gauge min. 304 stainless steel door and frame
 8. Letters: Die cut letters in black
 9. Glazing: Clear Acrylic
 10. Hardware: Continuous concealed piano hinge constructed of material which matches door and trim material. Satin finish pull handle with cam cylinder lock with safety pull designed to release upon firm pull on handle (Larsen's "Larsen-Loc"[™], J.L. Industries "Saf-T-Lok"[™]; or equivalent)
 11. Bracket: Hook type; Larsen's #1007, or equal.
 12. Finish of Exterior: #4 Stainless steel
 13. Fire Rating: as occurs, provide fire rated cabinet, for one or two hour rated conditions as indicated or required by specific location. Cabinet shall be tested and approved by Warnock Hersey to ASTM E-814, and shall bear the Warnock Hersey label.
- B. Multi-Purpose Chemical Fire Extinguishers (10 44 00.FE):
1. Models/Types:
 - a. Basis of design: J.L. Industries "COSMIC 5E", Multipurpose dry chemical with 5 lbs. capacity and UL 3A-40B:C rating
 2. Acceptable Manufacturers:
 - a. J.L. Industries, Inc.
 - b. Larsen's Manufacturing Company
 - c. Potter Roemer LLC
 - d. Amerex Corporation
 - e. Ansul Incorporated: Tyco International Ltd.
 - f. Badger Fire Protection; a Kidde company
 3. Mounting: Provide eye brackets for direct wall mounting to hook and for mounting in Fire Extinguisher cabinets. Refer to drawings for location(s) and quantity(s).
 4. Provide initial inspection tag for each extinguisher.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install fire extinguishers and cabinets in openings in accordance with manufacturer's printed instructions.
- B. Install fire extinguishers and cabinets where indicated on the drawings, or if not indicated, in locations required by governing code and as directed by Owner.

END OF SECTION

SECTION 11 53 13

LABORATORY FUME HOODS AND RELATED PRODUCTS

CONDITIONS OF THE CONTRACT AND DIVISION 01, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Bench-top High-Performance Laboratory Fume Hoods
 - 2. Service fixtures (i.e. water, gas, etc.) and electrical service fittings in fume hoods
 - 3. Piping and wiring within service fittings, light fixtures, switches, and other electrical devices
 - 4. Fume hood base support
 - 5. Work Surfaces within fume hoods
 - 6. Laboratory sinks and cup sinks in fume hoods
 - 7. Filler panels and ceiling enclosures for fume hoods
- B. Related Sections:
 - 1. Division 22: Furnish and installation of plumbing utilities and final connections to fume hoods.
 - 2. Division 23: Furnishing and installation of exhaust duct work and equipment, and final connection of hoods.
 - 3. Division 26: Furnishing and installation of electrical utilities and final connections to hoods.

1.2 SCOPE AND CLASSIFICATION

- A. This specification covers the requirements for the purchase of bench mounted laboratory fume hoods for use with remote exhaust blower systems.
- B. Bench-mounted laboratory fume hoods in 4, 5, 6 and 8-foot widths, internal depth of 23.3" and external depth of 37.7" is required.
- C. This specification sets the intent for quality, performance and appearance.

1.3 REFERENCES

- A. The laboratory hoods must conform to the following regulations and standards.
 - 1. SEFA 1-2010, Scientific Equipment and Furniture Association , Recommended Practices for Laboratory Fume Hoods
 - 2. SEFA 8-2010, Recommended Practices for Laboratory Grade Metal Casework, 8.0 Cabinet Surface Finish Tests
 - 3. NFPA 45-2011, National Fire Protection Association, Fire Protection for Laboratories Using Chemicals
 - 4. ASTM E84-09C, ANSI 2.5, NFPA 255, UL 723, UBC 8-1 (42-1), Standard Test method for Surface Burning Characteristics of Building Materials
 - 5. ASHRAE 110-95, American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Method of Testing Performance of Laboratory Fume Hoods
 - 6. ANSI/AIHA Z9.5-2011, American Industrial Hygiene Association, Laboratory Ventilation

7. OSHA, Federal Register 29 CFR Part 1910, Occupational Safety & Health Administration, U.S. Department of Labor, Occupational exposures to hazardous chemicals in laboratories.
- B. The laboratory fume hoods must carry the ETL listed mark for the following.
 1. UL 61010-1 (formerly 3101-1), Underwriters Laboratories Inc., Electrical Equipment for Laboratory Use
 2. CAN/CSA C22.2 No. 61010-1, Canadian Standards Association, Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use
 3. UL 1805, Underwriters Laboratories Inc., Standard for Laboratory Hoods and Cabinets
- C. 230 volt model fume hoods must carry the CE conformity marking as required by the Council of European Communities.

1.4 PERFORMANCE REQUIREMENTS

- A. General Design Requirements (See Part 2 for details)
 1. Fume hoods shall function as ventilated, enclosed workspaces, designed to capture, contain and exhaust fumes, vapors and particulate matter produced or generated within the enclosure.
 2. Fume hood shall be factory designed to function as a <by-pass fume hood> <variable air volume fume hood>.
 3. Structure and Materials of construction
 - a. Hoods are of double-wall construction
 - b. Powder-coated, cold rolled steel exterior
 - c. Galvanized steel support members
 - d. One-piece, monolithic, molded polyester resin liner
 4. Baffles
 - a. One-piece, monolithic, molded polyester resin
 - b. Moving or adjustable baffles are not acceptable
 5. Sash
 - a. Maximum opening is 28".
 - b. Unobstructed viewing height is 37.5".
 - c. Hood incorporates a perforated sash handle to bleed air into the hood chamber directing fume concentrations away from the user's breathing zone.
 6. Airfoil:
 - a. Hoods are provided with an air foil across the bottom of the sash area to allow airflow into the hood regardless of user's position.
 7. Besides the exhaust blower, no additional blowers are required for specified containment.
 8. Access for maintenance is from both the front and exterior sides of the hood.

9. Services:
 - a. Furnishing and delivering all service outlets, accessory fittings, electrical receptacles and switches, as listed in these specifications, equipment schedules or as shown on drawings.
 - b. Plumbing fittings mounted on the fume hood superstructures shall be pre-plumbed per section 2.03.
 - c. Final plumbing and electrical connections are the responsibility of those contractors fulfilling requirements of Divisions 22 and 26.
 - d. All electrical services are pre-wired to a single point internal junction box at the top right of the hood.
 10. Hoods without service fixtures pass through a 33" opening without disassembly.
- B. Containment
1. The purpose of this section is to set a standard of performance for the bidder's laboratory fume hood before award of contract, and may not necessarily represent the operating conditions of the hoods after installation. Before or after award of contract, owners may require representative witness to said testing at their option, with failure to meet passing criteria as grounds for rejection of the bidder. Test data shall be provided at no cost to the owner.
 2. Evaluation of manufacturer's standard product shall take place in manufacturer's test facility meeting the following criteria.
 - a. Lab to be located at manufacturer's place of business for the testing of bench-mounted laboratory hoods in accordance with ASHRAE Standard 110.
 - b. Room shall accommodate hoods up to 16' wide, while maintaining sufficient area so that a minimum of 15 feet of clear space is available in front of and 5' on both sides of hoods for viewing tests.
 - c. The facility's ventilation system shall have adequate heating and air conditioning so that room air temperatures can be maintained within the desired ranges.
 - d. One hundred percent non-recirculated air to be both carbon and HEPA filtered to ensure removal of contaminants that could interfere with containment testing before entering the lab.
 - e. Make-up air to the test room shall be ceiling-supplied through any combination of multiple diffusers to either minimize adverse airflow, or increase it depending on test objectives.
 - f. Exhaust volumes shall be computer controlled and measured via AMCA calibrated orifices and flow station at each exhaust trunk.
 - g. Room pressurization must be digitally monitored, and variable depending on test objectives.
 - h. All equipment must be properly calibrated.
 - i. Qualified personnel familiar with the laboratory and its operation shall be available to perform the test.
 - j. Include the following instrumentation and test equipment:
 - 1) Properly calibrated hot wire thermal anemometer capable of measuring air velocities from 10 to 600 ft/minute; correlate with computer data acquisition format to provide simultaneous readings at all points.

- 2) Theatrical smoke generator or other source of high volume smoke.
 - 3) Smoke tubes or other source of localized smoke.
 - 4) Leakmeter with traceable calibration, calibrated just before test, to indicated concentration of sulfur hexafluoride.
 - 5) Tracer gas: Sulfur hexafluoride supplied from a cylinder with two stage regulator.
 - 6) Adjustable mannequin, 5' 0' to 5'8" in height, with reasonable human proportions, clothed in a smock
 - 7) Inclined manometer with graduations no greater than 0.2 inch of water.
 - 8) Ejector system: Tracer gas ejector built to specific ASHRAE-110 requirements.
 - 9) Critical orifice: Sized to provide tracer gas at four or eight liters per minute at an upstream pressure sufficient to maintain release rate.
 - 10) Data acquisition software to include HoodPro™ and LabMeasurePro™ from Exposure Control Technologies, Inc.
3. Hood shall be tested to ASHRAE 110 modified test method as detailed below.
 4. Some fume hoods may use face velocity controls, motorized baffles, integral auxiliary make up, or supply fans. Because all of these devices are subject to failure, containment testing shall show both operational containment and product containment with these systems off.
 5. Fume hood sashes shall be placed in their full open position, at least 28" from the work surface, unless noted otherwise.
 6. Ambient Temperature: 68 to 74 degrees F
 7. Average Face Velocity: Face velocity average shall be 60 fpm, as noted below in subsection 8.d, parts 1 and 2, plus or minus 5%.
 - a. An imaginary grid is formed comprised of equal 12" by 12" squares, or smaller, across the face opening of the laboratory hood. Airflow velocity readings are taken at the intersections of these grids with calibrated hot wire anemometer over a twenty second period of time. Probes shall communicate readings to a computer data acquisition package, which will provide an average of each reading over the one-minute period and also an overall average upon completion of data acquisition. Face velocity shall be determined by averaging readings at the hood face.
 - b. Average face velocity must be achieved without exceeding the CFM noted in part C.
 8. Tracer Gas Detection: Hood shall achieve a rating of 4.0AM0.00 maximum average and 4.0AM0.01 maximum spike (unless specifically otherwise noted), wherein:
 - a. 4.0 = tracer gas release in liters/minute, AM = as manufactured, 0.01 = tracer gas in parts per million (PPM)
 - b. With the ejector body 6" from the rear of the sash plane, the test shall be conducted for each ejector position noted.
 - 1) Left position with ejector 12" from the left interior wall.

- 2) Center position with ejector equidistant from the sidewalls.
 - 3) Right position with ejector 12" from the right interior wall.
 - c. Install mannequin positioned in front of the hood, centered on the ejector.
 - d. Detector probes shall be placed 3" in front of the sash plane. The test shall be conducted for each detector probe position and corresponding face velocity.
 - 1) Detector probe in the region of the nose and mouth of the mannequin. Test with average face velocity of 60 fpm.
 - 2) With the mannequin height reduced 4", place detector probe in the chest of the mannequin, and even with the height of the ejector. Test with average face velocity of 60 fpm.
 - e. Open tracer gas valve, and collect readings with a computer data acquisition package, which is capable of monitoring and visually recording a minimum of one reading per second for a minimal five minute time period for each position.
 - f. The single control rating of the fume hood shall be the results of the test position yielding the highest average levels of tracer gas in any of the six mannequin/ejector configurations.
 - g. With the ejector and mannequin in the center position, detector probe in the region of the nose and mouth of the mannequin, average face velocity of 60 fpm, tracer gas released, and concentration recorded, open and close the sash in a smooth motion. Test to be repeated three times, with peak values of 0.01 PPM or less.
 - h. With the mannequin removed, the periphery of the hood is traversed by the probe at 1" in front of the hood opening at a rate of 3 inches per second. The hood shall have a maximum perimeter reading of 0.03 PPM or less.
9. Flow Visualization:
- a. Test the operation of the lower air bypass airflow opening and hood periphery by introducing light smoke under the air foil, and around the perimeter of the sash opening. If any smoke that enters the hood reverses directions and escapes from any of these locations, the hood fails this portion of the test and receives no rating.
 - b. Introduce smoke along both walls and the hood floor in a line parallel to the hood face and 6 inches (152 mm) back into the hood. Define air movement toward the face of the hood as reverse airflow and define lack of movement as dead air space. All smoke should be carried to the back of the hood and out.
 - c. Introduce a large volume of smoke at the work surface in the center of the hood, and 6" inside the plane of the sash. Define air movement toward the face of the hood as reverse airflow and define lack of movement as dead air space. All smoke should be carried to the back of the hood and out.
 - d. All data on the above, including instrumentation and equipment, and test conditions shall be provided on a report, including the average face velocities, and a separate graph-type performance curve on all tracer gas tests for all required fume hood widths. Performance test data for a 6' representative hood shall be conducted by an independent testing

agency and by a specific individual certified to perform such tests by the National Environmental Balancing Bureau (NEBB).

C. Efficiencies

1. The fume hood shall maintain constant volumetric rate (+/- 5 CFM) and static pressure losses (+/- 0.01" H2O) across all sash positions, unless the hood has a restricted by-pass for use with a variable air volume (VAV) system.
2. The fume hood shall demonstrate a minimization of the volumetric rate of air (CFM) requirement at any given face velocity. Required CFM to achieve desired face velocity shall not exceed that which is noted in the chart below.
3. The fume hood shall demonstrate a minimization of static pressure loss (inches of H2O) at any given CFM. Static pressure loss at desired face velocity, and corresponding CFM, shall not exceed that which is noted in the chart below.

Velocity (fpm) Sash at 28" Open	Airflow Volumetric Rate (CFM) @ Static Pressure (inches of water)			
	4' Hood	5' Hood	6' Hood	8' Hood
100	725, 0.22"	955, 0.31"	1180, 0.41"	1640, 0.28"
80	580, 0.14"	765, 0.20"	945, 0.26"	1310, 0.18"
60	435, 0.08"	575, 0.11"	710, 0.15"	985, 0.10"
50*	365, 0.06"	480, 0.08"	590, 0.10"	820, 0.07"
Velocity (fpm) Sash at 18" Open	Airflow Volumetric Rate (CFM) @ Static Pressure (inches of water)			
	4' Hood	5' Hood	6' Hood	8' Hood
100	450, 0.09"	595, 0.12"	735, 0.16"	1025, 0.11"
80	365, 0.06"	480, 0.08"	590, 0.10"	820, 0.07"
60	270, 0.03"	360, 0.04"	440, 0.06"	615, 0.04"

*There is not a written standard that would suggest a design face velocity below 60 fpm. This data is for informational purposes only.

- D. Noise Criterion: The hood shall have a Noise Criterion (NC) rating of less than 50; measured 36" in front of the hood with full open sash, at 100 fpm face velocity. NC is a factor of sound pressure level (dB) and frequency.
- E. Illumination: Shall be a minimum average of 80 foot-candles inside the work area. Work area is defined as the area inside the lined portion of the fume hood, from the face of baffle to sash plane, from interior left to interior right, and from the work surface to a height of 28 inches.
- F. Materials of Construction: Interior and Exterior materials of construction and finishes shall meet the requirements in Part 2 of this specification.

1.5 QUALITY ASSURANCE

- A. Fume hoods shall be designed, including comprehensive engineering analysis, by a qualified, licensed Professional Engineer.
- B. Manufacturer's Qualifications
 1. ISO 9001 Certified manufacturing plant and processes.
 2. Ten installations of equal or larger size and requirements. Provide contact at each.
 3. Only hood manufacturers who have had fume hoods as a principal product for 20 years are considered.

- C. Supply all equipment in accordance with this specification. Offering a product differing in materials, construction, or performance from this specification requires written approval obtained seven days or more before the proposal deadline.
- D. The owner/architect reserves the right to reject qualified or alternate proposals and to award based on product value where such action assures the owner greater integrity of product.
- E. Manufacturer's warranty against defects in material or workmanship on its fume hoods will be for 1 year from date of installation or 2 years from date of purchase, whichever is sooner, and includes replacement of parts (except lamps) and labor.

1.6 SUBMITTALS

- A. Action Submittals
 - 1. Laboratory hood specification sheets and product manuals shall be submitted by the hood manufacturer upon request, and include safe and proper operation and maintenance information.
 - 2. Shop Drawings: Include plans, elevations, sections, and details.
 - a. Indicate details for anchoring fume hoods to permanent building construction including locations of blocking and other supports.
 - b. Indicate locations and types of service fittings together with associated service supply connection required.
 - c. Indicate duct connections, electrical connections, and locations of access panels.
 - d. Include roughing-in information for mechanical, plumbing, and electrical connections.
 - e. Provide face opening, volumetric rates, and static pressure drop data.
 - 3. Submit a document detailing the information supplied on the Hood Safety Practices Label to verify compliance to specifications.
- B. Informational Submittals
 - 1. Product Test Reports: Showing compliance with specified performance requirements, including NEBB representative test report as defined previously.
 - 2. Independent validation:
 - a. Written verification that the laboratory fume hoods carry the ETL listed mark for the following.
 - 1) UL 61010-1 (formerly 3101-1), Underwriters Laboratories Inc., Electrical Equipment for Laboratory Use
 - 2) CAN/CSA C22.2 No. 61010-1, Canadian Standards Association, Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use
 - 3) UL 1805, Underwriters Laboratories Inc., Standard for Laboratory Hoods and Cabinets
 - b. Written verification that 230 volt model fume hoods carry the CE conformity marking as required by the Council of European Communities.
 - c. Written verification from an outside testing agency confirming coating compliance to SEFA 8-2010, Recommended Practices for Laboratory Grade Metal Casework, 8.0 Cabinet Surface Finish Tests

3. Documentation of ISO 9001 Certified manufacturing plant and processes.
 4. List of five installations (of equal or larger size and requirements) is available upon request. Provide contact at each.
 5. Declaration of Made in America. Owner reserves the right to evaluate Made in America claims for compliance with the Bureau of Consumer Protection.
- C. Material Submittals:
1. Samples for Verification: of the hood exterior wall material, interior liner and baffle material, epoxy work surface material, and color selection chips are available from the hood manufacturer upon request.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect finished surfaces during handling and installation with protective covering of polyethylene film or another suitable material.
- B. Schedule delivery of equipment so that spaces are sufficiently complete that equipment can be installed immediately following delivery.

1.8 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.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Specifications are based on products of manufacturers named as the Basis of Design. Manufacturers listed whose product meet or exceed the specifications are approved for use on the Project. Other manufacturers must have a minimum of five (5) years experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
 1. Labconco Corporation, 8811 Prospect Avenue, Kansas City, Missouri 64132
- B. Basis-of-Design Product: Labconco Protector Premier; for use with remote blower

2.2 MATERIALS

- A. Hood Interior Liner and Baffle
 1. Liner material must comply with UL 1805, and be listed within NRTL test report as proof of compliance.
 2. General Material Properties
 - a. Nonflammable, corrosion and chemical-resistant
 - b. Fiberglass reinforced polyester resin
 - c. Minimum thickness is 3/16"
 - d. Smooth, white finish
 3. Method of Construction
 - a. Liner shall be one continuous molded component, and of monolithic construction, including the left and right side walls, rear, ceiling, and duct collar. Liners that are bonded together, do not include the duct collar within the continuous structure, or are of panelized construction are not acceptable.

4. Flame and Smoke Characteristics
 - a. Flame retardant, self-extinguishing, with a flame spread rating of 25 or less in accordance with ASTM-E84
5. Chemical Resistance
 - a. Splash and Spill Resistance:
 - 1) Suspend sample panel in a vertical plane
 - 2) Apply five drops of each reagent listed with an eyedropper
 - 3) Apply liquid reagents at top of panel and allow to flow down full panel height
 - b. Fume Resistance:
 - 1) Place 25 milliliters of reagent into 100 milliliters beakers and position panel over beaker tops in the proper sequence. Ensure beaker pouring lip permits air to enter the interior atmosphere.
 - 2) After 24 hours remove panel, flush with water, clean with detergent, rinse, wipe dry and evaluate
 - c. Evaluation ratings: Change in surface finish and function shall be described by the following ratings
 - 1) E: Excellent for intended service with expected long and economic life.
 - 2) G: Some staining may result with prolonged usage. Satisfactory for limited service. Tests under actual conditions suggested.
 - 3) F: Surface deterioration may be experienced with prolonged usage. Test under actual conditions.
 - 4) NR: Not Recommended
 - a) Required minimum results for each reagent (Reagent, Rating)

1)	Acetic Acid	G	2)	Acetone	G
3)	Acrylic Acid	G	4)	Aluminum Fluoride	E
5)	Aluminum Sulfate	E	6)	Ammonia	E
7)	Ammonium Bicarbonate	E	8)	Ammonium Carbonate	G
9)	Ammonium Chloride	E	10)	Ammonium Fluoride	F
11)	Ammonium Hydroxide	G	12)	Ammonium Nitrate	E
13)	Ammonium Persulfate	E	14)	Ammonium Sulfate	E
15)	Ammonium Thiocyanate	E	16)	Amyl Acetate	E
17)	Amyl Alcohol	E	18)	Aniline	F
19)	Aniline Sulfate	E	20)	Antimony Pentachloride	E
21)	Antimony Trichloride	E	22)	Aqua Regia (HNO3-HCl)	

			Aromatic Hydrocarbon	E	
23)	Arsenious Acid	E	24)	Barium Carbonate	E
25)	Barium Chloride	E	26)	Barium Hydroxide	F
27)	Benzaldehyde	F	28)	Benzene	G
29)	Benzene Sulfonic Acid	E	30)	Benzoic Acid	E
31)	Bleach - Hypochlorite	E	32)	Bromine, liquid	F
33)	Butyl Acetate	E	34)	Butyl Alcohol	E
35)	Butyric Acid	E	36)	Calcium Chlorate	E
37)	Calcium Chloride	E	38)	Calcium Hydroxide	E
39)	Calcium Hypochlorite	E	40)	Calcium Sulfate	E
41)	Caprylic Acid(n-Octanoic Acid)	E	42)	Carbon Dioxide	E
43)	Carbon Disulfide Vapor	F	44)	Hydrocyanic Acid	E
45)	Hydrofluoric Acid	G	46)	Hydrofluorosilic Acid	F
47)	Hydrogen	E	48)	Hydrogen Chloride, Anhydrous	E
49)	Hydrogen Fluoride, Wet	F	50)	Hydrogen Peroxide	E
51)	Hydrogen Sulfide	E	52)	Hypochlorous Acid	E
53)	Kerosene	E	54)	Lactic Acid	E
55)	Lead Acetate	E	56)	Lime Slurry	E
57)	Linseed Oil	E	58)	Lithium Chloride	E
59)	Magnesium Carbonate	E	60)	Magnesium Chloride	E
61)	Magnesium Sulfate	E	62)	Malic Acid	E
63)	Mercaptan, Organic, H ₂ S, H ₂ O, Butanol	E	64)	Mercuric Chloride	E
65)	Mercurous Chloride	E	66)	Mercury	E
67)	Alcohol	E	68)	Methyl Chloride	F
69)	Methyl Ethyl Ketone	G	70)	Methyl Isobutyl Ketone	E
71)	Moisture	E	72)	Naptha	E
73)	Napthalene	E	74)	Nickel Chloride	E
75)	Nickel Nitrate	E	76)	Nickel Sulfate	E
77)	Nitric Acid	E	78)	Nitrobenzene	G
79)	Nitrogen	E	80)	Nitrous Acid	E
81)	Oleic Acid	E	82)	Oxalic Acid	E
83)	Perchloric Acid	NR	84)	Phenol	F
85)	Phosphate Salts	E	86)	Phosphonitrilic Chloride, Cl ₂ , HCl, benzene, H ₂ O Vapors	E

87)	Phosphoric Acid	E	88)	Phosphoric Vapor & Condensate	E
89)	Phosphoric: Nitric Vapor	E	90)	Phosphoric: HCl, Saturated with phosphorous	E
91)	Phosphoric: HCl, Sat. with Cl ₂	E	92)	Phosphorous Oxychloride, CHI, Cl ₂ , H ₂ O Vapors	E
93)	Phosphorous Trichloride, HCl, Cl ₂ , H ₂ O Vapors	E	94)	Phosphorous Sesquisulfide	E
95)	Phthalic Anhydride	E	96)	Picric Acid in Alcohol	E
97)	Potassium Bicarbonate	E	98)	Potassium Carbonate	E
99)	Potassium Chloride	E	100)	Potassium Dichromate	E
101)	Potassium Ferrocyanide	E	102)	Potassium Hydroxide	F
103)	Potassium Nitrate	E	104)	Potassium Permanganate	G
105)	Potassium Persulfate	E	106)	Potassium Sulfate	E
107)	Propylene Glycol	E	108)	PVA Emulsion	E
109)	Pyridine	F	110)	Silver Nitrate	E
111)	Sodium Acetate	G	112)	Benzoate	E
113)	Sodium Bicarbonate	E	114)	Sodium Bisulfate	E
115)	Sodium Borate	E	116)	Sodium Bromide	E
117)	Sodium Carbonate	E	118)	Sodium Chloride	E
119)	Sodium Cyanide	F	120)	Sodium Ferricyanide	E
121)	Sodium Hydroxide	G	122)	Sodium Hypochlorite	E
123)	Sodium Nitrate	E	124)	Sodium Sulfate	E
125)	Sodium Sulfide	E	126)	Sodium Sulfite	E
127)	Sodium Tetraborate	E	128)	Sodium Xylene Sulfonate	E
129)	Stannic Chloride	E	130)	Stannous Chloride	E
131)	Stearic Acid	E	132)	Styrene	G
133)	Sulfite Liquors	E	134)	Sulfur, molten, vapors	E
135)	Sulfur Chloride	E	136)	Sulfur Dioxide	E
137)	Sulfonated Aliphatics, HCl, H ₂ S, Butanol vapors	E	138)	Sulfur Dioxide Saturated H ₂ O; trace HF, H ₂ SO ₄ , H ₂ S, F ₂	E
139)	Sulfur Dioxide: SO ₃ wet vapor	F	140)	Sulfur Trioxide	E
141)	Sulfuric Acid	G	142)	Sulfuric Acid + Dichromate	G
143)	Sulfuric + Chromic	G	144)	Sulfuric Acid vapor	G

145)	Sulfuric-Nitric Acids	G	146)	Sulfuric - HCl	G
147)	Sulfurous Acid	G	148)	Tannic Acid	E
149)	Tartaric Acid	E	150)	Tetropotassium Pyrophosphate	E
151)	Toluene	G	152)	Toluene Diisocyanate	E
153)	Trichloroacetic Acid	E	154)	Trichloroethylene	G
155)	Trichloroethylene, HCl, Cl ₂ , H ₂ O vapors	G	156)	Trichlorophenol	F
157)	Trisodium Phosphate	F	158)	Waste, Organic, H ₂ O, HCl, Cl ₂ , vapors	E
159)	Water	E	160)	Zinc Chloride	E
161)	Zinc Sulfate	E	162)		

B. Sheet Steel

1. Side panels and access panels 20-gauge (or heavier) sheet steel.
2. Hood corner posts are 16-gauge sheet steel.
3. Ceiling enclosure panels are 18 gauge sheet steel.
4. Cold-rolled, commercial steel (CS) sheet, complying with ASTM A 1008/A 1008M.

C. Chemical Resistant Finish

1. General: Prepare, treat, and finish welded assemblies after welding. Prepare, treat, and finish components that are to be assembled with mechanical fasteners before assembling.
2. Chemical and Physical Resistance of Finish System: Finish complies with acceptance levels of cabinet surface finish tests in SEFA 8. Third party validation required.
3. Powder-coat process required. Paint processes that release Volatile Organic Compounds (VOC) are not acceptable.
4. Color for Fume Hood Finish: Glacier White

D. Safety Glass

1. Laminated

2.3 CONSTRUCTION

A. Superstructure:

1. Self-supporting, rigid structural assembly, to support inner wall consisting of fume hood liner and outer wall of sheet metal exterior.
2. Fabricated from galvanized steel.
3. Space shall accommodate fume hood wiring and plumbing components for service fixtures.
4. Access to fixture valves concealed in wall provided by exterior removable access panels or through removable access panels on the front posts.

B. Exterior

1. Fabricate from steel sheet with component parts screwed together.
2. Apply chemical-resistant finish to interior and exterior surfaces of component parts before assembly.
3. Interchangeable side panels shall lift off without the use of tools to allow access to plumbing lines, service fittings, electrical wiring, counterbalance sash weights, and light fixtures. Exposed fasteners or hardware, and Velcro type fasteners, are not acceptable.
4. Corner posts:
 - a. Pre-punched and plugged to accommodate up to 4 service fixtures per side
 - b. All services are accessible from the front of the hood.
 - c. Aerodynamic shape
 - d. Accommodate two electrical duplexes per side.
 - e. Right hand corner post includes electrical switches and pre-cut for Airflow monitor installation.
 - f. Un-used penetrations shall be plugged.
5. Top and sides of face opening to provide an aerodynamic shape to ensure smooth, even flow of air into fume hood.
6. Panel above header shall be removable without the use of tools to allow access to mechanical connection, electrical wiring, counterbalance sash weights, and light fixtures. Exposed fasteners or hardware, and Velcro type fasteners, are not acceptable.

C. Dimensions

1. Overall exterior dimensions are as follows:
 - a. 4 foot nominal width: 48" w x 59" h x 31.7"d
 - b. 5 foot nominal width: 60" w x 59" h x 31.7"d
 - c. 6 foot nominal width: 72" w x 59" h x 31.7"d
 - d. 8 foot nominal width: 96" w x 59" h x 31.7"d
2. Overall interior dimensions are as follows:
 - a. 4 foot nominal width: 38.1" w x 48" h x 23.3"d
 - b. 5 foot nominal width: 50.1" w x 48" h x 23.3"d
 - c. 6 foot nominal width: 62.1" w x 48" h x 23.3"d
 - d. 8 foot nominal width: 86.1" w x 48" h x 23.3"d

D. Hood Liner

1. Adhere interior liner components to superstructure.
2. Stainless steel fasteners shall be used on the interior ceiling for structural integrity.
3. Fasteners exposed to chemical environment are not acceptable.
4. Punch fume hood lining side panels to receive four service fittings, for use with remote controls, per side. Provide removable plug buttons for holes not used for indicated fittings.

- E. Hood Baffle
 - 1. Baffle system shall be designed to capture a wide range of gaseous densities without adjustment or moving components
 - 2. Shall provide a continuous horizontal slot at the work surface, vertical openings running the interior height of the hood on the left and right sides, and an opening at the ceiling running left to right.
 - 3. The baffle system shall be constructed with the same material as the fume hood liner.
 - 4. The baffles shall be removable for cleaning.
 - 5. Exposed components to be non-metallic. Metal components exposed to chemical environment are not acceptable.
 - 6. Moving parts or adjustment of any kind is not acceptable.
- F. Exhaust Connection
 - 1. Fiberglass reinforced polyester resin, and a continuous component of the fume hood liner. Duct collars attached with fasteners, adhesive, or varying in material of construction from the liner are not acceptable.
 - 2. 12.81" ID to accommodate any 12" nominal duct without the need for a transition adapter. 4, 5, and 6-foot hoods have one exhaust connection, 8-foot hoods have two exhaust connections. Additional components required to accommodate 12" nominal mechanical system are not acceptable.
 - 3. Ducting shall go inside the duct collar to ensure condensate travels into the hood and evaporates. Duct collars that allow duct connection over the collar are not acceptable.
- G. Airfoil
 - 1. 316 stainless steel with Chemical-Resistant Finish.
 - 2. Airfoil shall have an aerodynamic radius to sweep the air into the hood with minimal turbulence. Airfoil directs airflow across work top to remove heavier-than-air gases.
 - 3. Must have 5 rows of perforations to allow the air to bypass underneath and through the foil and sweep across the work surface to prevent any back flow of fumes escaping from the front of the hood opening. This airflow continues even if blocked by the presence of the operator.
 - 4. Foil must extend back under the sash to prevent closure of the lower by-pass opening when the sash is in the fully closed position, directly on top of the airfoil.
- H. Sash Assembly
 - 1. Glass: Glaze with laminated safety glass with unobstructed, side-to-side view of fume hood interior and service fixture connections.
 - 2. Dimensions: The full sash opening height is 28", the total unobstructed viewing height is 37.5" measured from the work surface.
 - 3. Sash Tracks: Steel with Chemical Resistant Finish. Shall include bump stops for opening and closing.
 - 4. Sash Handle: extruded aluminum with Chemical Resistant Finish. Sash handle includes a perforated air passage directly atop the handle to bleed air into the hood chamber and direct chemical fumes away from the user's breathing zone. The handle is ergonomic in design and is easy to grasp when operating
 - 5. Sash guides: Corrosion resistant extruded poly-vinyl chloride.

6. Sash System:
 - a. Vertical Sash (Cable and Pulley)
 - 1) Hoods have a single vertical sash counterbalanced by a single weight.
 - 2) Sash and weight to be connected via aircraft cable meeting MIL-W-83420 Military Specification.
 - 3) Rear pulleys shall be connected via timing shaft to prevent sash tilting and permit one finger operation at any point along full width sash handle. Maximum 7 pounds pull required to raise or lower sash throughout its full length of travel.
 - 4) Design system to hold sash at any position without creep and to prevent sash drop in the event of cable failure.
 - 5) Include a defeatable, and automatically resetting sash stop positioned for an 18" sash height.
- I. Electrical Components:
 1. Lighting
 - a. Provide UL Listed, high-efficiency, quick-start, T8 fluorescent lighting systems, including bulbs.
 - 1) 4 Foot Hoods - 2 each, 3-foot 25-watt fluorescent lamps
 - 2) 5 Foot Hoods - 2 each, 4-foot 32-watt fluorescent lamps
 - 3) 6 Foot Hoods - 2 each, 4-foot 32-watt fluorescent lamps
 - 4) 8 Foot Hoods - 4 each, 3-foot 25-watt fluorescent lamps
 - b. Vapor-Proof: all electrical components shall be outside of the contaminated air space. Lighting shall be located behind a laminated safety glass shield, sealed to the top of the hood liner.
 - c. The fluorescent light assemblies shall be serviceable from outside the fume hood cavity, without the use of tools.
 - d. Light switch to be included on the lower right corner post, at heights compliant with the Americans with Disabilities Act (ADA).
 2. Blower Switch:

Hoods shall be provided with blower switch, on the lower right corner post, at heights compliant with the Americans with Disabilities Act (ADA).
 3. Electrical Receptacles
 - a. The hoods shall accommodate up to four (two per corner post) electrical receptacles as indicted in schedule or drawings. Options to include:
 - 1) 115 volt, 60 Hz, three-wire polarized and grounded electrical duplex
 - 2) 115 volt, 60 Hz, three-wire polarized and grounded electrical duplex, with Ground Fault Circuit Interruption (GFCI)
 - 3) 230volt, 60 Hz, three-wire polarized and grounded electrical duplex
 - b. Receptacles shall be individually wired to field wiring box, and each rated at 20 Amperes.
 - c. Cover plates shall be acid resistant thermoplastic.

4. Wiring
 - a. Every electrical component shall be individually wired to a single point internal field wiring box (including individual duplexes/receptacles).
 - b. Field wiring box to be 7" x 4" x 2.5", grounded, and have (12) 7/8" diameter knock out penetrations.
 - c. Final wiring and circuit dedication is to be by others.
 - d. Each receptacle circuit shall accommodate being wired to a dedicated building circuit rated at 20A, or the receptacles ganged together on a building circuit with the total load not exceeding 20 Amperes.
5. Fume hood to have third party validation of compliance to UL 1805 and UL 61010-1 by a Nationally Recognized Testing Laboratory (NRTL)
- J. Electrical Requirements: Hoods to be EP rated, and appropriate for use in an electrically classified space per NFPA 70
Lighting: UL listed, EP rated incandescent light fixtures
Wiring: No wiring or switches are provided.
Hoods to be field wired to meet local codes for electrical equipment in a classified space having a potentially explosive atmosphere.
By-Pass Opening:
 1. The size of the by-pass opening is controlled by sash position for use with a constant volume mechanical system. The hood shall not have a change in static pressure or exhaust volume across all sash positions.
- L. Hood Safety Practices Label: Corrosion resistant plate attached to the left corner post of the fume hood with the following Hood Safety Practices:
 1. For use with substances that produce hazardous levels of airborne chemicals: gas, fumes, vapors, dust
 2. Do not put your head in the hood.
 3. Minimize drafts and sudden movements in front of the hood.
 4. Work a minimum of six inches inside the hood.
 5. Elevate equipment above the work surface.
 6. Keep sill and baffle unobstructed.
 7. Do not use the hood for storage.
 8. Adjust the sash to smallest opening possible when in use.
 9. Close sash when unattended.
 10. Do not remove any of the hood components.
 11. Do not place flammable solvents near heat, flame or sparks.
 12. Do not evaporate large amounts of flammable liquids.
 13. Wipe up spills immediately.
 14. Routinely validate airflow.
 15. If the ventilation system malfunctions, or airflow alarm indicates unsafe condition, close sash and discontinue hood operation immediately-call for help.
 16. Do not use with Biohazards and Perchloric Acid

M. Fume Hood Accessories:

1. Service Fixtures: Color-coded hose nozzle outlets and valves mounted inside the fume hood and controlled from the exterior with color-coded index handles
 - a. The hoods are equipped without service fixtures or will be provided with a total of up to 8 service fixtures as indicated in schedule.
 - b. Hose connectors located inside the fume hood cavity are chemically-resistant, glass-filled polypropylene with 6 serrations.
 - c. Service lines shall be factory installed from valve to outlet
 - 1) Copper tubing unless otherwise noted
 - 2) Brass service lines for gas
 - 3) Stainless steel service lines for Deionized Water
 - 4) Connections shall be made with quick-connect compression fittings on the inlet and outlet of the valve body, soldered and brazed connections not easily disassembled are not acceptable.
 - 5) Inlet tubing: pre-piped to the top of the hood, include a coil of tubing to be routed below the hood at time of installation
 - d. Valves
 - 1) Extruded brass valve and rotating seat, TFE-coated silicone bronze stem and TFE packing.
 - 2) Fixture handles are plastic and color coded as well as labeled for the designated type of service.
 - 3) Fixtures are rated at maximum pressure of 200 psi.
 - 4) Coefficient of flow for the valve, $C_v=0.43$.
 - 5) Valves are front loaded, located on the fume hood corner post for remote use, and include:
 - a) Hot and cold tap water (flow rate 3.5 GPM or 13.25 LPM at 67 psi at full open
 - b) Natural gas (theoretical flow rate of 71CFM at 100 psi, provides 1095 BTU/Sec at a density of .667 Lbs/CU. FT.)
 - c) Air (theoretical flow rate of 59 CFM at 100psi)
 - d) Vacuum (theoretical flow rate of 6 CFM at 10 psi)
 - e) Nitrogen
 - f) Argon
 - g) Steam
 - h) Oxygen (include oxygen compatible lubricant)
 - i) Deionized/Distilled water (Nickel plated and stainless steel components)
2. Tissue Screen: Provide epoxy-coated, stainless-steel screen at bottom baffle opening to prevent paper from being drawn into the exhaust plenum behind baffles.
3. Rear Finish Panel: Shall be the same materials and coating as the hood exterior.

4. Ceiling Enclosure Panels:
 - a. Provide filler panels matching fume hood exterior to enclose space above fume hoods at front and sides of fume hoods and extending from tops of fume hoods to ceiling.
 - b. Exposed fasteners are not acceptable.
 - c. Height adjustment to be within the following ranges as specified in the schedule.
 - 1) 11.0 - 14.0"
 - 2) 14.0 – 18.6"
 - 3) 18.6 – 24.4"
 - 4) Fixed height of <__ inches>
 5. Distillation Grid: Include stainless steel rods, connectors, and factory drilled liner.
 6. Fire Suppression System: An ABC dry powder fire suppression system, with 165 degree Fahrenheit fusible link, shall be factory supplied and prepped, and field installed through the ceiling of the fume hood.
 7. Face Velocity Monitor/Alarm:
 - a. Digital Airflow Monitor
 - 1) Provide audible and visual alarm in the event of an unsafe face velocity.
 - 2) Alarm must sit flush with the fume hood corner post.
 - 3) Based on a thermally compensated thermistor in the alarm module, and air passing through a separate airstream into the hood interior.
 - 4) Velocity shall be displayed digitally on the user facing LCD in fpm or m/s.
 - 5) LED lights display red for alarm, yellow for caution, and green for normal operation.
 - 6) Must include external alarm and night setback functions.
 - 7) Alarm mute shall be accessible from the front of the monitor; visual alarm must remain activated until alarm condition is corrected.
 - 8) UL Listed electrical components
 - 9) Calibration shall be through a menu driven step by step procedure.
 - 10) Calibration is the responsibility of the owner, following a complete balancing of the mechanical system, and concurrently with As-Installed testing.
 8. Variable Air Volume (VAV) Prepared
 - 1) Fume hoods shall come factory prepared with the proper cutouts and brackets to field mount specified VAV controller and sash position sensor.
- N. Work Surface
1. Refer to Section 12 35 53 "Laboratory Casework"

- O. Supporting Base Cabinets
 - 1. Refer to Section 12 35 53 "Laboratory Casework"

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.
- B. Coordinate with other trades for the proper and correct installation of plumbing and electrical rough-in and for rough opening dimensions required for the installation of the hood.
- C. 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.
- B. Install level, plumb, and true; shim as required, using concealed shims, and securely anchor to building and adjacent laboratory casework.
- C. 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.
- D. Neighboring splash blocks shall not be attached directly to the hood.
- E. Install according to standards required by authority having jurisdiction.
- F. Sequence installations to ensure utility connections are achieved in an orderly and expeditious manner.
- G. Touch up minor damaged surfaces caused by installation. Replace damaged components as directed by Architect.

3.3 FIELD QUALITY CONTROL

- A. NFPA 45 requires that fume hoods be field tested when installed.
- B. Field test installed fume hoods according to ASHRAE 110 to verify compliance with performance requirements.
 - 1. Adjust fume hoods, hood exhaust fans, building's HVAC system, and make other corrections until tested hoods perform as specified in fume hood schedule.
 - 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. Clean adjacent construction and surfaces that may have been soiled in the course of installation of work in this section.
- D. Provide all necessary protective measures to prevent exposure of equipment and surfaces from exposure to other construction activity.

- E. Advise contractor of procedures and precautions for protection of material and installed equipment and casework from damage by work of other trades.

END OF SECTION

SECTION 12 24 13
ROLLER WINDOW SHADES

CONDITIONS OF THE CONTRACT AND DIVISION 01, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. Provide manually operated, sunscreen and blackout roller shades as applicable.
 - 2. Provide electrically operated, sunscreen and blackout roller shades as applicable. Work includes local, group and master control systems for shade operation with addressable, encoded, electronic drive units (EDU).
- B. Related Requirements
 - 1. Section 09 21 16, "Gypsum Board Assemblies": Coordination with gypsum board assemblies for blocking, installation of shade pockets, closures and related accessories.
 - 2. Section 09 51 00 "Acoustical Ceilings": Coordination with acoustical ceiling systems for blocking, installation of shade pockets, closures and related accessories.
 - 3. Division 26 - Electrical: Electric service for EDU's, and EDU controls, internal communication, low voltage wiring and data transfer, and connection to the Internet and required.

1.2 SUBMITTALS

- A. Bid Submittal, Information Required with Submittal of Bid: In order to evaluate proposals for integrated lighting or AV control and window shade systems, the Architect requires the following information be submitted prior to the award of the system.
 - 1. Bid proposal shall be accompanied with a document that notes all deviations from these specifications on a line-by-line basis.
 - 2. Bid shall confirm that roller shade EDU's and all related controls shall be integrated into a compatible control system as specified herein.
 - 3. Bid shall include separate line items listing the control/interface components required for building automation systems and building management systems (BAS/BMS), daylighting, audiovisual, and/or central integration systems. Roller shade controls manufacturer shall list all components included in their bid and shall include a letter stating that they shall be financially responsible for any change orders and/or back charges required by the BAS/BMS, audiovisual, or lighting control systems contractors to interface with the motorized roller shade system.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Styles, material descriptions, dimensions of individual components, profiles, features, finishes and operating instructions.
 - 3. Storage and handling requirements and recommendations.
 - 4. Mounting details and installation methods.
 - 5. Typical wiring diagrams including integration of EDU controllers with building management system, audiovisual and lighting control systems as applicable.
- C. Shop Drawings: Plans, elevations, sections, product details, installation details,

operational clearances, power and control wiring diagrams, and relationship to adjacent work.

1. Prepare shop drawings on AutoCAD or Microstation format using base sheets provided electronically by the Architect.
 2. Prepare control, wiring diagrams based on, switching and operational requirements provided by the Architect in electronic format.
 3. Include one-line diagrams, wire counts, coverage patterns, and physical dimensions of each item.
- D. Window Treatment Schedule: For all roller shades. Use same room designations as indicated on the Drawings and include opening sizes and key to typical mounting details.
- E. Verification Samples: For each finish product specified, one complete set of shade components, unassembled, demonstrating compliance with specified requirements. Shade cloth samples and aluminum finish sample as selected. Mark face of material to indicate interior faces.
- F. Maintenance Data: Methods for maintaining roller shades, precautions regarding cleaning materials and methods, instructions for operating hardware and controls.
- G. Warranty: Provide manufacturer's warranty documents as specified in this Section.

1.3 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Obtain roller shades system through one source from a single manufacturer with a minimum of ten years experience and minimum of five projects of similar scope and size in manufacturing products comparable to those specified in this section. This includes but is not limited to all required extrusions, accessories, controls and fabricated roller shades or else all stated and published warranties may be void.
- B. Installer Qualifications: Engage an installer, which shall assume responsibility for installation of all system components, with the following qualifications.
1. Installer for roller shade system shall be trained and certified by the manufacturer with a minimum of ten years experience in installing products comparable to those specified in this section.
- C. Fire-Test-Response Characteristics: Passes NFPA 701-99 small and large-scale vertical burn. Materials tested shall be identical to products proposed for use.
- D. Electrical Components: NFPA Article 100 listed and labeled by either UL or ETL or other testing agency acceptable to authorities having jurisdiction, marked for intended use, and tested as a system. Individual testing of components will not be acceptable in lieu of system testing. Where applicable, system components shall be FCC compliant.
- E. Shadecloth Anti-Microbial Characteristics: 'No Growth' per ASTM G 21 results for fungi ATCC9642, ATCC 9644, and ATCC9645.
- F. PVC-Free Shadecloth: Comply with the following.
1. Environmental Certification: Submit written certification from the manufacturer, including third party evaluation, recycling characteristics, and perpetual use certification as specified below. Initial submittals, which do not include the Environmental Certification, below will be rejected. Materials that are simply 'PVC free' without identifying their inputs shall not qualify as meeting the intent of this specification and shall be rejected.
 2. Third Party Evaluation: Provide documentation stating the shade cloth has undergone third party evaluation for all chemical inputs, down to a scale of 100 parts per million, that have been evaluated for human and environmental safety. Identify any and all inputs, which are known to be carcinogenic, mutagenic,

teratogenic, reproductively toxic, or endocrine disrupting. Also identify items that are toxic to aquatic systems, contain heavy metals, or organohalogenes. The material shall contain no inputs that are known problems to human or environmental health per the above major criteria, except for an input that is required to meet local fire codes.

3. Recycling Characteristics: Provide documentation that the shade cloth can, and is part of a closed loop of perpetual use and not be required to be down cycled, incinerated or otherwise thrown away. Scrap material can be sent back to the mill for reprocessing and recycling into the same quality yarn and woven into new material, without down cycling. Certify that this process is currently underway and will be utilized for this project.
 4. Perpetual Use Certification: Certify that at the end of the useful life of the shade cloth, that the material can be sent back to the manufacturer for recapture as part of a closed loop of perpetual use and that the material can and will be reconstituted into new yarn, for weaving into new shade cloth. Provide information on each shade band indicating that the shade band can be sent back to the manufacturer for this purpose.
- G. Requirements for Electronic Hardware, Controls, and Switches:
1. Roller shade hardware, shade fabric, EDU, and all related controls shall be furnished and installed as a complete two-way communicating system and assembly.
- H. Mock-Up: Provide a mock-up, if Architect requires, of one roller shade assembly for evaluation of mounting, appearance and accessories.
1. Locate mock-up in window designated by Architect.
 2. Do not proceed with remaining work until, mock-up is accepted by Architect.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components in factory-labeled packages, marked with manufacturer and product name, fire-test-response characteristics, and location of installation using same room designations indicated on Drawings and in the Window Treatment Schedule.

1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Install roller shades after finish work including painting is complete and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Power and control wiring shall be complete and certified, fully operational with uninterrupted communication on the lines and minimal noise certified by a commissioning agent (engaged by others).
1. 485, ICON, Lonmark and Dry Contract Network: Noise on the line not to exceed shade manufacturer's limits.

1.6 WARRANTY

- A. Warranty: Provide manufacturer's standard warranties, including the following:
1. Roller Shade Hardware, and Shadecloth: Manufacturer's standard non-depreciating twenty-five year limited warranty.
 - a. EcoVeil standard non-depreciating 10-year limited warranty.
 2. Electronic Roller Shade EDU's and EDU Control Systems: Manufacturer's standard non-depreciating five-year warranty.
 3. Roller Shade Installation: One year from date of Substantial Completion, not

including scaffolding, lifts or other means to access to the work above 12' Feet AFF, which are the responsibility of others.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Specifications are based on products of manufacturers named as the Basis of Design. Manufacturers listed whose product meet or exceed the specifications are approved for use on the Project. Other manufacturers must have a minimum of five (5) years experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
1. Draper, Inc., Spiceland, IN; (765) 987-7999
 2. MechoSystems, Long Island City, NY; (718) 729-2020 ext. 1901

2.2 BASIS OF DESIGN

- A. Products by MechoSystems; Long Island City, NY

2.3 INTELLIGENT ENCODED ELECTRONIC DRIVE SYSTEM

- A. Electronic Drive Unit (EDU):
1. Intelligent Encoded EDU, and Control System: Tubular, asynchronous (non-synchronous) EDU's, with built-in reversible capacitor operating at 120VAC/60Hz, (230VAC/50Hz) single phase, temperature Class B, thermally protected, totally enclosed, maintenance free with line voltage power supply equipped with locking disconnect plug assembly furnished with each EDU.
 2. Quiet [42 – 46 db] (within 3 feet open air).
 3. Conceal EDU's inside shade roller tube.
 4. Maximum current draw for each shade EDU of 0.9Amps at 120VAC.
 5. Use EDU's rated at the same nominal speed for all shades in the same room.
 6. Use EDU's with minimum of 34RPM, that shall not vary due to load / lift capacity.
 7. Total hanging weight of shade band shall not exceed 80 percent of the rated lifting capacity of the shade EDU and tube assembly.
- B. EDU System: (software, two-way communication): Specifications and design are based on the Intelligent EDU Control System, WhisperShade®IQ® System) as manufactured by MechoSystems. Other systems may be acceptable providing all of the following performance capabilities are provided. EDU and control systems not in complete compliance with these performance criteria shall not be accepted as equal systems.
1. EDU shall support two methods of control.
 - a. Local Dry Contact Control Inputs:
 - 1) EDU shall be equipped with dry contact inputs to support moving the EDU/shade to the upper and lower limits.
 - 2) EDU shall be equipped with dry contact inputs to support moving the EDU/shade to local switch preset positions.
 - 3) Shall support configuring the EDU under protected sequences so that a typical user would not change the EDU's setup. At a minimum the configuration should include setting limits, setting custom presets and configuring key modes of operation.
 - b. Network Control:
 - 1) EDU shall be equipped with a bi-directional network communication capability in order to support commanding the

operation of large groups of shades over a common backbone.
The network communication card shall be embedded into the
tubular EDU assembly.

2. Upper and lower stopping points (operating limits) of shade bands shall be programmed into EDU's using either a hand held removable program module / configurator or a local switch.
3. Alignment Positions: Each EDU shall support a minimum of 133 repeatable and precisely aligned shade positions (including limits and presets).
 - a. All shades on the same switch circuit or with the same network group address with the same opening height shall align at each limit or preset (intermediate stopping position) when traveling from any position, up or down.
 - b. Shades of differing heights shall have capability for custom, aligned intermediate stop positions when traveling from any position, up or down.
 - c. Alignment of shades mechanically aligned on the same EDU shall not exceed +/- 0.125 inches (3.175mm) when commanded to the same alignment position.
 - d. Alignment of shades on adjacent EDU's shall not exceed +/- 0.25" inches (6.35mm) when commanded to the same alignment position.
 - e. Local Switch Presets: A minimum of 3 customizable preset positions shall be accessible over the local dry contact control inputs and over the network connection.
 - 1) Upon setting the limits for the shade EDU these preset positions shall automatically default to 25%, 50% and 57% of the shade travel.
 - 2) These positions shall be capable of being customized to any position between and including the upper and lower limits of the shade. A removable program module / configurator or local switch shall be capable of customizing the position of these presets.
 - f. Network Presets: A minimum of 29 customizable preset positions (including the 3 local switch presets) shall be accessible via network commands.
 - 1) Upon setting the limits for the shade EDU these preset positions shall automatically default to the lower limit unless customized elsewhere.
 - 2) These positions shall be capable of being customized to any position between and including the upper and lower limits of the shade. A removable program module / configurator shall be capable of customizing the position of these presets.
4. Network Control:
 - a. The system shall have the capability of two-way digital communication with the EDU's over a common backbone.
 - b. Each EDU shall possess 8 addresses capable of being employed for various levels of group control. These addresses shall be configurable via a handheld configurator and/or a PC controller. A 9th unique address shall enable the EDU(s) to be independently controlled and configured over the network via a handheld configurator and/or a PC controller.

- c. Low Voltage Communication Network Implementation.
 - 1) The low voltage network shall employ a bus topology with daisy chained network connections between nodes over a CAT5 cable (4 UTP) or over a 2 UTP cable employing at least 1 pair at 16 AWG for power and 1 pair at 22 AWG for data.
 - 2) The low voltage network (+/- 13VDC) shall be powered by the nodes attached to it. These nodes could be line voltage powered EDU's attached to 120 VAC or 230 VAC. Alternatively, low voltage nodes shall be powered typically by a centralized low voltage power supply. If a CAT5 network cable is employed and the node draws less than 1W then the node may be powered by DC power supplied by an associated line voltage EDU.
 - 3) Network Capacity: 4000 ft max, 250 nodes max
 - a) The number and size of a centralized DC supply shall vary depending upon the network requirements.
- 5. Operating Modes:
 - a. Uniform or Normal Modes of Operation:
 - 1) Uniform mode shall allow for shades to only move to defined intermediate stop positions to maintain maximum uniformity and organization.
 - 2) Normal Mode shall allow for shades to move to both intermediate stop positions, plus any position desired between the upper and lower limits as set by the installer.
- 6. Wall Switches:
 - a. Conference Center: Shades shall be operated by, 5, 7, or 10-button low voltage standard switches, or programmable intelligent switches [IS]. Standard switch shall be wired to a bus interface and the bus interface will be programmed to transmit an address for the local switch.
 - b. Intelligent switches may be installed anywhere on the bus line. Each IS shall be capable of storing one control level address to be broadcast along the bus line.
 - c. An address that is transmitted by either a switch or central controller shall be responded to by those EDU's with the same address in their control table.
 - d. IS shall provide for interface with other low voltage input devices via a set of dry contact terminals located on the switch.
 - e. Standard switch or IS may control an individual, sub-group or group of EDU's in accordance with the address in each EDU.

2.4 SHADE BANDS

- A. Shade Bands: Construction of shade band includes the fabric, the enclosed hem weight, shade roller tube, and the attachment of the shade band to the roller tube. Sewn hems and open hem pockets are not acceptable.
 - 1. Concealed Hembar: Shall be continuous extruded aluminum for entire width of shade band and with the following characteristics:
 - a. Hembar shall be heat sealed on all sides.
 - b. Open ends shall not be accepted.

2. Shade Band and Shade Roller Attachment:
 - a. Use extruded aluminum shade roller tube of a diameter and wall thickness required to support shade fabric without excessive deflection.
 - b. Provide for positive mechanical attachment of shade band to roller tube; shade band shall be made removable / replaceable with a "snap-on" snap-off" spline mounting, without having to remove shade roller from shade brackets.
 - c. Mounting Spline shall not require use of adhesives, adhesive tapes, staples, and/or rivets.
 - d. Any method of attaching shade band to roller tube that requires the use of: adhesive, adhesive tapes, staples, and/or rivets, does not meet the performance requirements of this specification and shall not be accepted.

2.5 ROLLER SHADE FABRICATION

- A. Fabricate shade cloth to hang flat without buckling or distortion. Fabricate with heat-sealed trimmed edges to hang straight without curling or raveling. Fabricate unguided shade cloth to roll true and straight without shifting sideways more than 1/8 inch (3.18 mm) in either direction per 8 feet (2438 mm) of shade height due to warp distortion or weave design.
- B. Provide battens in standard shades as required to assure proper tracking and uniform rolling of the shade bands. Contractor shall be responsible for assuring the width-to-height (W:H) ratios shall not exceed manufacturer's standards or, in absence of such standards, shall be responsible for establishing appropriate standards to assure proper tracking and rolling of the shade cloth within specified standards. Battens shall be roll-formed stainless steel or tempered steel, as required.
- C. For railroaded shade bands, provide seams in railroaded multi-width shade bands as required to meet size requirements and in accordance with seam alignment as acceptable to Architect. Seams shall be properly located. Furnish battens in place of plain seams when the width, height, or weight of the shade exceeds manufacturer's standards. In absence of such standards, assure proper use of seams or battens as required to, and assure the proper tracking of the railroaded multi-width shade bands
- D. Provide battens for railroaded shades when width-to-height (W:H) ratios meet or exceed manufacturer's standards. In absence of manufacturer's standards, be responsible for proper use and placement of battens to assure proper tracking and roll of shade bands.
- E. Blackout shade bands, when used in side channels, shall have horizontally mounted, roll-formed stainless steel or tempered-steel battens not more than 3 feet (115 mm) on center extending fully into the side channels. Battens shall be concealed in an integrally colored fabric to match the inside and outside colors of the shade band, in accordance with manufacturer's published standards for spacing and requirements.
 1. Battens shall be roll formed of stainless steel or tempered steel and concave to match the contour of the roller tube.

2.6 ROLLER SHADE COMPONENTS

- A. Access and Material Requirements:
 1. Provide shade hardware allowing for the removal of shade roller tube from brackets without removing hardware from opening and without requiring end or center supports to be removed.
 2. Provide shade hardware that allows for removal and re-mounting of the shade bands without having to remove the shade tube, drive or operating support

brackets.

3. Use only Delran engineered plastics by DuPont for all plastic components of shade hardware. Styrene based plastics, and /or polyester, or reinforced polyester shall not be accepted.

B. Motorized Shade Hardware and Shade Brackets:

1. Provide shade hardware constructed of minimum 1/8-inch (3.18 mm) thick plated steel, or heavier, thicker, as required to support 150 percent of the full weight of each shade. Plastic components without use of steel angle construction do not meet the intent of this specification and shall not be accepted.
2. Provide shade hardware system that allows for field adjustment of EDU or replacement of any operable hardware component without requiring removal of brackets, regardless of mounting position (inside, or outside mount).
3. Provide shade hardware system that allows for operation of multiple shade bands offset by a maximum of 8-45 degrees from the EDU axis between shade bands (4-22.5 degrees) on each side of the radial line, by a single shade EDU (multi-banded shade, subject to manufacturer's design criteria).
4. All bands within a single EDU group shall be aligned within 1/4 inch (6 mm).

C. Manual Operated Chain Drive Hardware and Brackets:

1. Provide for universal, regular and offset drive capacity, allowing drive chain to fall at front, rear or non-offset for all shade drive end brackets. Universal offset shall be adjustable for future change.
2. Provide hardware capable for installation of a removable fascia, for both regular and/or reverse roll, which shall be installed without exposed fastening devices of any kind.
3. Provide shade hardware system that allows for removable regular and/or reverse roll fascias to be mounted continuously across two or more shade bands without requiring exposed fasteners of any kind.
4. Provide shade hardware system that allows for operation of multiple shade bands (multi-banded shades) by a single chain operator, subject to manufacturer's design criteria. Connectors shall be offset to assure alignment from the first to the last shade band.
5. Provide shade hardware system that allows multi-banded manually operated shades to be capable of smooth operation when the axis is offset a maximum of 6 degrees on each side of the plane perpendicular to the radial line of the curve, for a 12 degrees total offset.
6. Provide positive mechanical engagement of drive mechanism to shade roller tube. Friction fit connectors for drive mechanism connection to shade roller tube are not acceptable.
7. Provide shade hardware constructed of minimum 1/8-inch (3.18 mm) thick plated steel or heavier as required to support 150 percent of the full weight of each shade.
8. Drive Bracket / Brake Assembly:
 - a. MechoShade Drive Bracket model M5 shall be fully integrated with all MechoShade accessories, including, but not limited to: SnapLoc fascia, room darkening side / sill channels, center supports and connectors for multi-banded shades.
 - b. M5 drive sprocket and brake assembly shall rotate and be supported on a welded 3/8 inch (9.525 mm) steel pin.

- c. The brake shall be an over running clutch design which disengages to 90 percent during the raising and lowering of a shade. The brake shall withstand a pull force of 50 lbs. (22 kg) in the stopped position.
 - d. The braking mechanism shall be applied to an oil-impregnated hub on to which the brake system is mounted. The oil impregnated hub design includes an articulated brake assembly, which assures a smooth, non-jerky operation in raising and lowering the shades. The assembly shall be permanently lubricated. Products that require externally applied lubrication and or not permanently lubricated are not acceptable.
 - e. The entire M5 assembly shall be fully mounted on the steel support bracket, and fully independent of the shade tube assembly, which may be removed and reinstalled without effecting the roller shade limit adjustments.
9. Drive Chain: #10 qualified stainless steel chain rated to 90 lb. (41 kg) minimum breaking strength. Nickel plate chain shall not be accepted.

2.7 ROLLER SHADE SCHEDULE

- A. Roller Shade Schedule: Refer to the Drawings for locations.
- 1. Shade Type WT-1: Manual operating, chain drive, sunscreen roller shades in all exterior windows of rooms and spaces shown on the Drawings.
 - a. Shade pockets
 - b. Fascias
 - 2. Shade Type WT-4: Motorized interior sunscreen roller shades in all exterior / interior windows of rooms and spaces as shown on referenced Drawings, and related EDU control requirements systems. Include the following as scheduled and as indicated on the Drawings:
 - a. Shade pockets
 - b. Fascias
 - 3. Shade Type WT-5: Motorized interior room darkening blackout roller shades in all exterior / interior windows of rooms and spaces as shown on referenced Drawings, and related EDU control requirements systems. Include the following as scheduled and as indicated on the Drawings:
 - a. Shade pockets
 - b. Fascias
 - c. Room darkening side and sill channels

2.8 SHADECLOTH

- A. Visually Transparent Single-Fabric Shadecloth: MechoSystems, ThermoVeil® group, single thickness, opaque non-raveling 0.030-inch (0.762 mm) thick vinyl fabric, woven from 0.018-inch (0.457 mm) diameter extruded vinyl yarn comprising of 21 percent polyester and 79 percent reinforced vinyl, in colors selected from manufacturer's available range.
- 1. Dense Basket Weave: "1300 series", 3 percent open, 2 by 2 dense basket-weave pattern.
 - 2. Color: Selected from manufacturer's standard colors.

- B. Room Darkening (PVC Free) Blackout with Opaque Acrylic Backing: MechoSystems, "Midnite 0200 series", .008 inches thick (.19 mm) blackout material and weighing .94 lbs. per square yard, comprising of 73% acrylic (coating), 27% polyester (yarn).
 - 1. Color: Selected from manufacturer's standard colors.

2.9 ROLLER SHADE ACCESSORIES

- A. Shade Pocket: For recessed mounting in acoustical tile or drywall ceilings as indicated on the drawings.
 - 1. Either extruded aluminum and or formed steel shade pocket, sized to accommodate roller shades, with exposed extruded aluminum closure mount, tile support and removable closure panel to provide access to shades.
 - 2. Provide "Vented Pocket" such that there will be a minimum of four 1 inch diameter holes per foot allowing the solar gain to flow above the ceiling line.
- B. Fascia:
 - 1. Continuous removable extruded aluminum fascia that attaches to shade mounting brackets without the use of adhesives, magnetic strips, or exposed fasteners.
 - 2. Fascia shall be able to be installed across two or more shade bands in one piece.
 - 3. Fascia shall fully conceal brackets, shade roller and fabric on the tube.
 - 4. Provide bracket / fascia end caps where mounting conditions expose outside of roller shade brackets.
- C. Room Darkening Side and Sill Channels:
 - 1. Extruded aluminum with polybond edge seals and SnapLoc-mounting brackets and with concealed fastening. Exposed fastening is not acceptable. Channels shall accept one-piece exposed blackout hembar with vinyl seal to assure side light control and sill light control.
 - a. MechoSystems side channels, 1-15/16 inches (49.2 mm) wide by 1-3/16 inches (30.1 mm) deep, two-band center channels, 2-5/8 inches (66.6 mm) wide by 1-3/16 inches (30.1 mm) deep. The 2-5/8-inch (66.6 mm) double-center channels may be installed at center-support positions of multi-band-shade ElectroShades. MechoSystems side channels 2-5/8 inch (66.6 mm) may be used as center supports for ElectroShades; shade bands up to 8 high. For shade bands over 8 feet (2438 mm), provide ElectroShade side channels.
 - b. ElectroShade side channels, 2-1/2 inches (63.5 mm) wide by 1-3/16 inches (30.1 mm) deep; two-band center channels 5 inches (127 mm) wide by 1-3/16 inches (30.1 mm) deep. The 2-5/8-inch (66.6 mm) double-center channels may be installed at center-support positions of multi-band-shade ElectroShades. MechoSystems side channels 2-5/8 inches (66.6 mm) may be used as center supports for ElectroShades. Also provide for use with manually operated room darkening MechoSystems's over 8 feet (2438 mm) in height.
 - c. Color: Selected from manufacturer's standard colors or custom color as selected by Architect.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared. If substrate

preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- B. Turn-Key Single-Source Responsibility for Interior Roller Shades: To control the responsibility for performance of the electric roller shade system; assign the design, engineering, and installation of electronic drive roller shade control system, shades, addressable controls, communication interfaces, and any required sensors, switches and low voltage control wiring specified in this Section to the manufacturer of the shade and control system. The Architect will not produce a set of electrical drawings for the installation of control wiring for the electric roller shade control system.
 1. General Contractor Responsibilities:
 - a. Provide power panels and circuits of sufficient size to accommodate roller shade manufacturer's requirements, as indicated on the mechanical and electrical drawings and manufacturer's shop drawings.
 - b. Coordinate with requirements of subcontractor for this section before inaccessible areas are constructed.
 - c. Coordinate requirements of ALSCS before inaccessible areas are constructed.
 - d. Provide conduit with pull wire in all areas, which might not be accessible to ALSCS due to building design, equipment location or schedule:
 - e. Coordinate with the main building electrical subcontractor to provide duplex 120 VAC power receptacle in Electric closet for floor/riser Communication Gateways.
 - f. Verify that wiring conditions, which have been previously installed under other sections or at a previous time, are acceptable for product installation in accordance with manufacturer's instructions.
 - g. Comply with manufacturer's product data, including shop drawings, technical bulletins, product catalog installation instructions, and product carton instructions for installation.
 - h. Protect installed product and finished surfaces from damage during all phases of installation including preparation, testing, and cleanup.
 - i. Be responsible for all other required electrical work including but not limited to roof penetrations, conduits, fireproofing, etc.
 - j. Provide conduit with pull wire in all areas, which might not be accessible to subcontractor due to building design, equipment location or schedule.
 2. Window Covering Subcontractor (WC) Responsibilities:
 - a. Shade Control Subcontractor shall furnish and install shade controllers, interfaces, splitters, coupler, sensors, switches, junction boxes, etc mounted in the ceiling in an accessible location. Locations for all visible devices to be coordinated with Architect. The shade control subcontractor shall inspect all material included in this contract prior to installation. Manufacturer shall be notified of unacceptable material prior to installation.
 - b. Line Voltage Wiring:

- 1) WC to ROLLER SHADE EDU: The WC shall furnish and install power connection between Shade control system and EDU, and shall be capable of providing single line voltage wire pull for each EDU.
3. Shade Power Wiring (WC)
 - a. Shall furnish and install line voltage Cable from roller shade motor into line voltage side of control system.
 - b. Shall wire from General Contractor, provided, power junction box to each motor on the shade network.
 - c. Shall furnish and install a disconnect plug at the end of the power wiring run to each EDU. The disconnect plug must mate with a matching disconnect plug on the motor cable. EDU cable disconnect plug must be prefabricated by the manufacturer to meet UL and ETL systems requirements.
4. Integration with Third Party Systems:
 - a. Main Contractor shall coordinate and provide for others to furnish, install or program any interfaces or wiring to integrate 3rd party systems to the roller shade control system as specified herein. Integration to shade control network can be accomplished locally through dry contact closures, or RS-232.

3.3 INSTALLATION OF ROLLER SHADES

- A. Contractor Furnish and Install Responsibilities:
 1. Window Covering Contractor (WC) shall provide an on site, Project Manager, and shall be present for all related jobsite scheduling meetings.
 2. WC shall supervise the roller shade installation, and setting of intermediate stops of all shades to assure the alignment of the shade bands within a single EDU group, which shall not exceed +/- 0.125 inches (3.175mm), and to assure the alignment between EDU groups, which shall not exceed +/- 0.25 inches (6.35mm).
 3. WC shall be responsible for field inspection on an area-by- area and floor-by-floor basis during construction to confirm proper mounting conditions per approved shop drawings.
 4. Verification of Conditions: examine the areas to receive the work and the conditions under which the work would be performed and notify General Contractor and Owner of conditions detrimental to the proper and timely completion of the work. Do not proceed until unsatisfactory conditions have been corrected. Commencement of installation shall constitute acceptance of substrate conditions by the installer.
 5. WC shall provide accurate to 0.0625 inch (1.5875mm); field measurements for custom shade fabrication on the Roller Shades manufacturers input forms.
 6. WC Installer shall install roller shades level, plumb, square, and true according to manufacturer's written instructions, and as specified here in. Blocking for roller shades installed under the contract of the interior General Contractor shall be installed plumb, level, and fitted to window mullion as per interior architect's design documents and in accordance with industry standard tolerances. The horizontal surface of the shade pocket shall not be out-of-level more than 0.625 inch (15.875mm) over 20 linear feet (6.096 meters)
 7. Shades shall be located so the shade band is not closer than 2 inches (50 mm)

to the interior face of the glass. Allow proper clearances for window operation hardware.

8. Adjust, align and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.
9. Installer shall set Upper, Lower and up to 3 intermediate stop positions of all motorized shade bands, and assure alignment in accordance with the above requirements.
10. WC shall certify the operation of all motorized shades and turn over each floor for preliminary acceptance.
11. The WC shall participate and cooperate with the electrical contractor, the window shade manufacturer and the Commissioning agent to verify and certify the installation is in full conformance with the specifications and is fully operational. This work to occur during the commissioning stage and is in addition to preliminary acceptance required for each floor.
12. Clean roller shade surfaces after installation, according to manufacturer's written instructions.
13. WC shall train Owner's maintenance personnel to adjust, operate and maintain roller shade systems.
14. Protect installed products until completion of project.
15. Touch-up, repair or replace damaged products before Substantial Completion.

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

SECTION 12 35 53
LABORATORY CASEWORK

CONDITIONS OF THE CONTRACT AND DIVISION 01, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. Wood casework
 - 2. Epoxy resin work surfaces
 - 3. Epoxy resin sinks, drain outlets
 - 4. Service fittings
 - 5. Accessory items as specified herein
- B. Related Requirements
 - 1. Section 06 10 00 "Rough Carpentry": Blocking within walls to adequately support casework.
 - 2. Section 09 65 13 "Resilient Base and Accessories": Furnishing and installing rubber base
 - 3. Section 11 53 00 "Laboratory Equipment": Fume hoods and miscellaneous laboratory equipment.
 - 4. Section 11 53 13 "Laboratory Fume Hoods": Laboratory Fume hoods
 - 5. Division 22 - Mechanical:
 - a. Furnishing and installation of piping, drainline, traps, final connections and setting of sinks and fixtures.
 - b. Furnishing and installation of exhaust ductwork, transition(s), blowers and equipment, and final connection to fume hood(s).
 - 6. Division 26 - Electrical: Furnishing and installation of electrical wiring, conduit and/or electrical items and final connections.

1.2 REFERENCES

- A. American Disabilities Act (ADA)
 - 1. American Disabilities Act Design Guidelines (ADADG)
- B. American National Standards Institute (ANSI)
 - 1. American National Standards Publications
- C. American Woodwork Institute
 - 1. Architectural Woodwork Quality Standards
- D. SEFA (Scientific Equipment and Furniture Association) standards.
 - 1. SEFA 1.2 – Fume Hoods
 - 2. SEFA 2.3 – Installation of Scientific Laboratory Furniture and Equipment.
 - 3. SEFA 3 – Work Surface.
 - 4. SEFA 7 – Laboratory and Hospital Fixtures
 - 5. SEFA 8 – Laboratory Furniture

1.3 DEFINITIONS

- A. Definitions of cabinet components by surface visibility:
1. Exposed Surfaces:
 - a. Surfaces visible when drawers and solid doors are closed.
 - b. Surfaces visible behind clear glass doors.
 - c. Interior surfaces of open units.
 - d. Bottoms of cabinets 42 inches or more above finished floor.
 - e. Tops of cabinets less than 78 inches above finished floor, or are visible from an upper floor or staircase after installation.
 - f. Front edges of cabinet body members visible though a gap greater than 1/8 inch with doors and drawers closed.
 - g. Surfaces visible when fixed appliances are installed.
 2. Semi-exposed Surfaces:
 - a. Surfaces visible when doors are open.
 - b. Bottoms of cabinets 30 inches - 42 inches above finished floor.
 - c. All front edges of shelving behind doors.
 3. Concealed Surfaces:
 - a. Surfaces not normally visible after installation.
 - b. Bottoms of cabinets less than 30 inches above finished floor.
 - c. Tops of cabinets over 78 inches above finished floor which are not visible from an upper level.
 - d. Stretchers, blocking, components concealed by drawers.

1.4 SUBMITTALS

- A. Manufacturer's Compliance Statement:
1. Pre-qualified manufacturers whose name appears below under acceptable Manufacturers shall provide statement of compliance as scheduled by General Contractor; or
 2. Manufacturers requesting substitution of products shall submit statement of compliance at proposal time in accordance with Division 1 requirements for substitutions.
- B. Shop Drawings: Provide large scale plans and elevations of casework, cross sections, rough-in and anchor placements, tolerances and clearances. Indicate relationship of units to windows, doors, surrounding walls and other building components.
- C. Product Data: Submit manufacturer's catalog for reference. Include cabinet dimensions, configurations, construction details, joint details, attachment details, and rough-in details as required.
- D. Product Samples to be submitted for approval (One (1) each):
1. Worktop: Four (4) inch x four (4) inch sample of each material.
 2. Finish: Three (3) inch x five (5) inch sample of each available standard stain color with finish for Architect's selection.
 3. Provide an actual sample of a cabinet in the color and finish selected for

Architect's approval. Approved cabinet color and finish will be basis for which all work will be judged. Approved sample cabinet may be used in the work. All cabinets shall match in color and finish to that of the approved sample and if found to vary in color, i.e., too light or too dark shall be refinished to match approved sample at no expense to Owner.

4. Hardware: Pulls, locks and hinges. Locks shall be keyed alike and masterkeyed to Owner's keying system.

1.5 QUALITY ASSURANCE

- A. Single source: Casework and fume hoods to be manufactured and furnished by a single laboratory furniture company.
- B. Manufacturer's qualifications: Modern plant with proper tools, dies, fixtures and skilled production staff to produce high quality laboratory casework and fume hoods, and shall meet the following minimum requirements:
 1. Minimum of ten (10) years experience in manufacture of wood laboratory casework and fume hoods.
 2. Ten (10) installations of equal or larger size.
- C. Installer qualifications: Certified by the manufacturer.
- D. Manufacturer to provide load test results certified by an independent testing laboratory for drawers, doors, suspension slides and unit shelving.
- E. Casework construction and performance characteristics shall be in full compliance with SEFA 8 standards. At the Owner's request, independent, third part testing must be submitted validating compliance and adheres to the architectural specifications.

1.6 PROJECT CONDITIONS

- A. Do not deliver or install wood product until the following conditions are met:
 1. Windows and doors are installed and the building is secure and weathertight.
 2. Ceiling, overhead ductwork and lighting are installed.
 3. All painting is completed and floor tile is installed.
 4. Interior building temperature to be between 65 degrees F and 80 degrees F, and ambient relative humidity maintained between 25 percent and 55 percent prior to delivery, and during and after installation. Frequent and/or excessive changes in temperature and/or humidity levels during casework installation, or once casework is installed, shall be avoided to prevent damage to materials.
- B. Field measurements shall be taken to verify that the equipment will fit into the designated space. Entryways, corridors and door openings shall be verified to ensure that the equipment be manufactured in a manner to permit it to be moved through properly into place.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Delivery: Schedule delivery so rooms are sufficiently complete that material can be installed immediately following delivery.
- B. Casework: Protect finished surfaces from soiling or damage during handling and installation.
- C. Work surfaces: Protect throughout the construction period.

1.8 WARRANTY

- A. Warrant casework against becoming unserviceable or causing an objectionable

appearance resulting from defects in materials and workmanship, including workmanship of installation. Materials provided by Casework Manufacturer shall carry a warranty for five (5) years from date of Substantial Completion. Other materials and equipment shall carry warranty by the product manufacturer.

- B. Defects shall include, but not limited to:
 - 1. Discoloration of finish.
 - 2. Missing or loose parts.
 - 3. Noisy or hard operation of moving parts.
 - 4. Failure to meet specifications.

PART 2 - PRODUCTS

2.1 APPROVED PRODUCT/MANUFACTURERS

- A. Design, materials, construction and finish of casework as specified represents the minimum acceptable standard of quality for wood laboratory casework.
- B. Manufacturers listed who produce equivalent products to those specified are approved for use on this Project. Other manufacturers must have a minimum of five (5) years experience manufacturing equivalent products to those specified and comply with Division 1 requirements regarding substitutions to be considered.
 - 1. Campbell Rhea Caseworks
 - 2. Diversified Woodcrafts, Inc.
 - 3. Kewaunee Scientific Corp.
 - 4. Leonard Peterson & Co.
 - 5. MGC Millwork
 - 6. Sheldon Laboratory Systems
 - 7. TMI Systems Design Corp.
- C. Specifications are based on products manufactured by Sheldon Laboratory Systems, Crystal Springs, MS (601) 892-2731, to match existing.

2.2 CASEWORK DESIGN

- A. Door and Drawer Design:
 - 1. Lipped Overlay: partial overlay design with 3/8 inch reveals between door or drawer and frame, door to door, door to drawer, drawer to drawer; 7/16 inch vertical reveal between doors/drawers and cabinet ends.
- B. Standard grain pattern on end panels is vertical.
- C. Grain pattern on cabinet fronts:
 - 1. Combination Grain: Horizontal grain on drawer fronts, vertical grain on door fronts.
- D. Cabinet end panels exposed to view after installation shall be specified as a "finished end" panel. All end panels not exposed to view after installation shall be as listed under "unexposed" plywood.
- E. Cabinets to be rigid, self-supporting design for use in assembly or as single, interchangeable stand-alone units.
- F. Flush Interiors: Surface mounted bottoms and offsets caused by front face frames which interfere with ease of cleaning are not acceptable.

- G. Joinery: 32mm doweled joinery system glued, clamped and screwed. Dowels are to be hardwood, laterally fluted with chamfered ends and a minimum diameter of 8mm.
- H. Where shown or required, provide products conforming to ADADG for barrier-free design.

2.3 CASEWORK MATERIALS

- A. Hardwood:
 - 1. Lumber core shall conform to ANSI/HPVA HP-1 product standards.
 - 2. Hardwood lumber, clean and free of defects. All lumber kiln-dried to uniform moisture content of six (6) percent.
 - a. Exposed material: Match student workstations.
 - b. Semi-exposed material: Select hardwood.
 - c. Unexposed material: Sound hardwood of species suitable for the intended purpose.
- B. Plywood:
 - 1. Hardwood plywoods shall conform to ANSI/HPVA HP-1 product standards.
 - 2. Core: 7-ply (3/4 inch thick) and 9-ply (one (1) inch thick) veneer core plywood with cross and face plies bonded with Type II water-resistant glue; drawers are 9-ply, 1/2 inch thick.
 - 3. Face veneer:
 - a. Exposed surfaces: Match student workstations.
 - b. Semi-exposed: Same species as specified for exposed face veneer, grade 2 for oak.
 - c. Unexposed: Same species as specified for exposed and semi-exposed veneer, grade at option of manufacturer.
- C. Welded fiberboard: Tempered welded fiber shall be wood fibers and natural resin binding agent compressed into dense homogeneous sheets. Sheets are impregnated with a special tempering compound polymerized by baking to give exceptional strength, and shall conform to ANSI/AHA A135.4 Basic Hardboard for Class 1 tempered grade.
- D. Glass: 7/32 inch for tall cases and unframed wall and upper case doors, 1/8 inch for framed wall and upper case doors, without imperfections or marred surfaces of clear float glass.
- E. Glue: Laminating - Type II water-resistant; assembly - Type III water-resistant.
- F. Edgebanding: 3mm hardwood of same species as exposed face veneers.
- G. Finish: Highly chemical-resistant modified acrylic urethane finish with built in U.V. blocker or equal finish applied over stain of selected color. Finish shall meet performance characteristics of TR-5, Section 1500, AWI Architectural Woodwork Quality Standards (latest edition).

2.4 LABORATORY CASEWORK (12 35 53.LC)

- A. Base Units:
 - 1. Cabinet ends: 3/4 inch thick plywood with 3mm hardwood banding on front edges. Bore interior faces, as appropriate, for security panels, rails, and four rows of shelf support holes:
 - 2. Levelers: Provide four (4) metal corner gusset levelers with threaded adjustment screws and floor pad on all base cabinets.

3. Top rails:
 - a. Full Top Frame:
 - 1) Horizontal front top rail: One (1) inch x three (3) inch solid hardwood. Attach to cabinet ends with glued 8mm dowel joinery and screws.
 - 2) Vertical back top rail: 3/4 inch x 3-3/4 inch hardwood. Attach to cabinet ends with glued 8mm dowel joinery and screws.
 - 3) Top side rails: 3/4 inch x 1-1/2 inch hardwood between front horizontal and back vertical rails, glued and screwed in place.
4. Intermediate rails: Front horizontal intermediate rail: 3/4 inch x 1-1/2 inch exposed hardwood rail to be provided between doors and drawers. Secure to cabinet end panels with glued 8mm dowel joinery.
5. Toe space rail: 3-3/4 inch x 3/4 inch hardwood or 7-ply veneer core plywood, mounted between end panels with glued 8mm dowel joinery and metal fasteners, forming a 4 inch high x 2-1/2 inch deep toe space, closed to cupboard bottom.
6. Bottoms: 3/4 inch thick plywood, set flush and joined to cabinet end panels with glued 8mm dowels on 96mm spacing and metal fasteners. Front edge to be banded with 3mm hardwood banding.
7. Backs:
 - a. Cupboard units: One-piece 3/16 inch thick hardboard, rabbetted into rear top rail for easy removal from inside of cabinet.
 - b. Drawer units: Open back.
 - c. Sink units: Half-height, one piece 3/16 inch thick hardboard, rabbetted into rear rail for easy removal from inside of cabinet.
8. Vertical dividers in combination cabinets: 1-1/2 inch thick plywood panel (frames not permitted) glued and screwed in place, top and bottom, with 3mm hardwood banding on front edge.
9. Security panels: None required.
10. Shelves (for base units): Veneer core plywood, 3mm hardwood banded on front edge, adjustable on 32mm centers:
 - a. Full-depth shelf, 17-3/4 inches deep.
 - b. Thickness: 3/4 inch thick for all shelves up to and including 30 inches wide, one (1) inch thick for all shelves over 30 inches wide.
 - c. 1/2 inch wide x 1/2 inch high raised lip on all four (4) sides of shelves for spill containment.
11. Drawer construction:
 - a. Box: Four-sided drawer box with back, front and sides of 12mm (1/2 inch nominal) 9-ply Birch plywood with chemical-resistant finish and finished top edges. (Three-sided drawer box attached to outer drawer front is not acceptable.) Sides shall be joined by Lock joint, glued and pinned.
 - b. Bottom: Nominal 1/4 inch, inset into all four (4) sides of drawer box and sealed with hot melt glue process around entire drawer bottom perimeter. Material to be white melamine-clad tempered hardboard.
12. Door and removable drawer front construction: 3 ply 3/4 inch thick (door) and 1/2

inch thick (drawer), particleboard core, hardwood framed all four (4) sides, face veneer on both surfaces, radiused edges all four (4) sides; doors to be routed on inside perimeter to allow 1/4 inch inset into door opening.

B. Hardware:

1. Drawer suspension: 3/4 extension, open roller, 75 lb. dynamic load, self-closing epoxy-coated Blum 230 series or equal on all drawers except file drawers. All file drawers to have full extension with overtravel, ball-bearing roller, 150 lb. dynamic load, zinc-plated Accuride 4034 series, or Architect approved equal.
2. Drawer and hinged door pulls: Satin chrome wire pulls. Provide 4 inch DP3/AS Series Tab Pull as manufactured by Mockett where indicated on Drawings.
3. Hinges: Provide two (2) hinges for doors up to 36 inches high; three (3) hinges for doors over 36 inches high. Notch for proper fit. 5-knuckle, stainless steel hinges.
4. Unit shelf supports: Metal pin and socket.
5. Door catches: Adjustable, spring-actuated nylon roller.
6. Elbow catches: Spring type with strike.
7. Locks, where indicated on drawings: 5-pin tumbler keyed alike and master keyed to Owner's keying system.

2.5 SERVICE FITTINGS

A. Manufacturer: Sheldon Laboratory Systems or Architect approved equal

B. All fixtures to be vandal resistant.

C. Laboratory Service Fittings:

1. Service fittings shall be laboratory grade, and water faucets and valve bodies shall be cast red brass alloy or bronze forgings, with a minimum content of 85%. All fittings shall be powder-coated epoxy unless specified otherwise.

D. Water Fittings:

1. Water fittings shall be provided with a renewable unit containing all operating parts which are subject to wear. The renewable unit shall contain an integral volume control device and all faucets shall be capable of being readily converted from compression to self-closing, without disturbing the faucet body proper. Four (4) arm forged brass handles shall contain plastic screw-on type colored service index buttons.

E. Ground Key Valve Hose Cocks:

1. Ground key type valves shall have forged body with 10 serration hose end. Handle plug shall be forged brass, long, tapered type with screw-on colored service index button. Valves shall be individually ground, lapped and sealed.

F. Needle Valve Hose Cocks:

1. Needle type valves shall have a stainless steel replaceable floating cone, precision finished and self-centering. Cone locates against a stainless steel seat, easily removable and replaced with a socket wrench. Valve shall have "Teflon" impregnated packing and designed so unit can be repacked while under pressure.
 - a. Air (12 35 53.FA1): Air Fixture with 1 connection
 - b. Gas (12 35 53.FG1): Gas Fixture with 1 connection
 - c. Vacuum (12 35 53.FV1): Vacuum Fixture with 1 connection

- G. Gooseneck Type Outlets: Gooseneck outlets shall have a separate brazed coupling to provide a full thread attachment of anti-splash, serrated tip or filter pump fittings.
1. Cold Water (12 35 53.FC):
 - a. Cold Water
 - b. Serrated Hose Connection
 - c. Vacuum Breaker
 - d. Wrist Blades at ADA Workstation
 - e. Approved Product/Manufacturer: Unicast Model No. 80022 fixtures as manufactured by Sheldon Laboratory Systems, or Architect approved equal.
- H. Remote Control Valves: All valves for remote control use shall be as previously specified, but shall be complete with brass extension rods, escutcheon plates, brass forged handles and screw-on type colored service index button.
- I. Tank Nipples: Tank nipples shall be provided with locking nut and washer for all fixtures where fittings are anchored to equipment.
- J. Service Indexes: Fittings shall be identified with service indexes in the following color coding:
1. Hot Water Red
 2. Cold Water Dark Green
 3. Gas Dark Blue
 4. Air Orange
 5. Vacuum Yellow
 6. Distilled Water White
 7. Steam Black
 8. Nitrogen Gray
 9. Oxygen Light Green
 10. Hydrogen Pink
 11. Special Gases Light Blue
- K. Electrical Fittings: Electrical fittings shall contain 20 Amp., 125 Volt AC, 3-wire polarized grounded receptacles, unless otherwise specified. Pedestal and line-type boxes shall be of aluminum, metallic finish with stainless steel flush plates. Receptacle boxes shall be of plated steel. All electrical or conduit fittings called for or to be furnished under these specifications shall meet the requirements of the National Electrical Code.
- L. Sink Outlets: Unless otherwise specified, sink outlets for other than stainless steel sinks shall be Molded Epoxy Resin, with integral cross bars, tapered for overflow and be complete with gasket and lock nut with 1-1/2 inch I.P.S. male straight thread outlet. Overflows shall not be furnished for sink outlets unless specifically called for.
- M. Crumb Cup Strainers: Crumb cup strainers shall be stainless steel or chromium plated brass, as specified and shall be furnished for stainless steel sinks, and be complete with gasket, lock nut and 4 inch long unthreaded tailpiece outlet in 1-1/2 inch size.

2.6 WORKSURFACES

- A. Phenolic Work Surfaces: Phenolic resin formulation, (1) inch thickness. Color shall be

non-glare black. Plain butt type joints assembled with adhesive.

2.7 LABORATORY PEGBOARD

- A. Wall Mounted drying rack with 53 pegs and stainless steel drip trough
- B. Approved Product/Manufacturer: Model No. 79530/MET511-32 as manufactured by Sheldon Laboratory Systems or Architect approved equal.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Casework installation:
 - 1. Set casework components plumb, square, and straight with no distortion and securely anchored to building structure. Shim as required using concealed shims.
 - 2. Fasten continuous cabinets together with joints flush, tight and uniform, with alignment of adjacent units within 1/16 inch tolerance.
 - 3. Secure wall cabinets to solid supporting material, not to plaster, lath or gypsum board. Blocking in wall by rough carpentry as specified in Section 06 10 00 "Rough Carpentry".
 - 4. Abut top edge surfaces in one true plane. Provide flush joints not to exceed 1/8 inch between top units.
- B. Work surface installation:
 - 1. Where required due to field conditions, scribe or caulk to abutting surfaces.
 - 2. Secure joints in the field, where practicable, in the same manner as in factory, with dowels, adhesive or fasteners recommended by manufacturer.
 - 3. Secure work surfaces to casework and equipment components with material and procedures recommended by the manufacturer.
- C. Sink installation: Sinks shall be set in chemical-resistant sealing compound, secured and supported per manufacturer's recommendations.
- D. Accessory installation: Install accessories and fittings in accordance with manufacturer's recommendations. Turn screws to seat flat; do not drive.

3.2 ADJUSTING

- A. Repair or remove and replace defective work, as directed by Architect upon completion of installation.
- B. Adjust doors, drawers, hardware, fixtures and other moving or operating parts to function smoothly.

3.3 CLEANING

- A. Broom clean finished casework, touch up as required.
- B. Clean materials as recommended by manufacturer.

3.4 PROTECTION OF FINISHED WORK

- A. Provide necessary protective measures to prevent damage of casework and equipment from exposure to other construction activity.
- B. Advise contractor of procedures and precautions for protection of material, installed laboratory casework and fixtures from damage by work of other trades.

END OF SECTION

SECTION 22 05 00

COMMON WORK RESULTS FOR PLUMBING

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SUMMARY

- A. Provide all work for mechanical, plumbing and fire protection systems required in the project to be properly installed, tested and performing their intended function.
- B. All materials and equipment for the potable water system shall meet the latest mandates and requirements for lead free required by law that goes into effect January 2014.
- C. Phased Construction:
 - 1. This project consists of work that must be accomplished in a specific sequence on premium time to avoid interruption of services to existing portions of the buildings and mechanical, plumbing and fire protection systems that must remain operational
 - 2. Contractor shall include any and all temporary services required to keep the Owner occupied portions of the buildings operation without interruption of HVAC, plumbing and fire protection services for the duration of the project.
 - 3. Refer to Architectural drawings for description of phasing, stage all mechanical, plumbing and fire protection work accordingly.
- D. The Drawings and Specifications are complementary to each other and what is called for by one shall be as binding as if called for by both. If a discrepancy exists between the Drawing and Specifications, the higher cost shall be included, and the Engineer shall be notified of the discrepancy.

1.2 QUALITY ASSURANCE

- A. Perform all work in accordance with the latest edition of the applicable codes, specifications, local ordinances, industry standards, utility company regulations, nationally accepted codes.
- B. All materials and distribution, and utilization equipment shall be UL Listed.
- C. All equipment and materials shall be new, unused and of United States Domestic manufacture unless approved otherwise by engineer or owner.
- D. Eliminate any abnormal sources of noise that are considered by the Architect or Engineer not to be an inherent part of the systems as designed without additional cost to the Owner.

1.3 COORDINATION WITH OTHER TRADES

- A. Coordinate the work of this division with all other divisions to ensure that all components of the mechanical, plumbing and fire protection system will be installed at the proper time and fit the available space.

- B. Locate and size all openings in work of other trades required for the proper installation of the mechanical, plumbing and fire protection system components.
- C. Make all mechanical, plumbing and fire protection connections to all equipment furnished by this division and as required by any other division.
- D. Electrical wiring, control equipment and motor starters indicated on the electrical drawings, except items otherwise specifically noted, shall be furnished and installed by the electrical trades. Items of electrical control equipment specifically mentioned to be furnished by the mechanical trades, either in these specifications or on the mechanical drawings, shall be furnished, mounted and wired by this trade unless where otherwise specified in Division 26 or noted on the electrical drawings to be by the electrical trades. All wiring shall be in accordance with all requirements of the electrical Sections of these specifications.
- E. Any changes or additions required by specific equipment furnished shall be the complete responsibility of the Contractor furnishing the equipment. All controllers furnished with mechanical equipment shall have overload protection in all phases. It shall be the responsibility of each subcontractor furnishing motors and devices to advise Electrical Contractor of exact function of systems to assure proper type of starter with correct number auxiliary contacts for proper operation of the system.
- F. The mechanical trades shall coordinate with the electrical to ensure that all required components of control work are included and fully understood. No additional cost shall accrue to the Owner as a result of lack of such coordination.
- G. The design of the electrical systems is based on the mechanical equipment specified and scheduled on the drawings. Where changes or substitutions are made that involve additional electrical work (larger-size motors, larger number of motors, additional wiring of equipment, etc.), the mechanical trades shall pay the electrical trades for the cost of the additional work, except for changes by bulletin.
- H. Motor control equipment which is furnished loose under Division 23 shall be delivered to the Electrical Contractor at the site for custody, erection in place, and wiring as specified.
- I. Smoke detection systems will be furnished and installed under Division 26 – electrical. Coordinate locations with Electrical Contractor.

1.4 DRAWINGS

- A. The drawings are schematic in nature, but show the various components of the systems approximately to scale and attempt to indicate how they are to be integrated with other parts of the building. Determine exact locations by review of equipment manufacturer's data, by job site measurements, by checking the requirements of other trades, and by reviewing all Contract Documents. The size of the mechanical, plumbing and fire protection equipment indicated on the Drawings may be based on the dimensions of a particular manufacturer. While other listed manufacturers will be acceptable, it is the responsibility of the Contractor to determine if the equipment that the Contractor proposes to furnish will fit in the space. The drawings are not intended to show exact locations of pipes and ducts, or to indicate all offsets and fittings or supports, but rather to indicate approximate layout.

- B. The mechanical, plumbing and fire protection Drawings are necessarily diagrammatic in character and cannot show every connection in detail in its exact location. These details are subject to the requirements of ordinances and also structural and architectural conditions. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades in order to avoid interference between the various phases of work. Work shall be laid out so that it will be concealed in furred chases and suspended ceilings, etc., in finished portions of the building, unless specifically noted to be exposed. Work shall be installed to avoid crippling of structural members. All exposed work shall be installed parallel or perpendicular to the lines of the building unless otherwise noted.
- C. When the mechanical, electrical, plumbing and fire protection Drawings do not give exact details as to the elevation of pipe, conduit and ducts, physically arrange the systems to fit in the space available at the elevations intended with the proper grades for the functioning of the system involved. Exposed piping and ductwork is generally intended to be installed true and square to the building construction, and located as high as possible against the structure in a neat and workmanlike manner. The Drawings do not show all required offsets and their location details. Work shall be concealed in all finished areas.
- D. The locations, arrangement and extent of equipment, devices, and other appurtenances related to the installation of work shown on the Drawings are approximate. The Contractor shall not scale drawings, but shall refer to the architectural drawings for exact dimensions of building components. Should a conflict exist between the architectural and engineering drawings regarding dimensions and scale, the Contractor shall notify the Architect of the discrepancy for resolution.
- E. Materials, equipment or labor not indicated but which can be reasonably inferred to be necessary for a complete installation shall be provided. Drawings and Specifications do not undertake to indicate every item of material, equipment, or labor required to produce a complete and properly operating installation.

1.5 SUBMITTALS

- A. Provide shop drawings and complete product data as indicated in each specification section.
- B. Coordination Drawings: Using the mechanical ductwork shop drawings as a basis, provide a composite set of AutoCAD drawings in which the major mechanical, plumbing and fire protection equipment, ductwork and piping are superimposed on the architectural reflected ceiling plan and structural framing plan. Include spot elevations of bottom of steel along with finished ceiling height. Prepare at 1/8 inch scale or larger, one drawing per building area. Provide 1/4 inch scale enlargements of locations where special attention to rough-in dimensions as required to ensure all systems will fit within the available space. Obtain approval of coordination drawings prior to duct fabrication and mechanical system hanger rough-ins.
- C. Shop Drawings will be reviewed and returned to the Contractor with one of the following categories:
 - 1. **Reviewed:** No further submittal action is required. Submittal to be included in O & M Manual.
 - 2. **Revise and Resubmit:** Contractor to resubmit submittal as indicated in comments section of Engineer's Submittal Cover Letter.

3. **Rejected:** Contractor to resubmit new submittal when alternate or substitution is not approved and be required to furnished product named in Specification and or Drawings.
 4. **Furnish as Corrected:** Contractor to submit letter verifying that required corrections noted on Engineer's Submittal Cover Letter have been received and complied with by manufacturer. If equipment on site is not in compliance with corrections noted, contractor shall be responsible for the cost of removing and replacing equipment.
- D. Materials and equipment which are purchased or installed without Submittal review and approval will be removed and replaced with specified equipment at Contractor's expense.
- E. Provide a specification review that consists of a copy of related specification section with notations indicating compliance or deviation with each element of specification.

1.6 CLOSEOUT SUBMITTALS

- A. Submit in accordance with Division 1 - General Requirements and each specification section.

1.7 INTERFERENCE DRAWINGS

- A. Where field conditions prohibit the installation of the mechanical, plumbing or fire protection system components within the available space as indicated on drawings, the Contractor shall prepare a sketch to the minimum 1/8 inch scale, clearly depicting the conflict along with an alternate installation arrangement that satisfies the design intent of the documents without incurring additional cost.
- B. Obtain written approval of proposed interference resolution prior to proceeding with alternate installation.

1.8 EXISTING CONDITIONS

- A. The Contractor shall be familiar with the required scope of work to accomplish the work required by these documents. All demolition work implied or required shall be included in the scope of this contract.
- B. Outages of services are required by the new installation will only be permitted at a time approved by the Owner. The contractor shall allow the Owner a 2 week window in order to schedule required outages. The time allowed for outages will not be during normal operating hours unless otherwise approved by the Owner. All costs for outages, including overtime charges, shall be included in the contract amount.
- C. Work Sequence, Timing, Coordination with Owner:
1. During the construction of this project, normal facility activities will continue in existing buildings until new buildings or renovated areas are completed. Plumbing, fire protection, lighting, electrical, communications, heating, air conditioning, and ventilation systems will have to be maintained in service within the occupied spaces of the existing building.
- D. Demolition and Work within Existing Buildings:
1. In the preparation of these documents every effort has been made to show the approximate locations of, and connections to the existing piping, duct, equipment and other apparatus related to this phase of the work. However, the Contractor

shall be responsible for verifying all existing conditions. The Contractor shall visit the existing site to inspect the facilities and related areas. The Contractor shall inspect and verify all details and requirements of all the Contract Documents, prior to the submission of a proposal. All discrepancies between the Contract Documents and actual job-site conditions shall be resolved by his contractor, who shall produce drawings which shall be submitted to the Architect/Engineer for review. All labor and materials required to perform the work described shall be part of this Contract.

2. All equipment and/or systems noted on the Drawings "To Remain" shall be inspected and tested on site to certify working condition. A written report on the condition of all equipment to remain, including a copy of the test results and recommended remedial actions and costs shall be made by this Contractor to the Architect/Engineer for review.
3. All equipment and/or systems noted on the Drawings "To Be Removed" shall be removed including associated system connections. Where duct or pipe is to be capped for future extension or end of line use, it shall be properly tagged with its function or service appropriately identified. Where existing equipment is to be removed or relocated and has an electric connection, the Electrical Contractor shall disconnect equipment and remove wiring back to panel or disconnect switch. Contractor shall remove or relocate equipment and associated disconnect.
4. During the construction and remodeling, portions of the Project shall remain in service. Construction equipment, material tools, extension cords, etc., shall be arranged so as to present minimum hazard or interruption to the occupants of the building. None of the construction work shall interfere with the proper operation of the existing facility or be so conducted as to cause harm or danger to persons on the premises. All fire exits, stairs or corridors required for proper access, circulation or exit shall remain clear of equipment, materials or debris. The General Contractor shall maintain barricades separating work area from occupied areas.
5. Certain work during the demolition and construction phases of construction may require temporary evacuation of the occupants. Coordinate and schedule all proposed evacuation with the Project Administrator at least seventy-two (72) hours in advance in writing.
6. Any salvageable equipment as determined by the Owner, shall be delivered to the Owner, and placed in storage at the location of his choice. All other debris shall be removed from the site immediately.
7. Equipment, piping or other potential hazards to the occupants of the building shall not be left overnight outside of the designated working or construction area.
8. Make every effort to minimize damage to the existing building and the owner's property. Repair, patch or replace as required any damage which might occur as a result of work at the site. Care shall be taken to minimize interference with the Owner's activities during construction and to keep construction disrupted areas to a minimum. Coordinate with the Owner and other trades in scheduling and performance of the work.
9. Include in the contract price all rerouting of existing pipe, duct, etc., and the reconnecting of the existing equipment and plumbing fixtures as necessitated by field conditions to allow the installation of the new systems regardless of whether or not such rerouting, reconnecting or relocating is shown on the drawings. Furnish all temporary pipe, duct, controls, etc., as required to maintain heating, cooling, ventilation and plumbing services for the existing areas.
10. All existing plumbing fixtures, pipe, duct, materials, equipment, controls and appurtenances not included in the remodel or alteration areas are to remain in place.

11. Pipe, duct, equipment and controls that are disconnected to perform remodeling work, shall be reconnected in such a manner as to leave systems in proper operating condition.
12. No portion of the fire protection systems shall be turned off, modified or changed in any way without the express knowledge and written permission of the Owner's representative in order to protect systems that shall remain in service.
13. It is the intention of this Section of the Specifications to outline minimum requirements to furnish the Owner with a turn-key and operating system in cooperation with other trades with a minimum of disruption or downtime.
14. Refer to Architectural "Demolition and/or Alteration" plans for actual location of walls, ceiling, etc., being removed and/or remodeled.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- B. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.
- C. Do not deliver items to project before time of installation. Limit shipment of bulk and multiple-use materials to quantities needed for immediate installation.

1.10 GENERAL ELECTRICAL REQUIREMENTS

- A. Provide electric motors, control panels, certain control and safety devices and control wiring when specified or required for proper operation of electrical systems associated with mechanical equipment specified in Division 23.
- B. Electrical materials and work provided shall be in accordance with Division 26.
- C. Notify Architect/Engineer in writing 14 days before bids are due if it is necessary to increase horsepower of any motors or change any electrical requirements listed or shown. After this period, costs incurred because of changes shall be assumed by the responsible Contractor.

1.11 ELECTRICAL REQUIREMENTS FOR MECHANICAL EQUIPMENT

- A. Mechanical equipment with factory assembled and/or attached electric equipment shall be Underwriters' Laboratories (UL) listed as an assembly when such listing is available from UL, and shall meet the latest edition of the National Electrical Code.
- B. Unless otherwise specified, the electrical supply being furnished is a 480 volt, 3 phase, 3 wire, 60 hertz source. A neutral connection will not be provided, the manufacturer shall include any transformers for equipment requiring other voltages (277volt, 220 volt, 120 volt, 24 volt, etc.).
- C. Electric Motors:
 1. For each piece of equipment requiring electric drive, provide a motor having starting and running characteristics consistent with torque and speed requirements of the driven machine.

2. Manufacturers furnishing motors shall verify motor horsepower with the characteristic power curves of driven equipment on shop drawings.
3. Each motor shall be furnished in accordance with Section 23 05 13 - Common Motor Requirements for HVAC Equipment.
4. Contractor shall verify electrical characteristics of each motor with electrical drawings.
5. Motors which are shipped loose from equipment shall be set by supplying subcontractor.
6. Alignment of motors factory coupled to equipment and motors field coupled to equipment shall be rechecked by millwright after all connections (belt drives, gear drives, impellers, piping, etc.) have been completed and again after 48 hours of operation in designed service.
7. Where possible, motors shall be factory mounted.

PART 2 – PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. All equipment, materials, accessories, etc. used shall be new and of current production unless specified otherwise. Equipment not specified in the Contract Documents shall be suitable for the intended use and shall be subject to approval by the Engineer.
- B. All equipment, products and materials shall be free of defects and shall be constructed to operate in a safe manner without excessive noise, vibration, leakage, or wear.
- C. All equipment shall bear the inspection label of Underwriters Laboratories Inc.
- D. All equipment and material for similar applications or systems shall be provided from the same manufacturer unless noted otherwise.
- E. Cast iron soil pipe and fittings shall bear the collective trademark of the Cast Iron Soil Pipe Institute.

2.2 ACCESS PANELS

- A. Group valves together above suspended ceilings, walls, furred spaces to minimize the number of access panels, but with all valves freely accessible for maintenance. Locate all valves within 1'-0" of access point.
- B. Furnish access panels of proper size to service concealed valves and cleanouts. Panels shall be of the proper type for material in which they occur and are to be furnished by the Contractor, but installed by the particular trade for the material within which the access panel is installed.
- C. Panels shall have flush doors with No.14 USCG steel door and trim No. 16 USCG steel frame, metal wings for keying into construction, concealed hinges, and screwdriver operated stainless steel cam lock. Panels shall be shop coated with one coat of zinc chromate primer. Valves above removable ceilings shall have tile clips by the Contractor for identification.

- D. Access panels are not allowed in gypsum ceilings in public spaces.

2.3 INSULATION

- A. The following shall be insulated:
 - 1. All new domestic cold water piping above grade except at horizontal chase branch piping to individual plumbing fixtures.
 - 2. All new hot water and hot water return piping except at horizontal chase branch piping to individual plumbing fixtures.
- B. Domestic hot, cold, hot water recirculation, primary storm drainage, and waste drainage piping shall be insulated with 4 lb. density sectional fiberglass insulation with a thermal conductivity not to exceed 0.24 with white all service jacket and vapor barrier. All joints and seams shall be sealed vapor tight. All seams and staples shall then be covered with "All Service Jacket" three-inch wide tape.
- C. All interior horizontal storm drainage piping systems and roof drain bodies are to be insulated with blanket type glass fiber bonded with thermosetting resin with white vinyl vapor retarding facing, 2" wide stapling/taping tab.
- D. Materials as specified in this section shall be manufactured by CertainTeed, Johns Manville, Knauf, Owens Corning or equal. Insulation thicknesses shall be as shown in the following table:

Piping System Types	Minimum Pipe Insulation		Insulation Thickness for Pipe Sizes				
	Fluid Temperature Range		1 in. and Less	1-1/4 to 2 in.	2-1/2 to 4 in.	5 and 6 in.	8 in. and Larger
	°C	F	In.	In.	In.	In.	In.
PLUMBING							
Domestic Water	Ambient	Ambient	0.5	1.0	1.0	1.0	--
Domestic Hot Water And Hot Water Recirculation	43-71	110-160	1.0	1.0	1.5	1.5	--
Above Grade Drains and Piping Receiving Condensate or Ice Machine Discharge	4.5-15.5	40-60	0.5	1.0	1.0	1.5	--
Horizontal Storm Drainage	Ambient	Ambient	--	--	1.0	1.0	1.0

2.4 FLASHING

- A. Vent pipes passing through roof shall be flashed watertight.
- B. The roof connections shall meet the approval of the manufacturer of the roofing materials and shall comply with the roof bond requirements.

- C. All vent piping shall be offset above ceilings or in attic space and as shown on the Drawings to penetrate roofs on the least visible sides of building.

2.5 FLOOR, WALL & CEILING PLATES

- A. Furnish and install heavy gauge chromium plated steel wall and ceiling plates on all exposed pipes in finished areas where they pass through walls, ceilings, etc. Plates shall be of type that will remain permanently in position and where pipes are insulated they shall be of size necessary to cover insulated pipe.

2.6 GALVANIC PROTECTION

- A. Insulate joints between dissimilar metals with suitable isolation gasket and bolts with fiber ferrules and washers and/or suitable armored insulation fittings by Clearflow, Crane, Capital, or Epco, so there will be no contact between the metals or with insulating bushings.

2.7 PIPING SYSTEMS IDENTIFICATION

- A. A marker showing the service and an arrow indicating the direction of flow shall be applied on all of the following piping systems applicable to the project installed under this section of the Specifications:
 - 1. Acid vent piping
 - 2. Acid waste piping
 - 3. Compressed air piping
 - 4. Domestic hot, cold and hot water recirculation water piping
 - 5. Fuel oil piping
 - 6. Gas piping
 - 7. Primary and emergency storm drainage piping
 - 8. Sanitary, waste and vent piping
 - 9. Softened water piping
 - 10. Steam piping
 - 11. Vacuum piping
- B. Piping identification shall be applied on all piping systems in areas of exposed construction and in areas with accessible or lay-in ceilings. The piping shall be labeled at each wall and floor penetration (both sides), and at connections to equipment. In addition, straight runs of piping shall be labeled at intervals not greater than 25 feet.
- C. The letter size and background color shall conform to the Identification of Pipe System ANSI A-13-1. The vinyl plastic markers shall be as manufactured by Seton Name-Plate Company, W. H. Brady Company, or Westline products.
- D. Each valve in the Plumbing and Fire Protection systems is to be provided with an individually numbered valve tag.
- E. Valve tags are to be brass or plastic laminate, 1-1/2" minimum diameter with brass chain and hook for securing to the valve.
- F. Valve tags will include a "P" or "FP" lettering designation to indicate the appropriate system. Numbering shall be consecutive for each service of either the Plumbing or Fire Protection systems.

- G. A printed list or schematic drawing shall be compiled for each system indicating the location and detailed description of the system or equipment served.
- H. One copy of each list shall be framed and mounted at the location designated by the Building Engineer. An additional copy of each list is to be included in the Operations and Maintenance Manual.

2.8 EQUIPMENT LABELING

- A. All equipment shall be labeled. This shall include all pumps, water heaters, storage tanks, and other similar equipment.
- B. Equipment labeling shall be one of the following, unless noted or specified otherwise.
 - 1. Permanently attached plastic laminate signs with 1" high lettering.
 - 2. Stencil painted identification, 2" high letters, with standard fiberboard stencils and standard black (or other appropriate color) exterior stencil enamel.

PART 3 - EXECUTION

3.1 EXISTING WORK

- A. Disconnect mechanical, plumbing and fire protection systems in walls, floors, and ceilings scheduled for removal.
- B. Provide all required connections to maintain existing systems in service during construction.
- C. When performing work on operating systems use personnel experienced and trained in similar operations.
- D. Remove, relocate, and extend existing installations to accommodate new construction.
- E. Repair adjacent construction and finishes damaged during demolition and extension work.
- F. Normal facility activities will continue in existing areas. MEP systems servicing existing occupied spaces will have to be maintained in service. Schedule any required outages and system service interruptions with Owner and Architect. Submit a written request indicating service(s) to be interrupted along with proposed duration and summary of work to be performed during downtime.
- G. Removed Equipment:
 - 1. Store removed items at site; Owner retains rights to all removed items.
 - 2. Allow Owner ample time to review removed items and to designate which items to be kept by Owner.
 - 3. Dispose properly, off-site, all items Owner chooses not to keep.

3.2 DEMOLITION AND EXTENSION OF EXISTING MECHANICAL WORK

- A. Remove, relocate and extend existing installations to accommodate new construction.
- B. Remove abandoned piping to source of supply.

- C. Remove exposed abandoned piping systems, including abandoned systems above accessible ceiling finishes. Cut systems flush with walls and floors, and patch surfaces.
- D. Repair adjacent construction and finishes damaged during demolition and extension work.
- E. Maintain access to existing installations which remain active. Modify installation or provide access panels as appropriate.
- F. Extend existing installations using materials and methods compatible with existing installations, or as specified.

3.3 CLEANING AND REPAIR

- A. Clean and repair existing materials and equipment which remain or are to be reused.

3.4 INSTALLATION

- A. Install relocated materials and equipment.

3.5 REMOVAL OF MATERIALS

- A. The Contractor shall modify, remove, and/or relocate all materials and items so indicated on the drawings or required by the installation of new facilities. All removals and/or dismantling shall be conducted in a manner as to produce maximum salvage. Salvage destination as directed by the Owner. Materials and/or items scheduled for relocation and which are damaged during dismantling or reassembly operations shall be repaired and restored to good operative condition. The contractor may, at his discretion and upon the approval of the Owner, substitute new materials and/or items of like design and quality in lieu of materials and/or items to be relocated.
- B. All items which are to be relocated shall be carefully removed in reverse to original assembly or placement and protected until relocated. The Contractor shall clean and repair and provide all new materials, fittings, and appurtenances required to complete the relocations and to restore to good operative order. All relocations shall be performed by workmen skilled in the work and in accordance with standard practice of the trades involves.
- C. When items scheduled for relocation are found to be in damaged condition before work has been started on dismantling, the contractor shall call the attention of the Owner to such items and receive further instructions before removal. Items damaged in repositioning operations are the contractor's responsibility and shall be repaired or replaced by the contractor as approved by the Owner, at no additional cost to the Owner.
- D. Service lines and wiring to items to be removed, salvaged, or relocated shall be removed to points indicated on the drawings, specified, or acceptable to the Owner. Service lines and wiring not scheduled for reuse shall be removed to the points at which reuse is to be continued or service is to remain. Such services shall be sealed, capped, or otherwise tied-off or disconnected in a safe manner acceptable to the Owner. All disconnections or connections into the existing facilities shall be done in such a manner as to result in minimum interruption of services to adjacent occupied areas. Services to existing areas or facilities which must remain in operation during the construction period shall not be interrupted without prior specific approval of the Owner as hereinbefore specified.

- E. Include in the contract price all rerouting of existing conduits, wiring, outlet boxes, fixtures, etc., and the reconnecting of existing fixtures as necessitated by field conditions to allow the installation of the new systems. Furnish all temporary conduit, wiring, boxes, etc., as required to maintain lighting and power service for the existing areas with a minimum of interruption. Remove wire and conduit back to nearest accessible active junction box and extend to existing homeruns as required.
- F. The Contractor shall be responsible for loss or damage to the existing facilities and shall be responsible for repairing such loss or damage. The Contractor shall send proper notices, make necessary arrangements, and perform other services required for the care, protection and operational maintenance of all electrical services for the new and existing facilities, The Contractor shall erect temporary barricades, with necessary safety devices, as required to protect personnel from injury, removing all such temporary protection upon completion of the work.
- G. Where existing construction is removed to provide working and extension access to existing utilities, Contractor shall remove doors, piping, conduit, outlet boxes, wiring, light fixtures, air conditioning ductwork and equipment, etc., to provide this access and shall reinstall same upon completion of work in the areas affected.
- H. Where partitions, walls, floors, or ceilings of existing construction are being removed, all contractors shall remove and reinstall in locations approved by the Architect all devices required for the operation of the various systems installed in the existing construction.

3.6 OWNER INSTRUCTION - GENERAL

- A. Provide on-site Owner training for all new equipment by factory trained specialists.
- B. Use Operation and Maintenance manuals and actual equipment installed as basis for instruction.
- C. At conclusion of on-site training program have Owner personnel sign written certification they have completed training and understand equipment operation. Include copy of training certificates in final Operation and Maintenance manual submission.
- D. Refer to individual equipment specifications for additional training requirements.

END OF SECTION

SECTION 22 05 16

EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Expansion joints.
 - 2. Pipe alignment guides.
 - 3. Pipe anchors.
- B. Related Sections:
 - 1. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment: Product and installation requirements for piping hangers and supports.

1.2 DESIGN REQUIREMENTS

- A. Provide structural work and equipment required for expansion and contraction of piping. Verify anchors, guides, and expansion joints provide and adequately protect system.
- B. Expansion Compensation Design Criteria:
 - 1. Installation Temperature: 50 degrees Fahrenheit.
 - 2. Domestic Hot Water: 140 degrees Fahrenheit.
 - 3. Safety Factor: 30 percent.

1.3 SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Shop Drawings: Indicate layout of piping systems, including flexible connectors, expansion joints, expansion compensators, loops, offsets and swing joints. Submit shop drawings sealed by a registered professional engineer.
- C. Product Data:
 - 1. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.
 - 2. Expansion Joints: Indicate maximum temperature and pressure rating, and maximum expansion compensation.
- D. Design Data: Indicate criteria and show calculations. Submit calculations sealed by a registered professional engineer.
- E. Manufacturer's Installation Instructions: Submit special procedures.
- F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- G. Welders' Certificate: Include welders' certification of compliance with AWS D1.1.

- H. Manufacturer's Field Reports: Indicate results of inspection by manufacturer's representative.

1.4 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of flexible pipe connectors, expansion joints, anchors, and guides.
- B. Operation and Maintenance Data: Submit adjustment instructions.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with ASME B31.9 code for installation of piping systems and ASME Section IX for welding materials and procedures.

1.6 QUALIFICATIONS

- A. Installer: Company specializing in performing Work of this section with minimum three (3) years documented experience.
- B. Design expansion compensating system under direct supervision of Professional Engineer experienced in design of this Work and licensed at Project location.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Accept expansion joints on site in factory packing with shipping bars and positioning devices intact. Inspect for damage.
- B. Protect equipment from exposure by leaving factory coverings, pipe end protection, and packaging in place until installation.

1.8 WARRANTY

- A. Furnish five (5) year manufacturer warranty for leak free performance of packed expansion joints.

PART 2 - PRODUCTS

2.1 EXPANSION JOINTS

- A. Manufacturers:
 - 1. Amber / Booth
 - 2. Triplex
 - 3. Mason Industries
 - 4. Uponor
- B. Stainless Steel Bellows Type:
 - 1. Pressure Rating: 200 psig WOG and 250 degrees Fahrenheit.
 - 2. Maximum Compression: 1-3/4 inch.
 - 3. Maximum Extension: 1/4 inch.
 - 4. Joint: As specified for pipe joints.
 - 5. Size: Use pipe sized units
 - 6. Application: Steel piping three (3) inch and smaller.

- C. External Ring Controlled Stainless Steel Bellows Type:
 - 1. Pressure Rating: 200 psig WOG and 250 degrees Fahrenheit.
 - 2. Maximum Compression: 15/16 inch.
 - 3. Maximum Extension: 5/16 inch.
 - 4. Maximum Offset: 1/8 inch.
 - 5. Joint: Flanged
 - 6. Size: Use pipe sized units
 - 7. Accessories: Internal flow liner.
 - 8. Application: Steel piping three (3) inch and larger.

- D. Double Sphere, Flexible Compensators:
 - 1. Body: Multi-layered Kevlar tire cord fabric reinforced with EPDM cover, liner and fabric frictioning with reinforcing ring.
 - 2. Working Pressure: 215 psi
 - 3. Maximum Temperature: 250 degrees Fahrenheit.
 - 4. Maximum Compression: 1-1/4 inch through 6 inch pipe; 1-1/2 inch 8 inch through 12 inch; 1-1/5 inch for 14 inch.
 - 5. Maximum Elongation: 3/4 inch through 6 inch pipe; 1-1/2 inch 8 inch through 12 inch; 5/8 inch for 14 inch.
 - 6. Maximum Offset: 3/8 inch through 6 inch pipe; 7/8 inch 8 inch through 12 inch; 1 inch for 14 inch.
 - 7. Maximum Angular Movement: 15 degrees.
 - 8. Joint: Steel flanges or ductile iron pipe flanges.
 - 9. Size: Use pipe sized units
 - 10. Accessories: Control rods.
 - 11. Application: Steel piping two (2) inch and larger.

- E. PEX-a Pipe Support (Uponor):
 - 1. For use with Uponor PEX-a pipe
 - 2. PEX-a pipe continuously supported with PEX-a Pipe Support and utilizing fixed anchor points every:
 - a. 65 feet for domestic hot water
 - b. 150 feet for domestic cold water
 - 3. Utilize the included stainless-steel straps to secure the PEX-a Pipe Support to the pipe at the intervals specified in the manufacturer's installation instructions.
 - 4. Refer to the Uponor Plumbing Design Assistance Manual for more information.

2.2 ACCESSORIES

- A. Manufacturers:
 - 1. Amber / Booth
 - 2. Triplex
 - 3. Mason Industries

- B. Pipe Alignment Guides: Two piece welded steel with enamel paint, bolted, with spider to fit standard pipe, frame with four mounting holes, clearance for minimum 1 inch thick insulation, minimum 3 inch travel.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install Work in accordance with ASME B31.9.

- B. Rigidly anchor pipe to building structure to prevent stresses and transfer of loading to connected equipment.
- C. Provide support and anchors for controlling expansion and contraction of piping. Provide loops, pipe offsets, and swing joints, or expansion joints where required. Refer to Section 23 05 29 for pipe hanger installation requirements.
- D. Provide grooved piping systems with minimum one joint per inch pipe diameter instead of flexible connector supported by vibration isolation. Grooved piping systems need not be anchored.
- E. Provide expansion loops as indicated on Drawings.
- F. Install expansion compensating devices for PEX tubing in accordance with the manufacturer's installation instructions.

3.2 MANUFACTURER'S FIELD SERVICES

- A. Furnish inspection services by flexible pipe manufacturer's representative for final installation and certify installation is in accordance with manufacturer's recommendations and connectors are performing satisfactorily.

END OF SECTION

SECTION 22 05 29

PLUMBING HANGERS AND SUPPORTS

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SUMMARY

- A. Provide a complete system of pipe hangers and supports for all plumbing and fire protection equipment and piping.

1.2 DEFINITIONS

- A. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

1.3 SUBMITTALS

- A. Product Data:
 - 1. Hangers and Supports: Submit manufacturers catalog data including load capacity.
 - 2. Firestopping: Submit data on product characteristics, performance and limitation criteria.
- B. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers. Indicate calculations used to determine load carrying capacity of trapeze, multiple pipe, and riser support hangers.
- C. Manufacturer's Installation Instructions:
 - 1. Hangers and Supports: Submit special procedures and assembly of components.
 - 2. Firestopping: Submit preparation and installation instructions.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- B. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.

1.5 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply firestopping materials when temperature of substrate material and ambient air is below 60 degrees Fahrenheit.
- B. Maintain this minimum temperature before, during, and for minimum three (3) days after installation of firestopping materials.
- C. Provide ventilation in areas to receive solvent cured materials.

PART 2 - PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

- A. Manufacturers:
 - 1. Unistrut Corp.

- B. Pipe Supports:
 - 1. Conform to MSS SP58.
 - 2. Hangers for Pipe sizes 1/2 to 1-1/2 inch: Carbon steel, adjustable swivel, split ring.
 - 3. Hangers for Pipe sizes two (2) inches and Larger: Carbon steel, adjustable, clevis.
 - 4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
 - 5. Wall Support for Pipe sizes three (3) inches and Smaller: Cast iron hook.
 - 6. Wall Support for Pipe sizes four (4) inches and Larger: Welded steel bracket and wrought steel clamp.
 - 7. Vertical Support: Steel riser clamp.
 - 8. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 - 9. Copper Pipe Support: Copper-plated, carbon-steel adjustable, ring.

2.2 ACCESSORIES

- A. Hanger Rods: Mild steel threaded both ends, threaded on one end, or continuous threaded.

2.3 INSERTS

- A. Inserts: Malleable iron case of steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.4 SLEEVES

- A. Sleeves for Pipes Through Non-fire Rated Floors and Walls: 18 gage thick galvanized steel.
- B. Provide chrome plated escutcheon plates on pipes passing through walls, floors, and ceilings exposed to view. Provide stainless steel sheet metal for exterior walls.
- C. Sealant: Acrylic

2.5 MECHANICAL SLEEVE SEALS

- A. Manufacturers:
 - 1. Thunderline Link-Seal, Inc., or approved equal.

- B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.6 FORMED STEEL CHANNEL

- A. Manufacturers:
 - 1. Unistrut Corp., or approved equal.
- B. Product Description: Galvanized 12 gage thick steel. With holes 1-1/2 inches on center.

2.7 FIRESTOPPING

- A. Manufacturers:
 - 1. Dow Corning Corp. Model.
 - 2. 3M fire Protection Products Model.
- B. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.
 - 1. Silicone Firestopping Elastomeric Firestopping: Multiple component silicone elastomeric compound and compatible silicone sealant.
 - 2. Foam Firestopping Compounds: Multiple component foam compound.
 - 3. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
 - 4. Fiber Stuffing and Sealant Firestopping: Composite of mineral fiber stuffing insulation with silicone elastomer for smoke stopping.
 - 5. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.
 - 6. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.
 - 7. Firestop Pillows: Formed mineral fiber pillows.
- C. Color: Dark gray Black As selected from manufacturer's full range of colors.

2.8 FIRESTOPPING ACCESSORIES

- A. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.
- B. Dam Material: Permanent:
 - 1. Mineral fiberboard.
 - 2. Mineral fiber matting.
 - 3. Sheet metal.
 - 4. Plywood or particle board.
 - 5. Alumina silicate fire board.
- C. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.
- D. General:
 - 1. Furnish UL listed products or products tested by independent testing laboratory.
 - 2. Select products with rating not less than rating of wall or floor being penetrated.
- E. Non-Rated Surfaces:
 - 1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where piping is exposed.

2. For exterior wall openings below grade, furnish mechanical sealing device to continuously fill annular space between piping and cored opening or water-stop type wall sleeve.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.
- B. Remove incompatible materials affecting bond.
- C. Install backing or damming materials to arrest liquid material leakage.
- D. Do not drill or cut structural members.

3.2 INSTALLATION - INSERTS

- A. Install inserts for placement in concrete forms.
- B. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe four (4) inches and larger.
- D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
- E. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.

3.3 INSTALLATION - PIPE HANGERS AND SUPPORTS

- A. Install in accordance with MSS SP 58.
- B. Supports for Gas Piping:
 1. Horizontal supports for steel and copper gas piping, threaded or welded, are every six (6) feet for 1/2 inch, every eight (8) feet for 3/4 inch and one (1) inch, and every ten (10) feet for 1-1/4 inches or larger.
 2. Vertical supports for steel gas piping, threaded or welded, are every six (6) feet for 1/2 inch, eight (8) feet for 3/4 inch and one (1) inch, and every floor for 1-1/4 inch and larger.
- C. Place hangers within 12 inches of each horizontal elbow.
- D. Use hangers with 1-1/2 inch minimum vertical adjustment.
- E. Support horizontal cast iron pipe adjacent to each hub, with five (5) feet maximum spacing between hangers. Support hubless cast iron at every other joint unless over four (4) feet then support at each joint. Support copper every six (6) feet for 1-1/2 inch and smaller; every ten (10) feet for two (2) inches and larger.
- F. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.

- G. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.
- H. Support riser piping independently of connected horizontal piping.
- I. Provide copper plated hangers and supports for copper piping .
- J. Design hangers for pipe movement without disengagement of supported pipe.
- K. Provide clearance in hangers and from structure and other equipment for installation of insulation.
- L. Install hangers with minimum 1/2 inch space between finished covering and adjacent work.

3.4 INSTALLATION - SLEEVES

- A. Exterior watertight entries: Seal with mechanical sleeve seals.
- B. Set sleeves in position in forms. Provide reinforcing around sleeves.
- C. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- D. Extend sleeves through floors one (1) inch above finished floor level. Caulk sleeves.
- E. Where piping penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with firestopping insulation or caulk. Firestopping required at all penetrations of rated floor and walls.
- F. Install chrome plated steel escutcheons at finished surfaces.

3.5 INSTALLATION - FIRESTOPPING

- A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, and other items, requiring firestopping.
- B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.
- C. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating. Refer to Architectural drawings for location of all rated walls and floors.
- D. Fire Rated Surface:
 - 1. Seal opening at floor and wall as follows:
 - a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
 - b. Size sleeve allowing minimum of one (1) inch void between sleeve and building element.
 - c. Pack void with backing material.
 - d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.
- E. Non-Rated Surfaces:

1. Seal opening through non-fire rated wall, partition floor, ceiling, and roof opening as follows:
 - a. Install sleeve through opening and extending beyond minimum of one (1) inch on both sides of building element.
 - b. Size sleeve allowing minimum of one (1) inch void between sleeve and building element.
 - c. Install type of sealant or caulk suitable for application.
2. Install escutcheons where pipe, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.
3. Exterior wall openings below grade: Assemble rubber links of mechanical sealing device to size of piping and tighten in place, in accordance with manufacturer's instructions.

END OF SECTION

SECTION 22 11 16

DOMESTIC WATER PIPING

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SUMMARY

- A. Provide a complete domestic water piping system.
- B. All materials and equipment for the potable water system shall meet the latest mandates and requirements for lead free required by law that goes into effect January 2014.

1.2 SUBMITTALS

- A. Product Data:
 - 1. Piping: Submit data on pipe materials, fittings, and accessories.
 - 2. Valves: Submit manufacturers catalog information with valve data and ratings for each service.
 - 3. Domestic Water Specialties: Submit manufacturers catalog information, component sizes, rough-in requirements, service sizes, and finishes.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- B. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.4 ENVIRONMENTAL REQUIREMENTS

- A. Do not install underground piping when bedding is wet or frozen.

1.5 EXTRA MATERIALS

- A. Furnish two (2) packing kits for each size valve and two (2) loose keys for outside hydrants.

PART 2 - PRODUCTS

2.1 WATER PIPING, ABOVE GRADE

- A. Copper Tubing 4" and smaller: ASTM B88, Type [L,] [K,] hard drawn.
 - 1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
 - 2. Joints: Solder, lead free, ASTM B32, 95-5TA (tin-antimony), or tin and silver, with melting range 430 to 535 degrees F. [Braze, AWS A5.8 BCuP silver/phosphorus/copper alloy with melting range 1190 to 1480 degrees F.]
 - 3. At the contractors option, Press connection copper fittings manufactured by NIBCO INC. or approved equal will be acceptable. Building services piping –20 degrees to +250 degrees up to 200 PSI. Fittings shall comply with NSF-61, CSA,

UPC. Seals shall be made of EPDM material and manufactured with an inboard bead design. All fittings shall be installed in accordance with the manufacturer's installation instructions and according to local plumbing and mechanical codes.

2.2 FLANGES, UNIONS, AND COUPLINGS

- A. Pipe Size two (2) inches and Smaller:
 - 1. Ferrous pipe: Class 150 malleable iron threaded unions.
 - 2. Copper tube and pipe: Class 150 bronze unions with soldered joints.

- B. Pipe Size 2-1/2 inches and Larger:
 - 1. Ferrous pipe: Class 150 malleable iron threaded or forged steel slip-on flanges; preformed neoprene gaskets.
 - 2. Copper tube and pipe: Class 150 slip-on bronze flanges; preformed neoprene gaskets.

- C. Dielectric Connections:
 - 1. Two (2) inches and smaller union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.
 - 2. 2-1/2 inches and larger, forged steel flanges, screwed neck, 1/16 inch thick performed neoprene gasket. (Same as paragraph B, above.)

2.3 VALVES

- A. General
 - 1. Valves shall be located to permit easy operation, replacement and repair. They shall be installed where shown on the Drawings, or as herein specified.
 - 2. Control valves shall be provided for the domestic hot and cold water supply to all risers and specific areas such as restrooms, fixture groups, equipment, hose bibbs and wall hydrants, food service areas and building separations. Valves shall be located in back-of-house or service areas with access panels or above lay-in ceilings. No access panels will be permitted in public spaces with gypsum ceilings.

- B. Ball Valves:
 - 1. Manufacturers: NIBCO INC., or approved equal.
 - 2. Two (2) inches and Smaller: NIBCO INC., S/T-585-80-LF, full-port, MSS SP 110, Class 150, 600 psi CWP, silicon bronze, two piece body, chrome plated silicon bronze ball, teflon seats and stuffing box ring, blow-out proof stem, lever handle with balancing stops, solder or threaded ends. No Lead.
 - 3. Where piping is insulated, ball valves shall be equipped with two (2) inch extended handles of non-thermal conductive CPVC material that meets UL 2043 approved for inside air plenum. Also provide a protective sleeve that allows operation of the valve without breaking the vapor seal or disturbing the insulation. Memory stops, which are fully adjustable after insulation is applied, shall be included.
 - 4. Ball valves installed outdoors or in-ground shall have stainless steel handle.

- C. Swing Check Valves:
 - 1. Manufacturers: NIBCO INC., or approved equal.
 - 2. Two (2) inches and Smaller: Nibco S-413-LF Series, class 125, MSS SP 80, silicon bronze body, stainless steel and PTFE disc, and soldered ends. No Lead.
 - 3. 2-1/2 inches and Larger: NIBCO INC., F918-SS Series, MSS SP 71, cast iron body, stainless steel fitted, stainless steel disc, flanged ends. No Lead.

2.4 RELIEF VALVES

- A. Manufacturers: Watts Industries, or approved equal.
- B. Temperature and Pressure Relief:
 - 1. ANSI Z21.22 certified, bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, temperature relief maximum 210 degrees Fahrenheit, capacity ASME Section IV certified and labeled.
- C. Vacuum Relief Valves:
 - 1. Watts N36 Lead Free Series.

2.5 STRAINERS

- A. Manufacturer: NIBCO INC., Mueller Steam Specialty, or approved equal.
- B. Two (2) inches and Smaller: Threaded bronze body for 200 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen. NIBCO INC., 221 Series.
- C. 2-1/2 and Larger: Class 125, flanged iron body, Y pattern with 1/16-inch stainless steel perforated screen. NIBCO INC., F-271 Series.
- D. Lead Free.

2.6 PLUMBING PIPE INSULATION

- A. 1 inch fiberglass with service jacket.
 - 1. Insulation shall have aluminum jacket when exposed to exterior.
- B. Fiberglass:
 - 1. High density factory molded fiberglass insulation with factory applied, all service, and reinforced vapor retarder jacket. Provide with a factory applied pressure sensitive tape closure system and matching butt strips. Provide thickness scheduled.
 - a. Thermal conductivity "k" of 0.23 of btu-in / hr-sq.ft. degree F at 75 degree mean temperature.
 - b. Maximum jacket permeance shall be 0.02.
 - c. Manufacturers:
 - 1) Johns Manville
 - 2) Owens Corning
 - 3) Knauf
- C. Aluminum Jacket:
 - 1. Jacket for piping shall be 0.016 inch thick type 3105 aluminum with factory applied one mil polykraft moisture barrier
 - 2. Fitting covers shall be factory made 0.024 inch type 1100 aluminum to match pipe covering.
 - 3. Aluminum jacketing shall be provided for all exterior piping.
 - 4. Manufacturers:
 - a. Childers
 - b. Pabco
 - c. RPR

2.7 SLEEVES AND ESCUTCHEONS

- A. The Contractor shall furnish and set pipe sleeves and inserts for all work under this section and shall be responsible for their proper and permanent location. In the event that failure to do so requires cutting and patching, the remedial work shall be the responsibility of the Contractor.
- B. All pipes passing through floors, walls or partitions shall be provided with sleeves having an internal diameter 1-1/2" (3/4" annular space) larger than the outside diameter of the pipe or insulation on covered lines, except as otherwise specified herein.
- C. Sleeves for all pipes through walls, beams and partitions shall finish flush with the finish line of the walls, beams and partitions.
- D. Sleeves for all piping shall extend 1/2" above finish floor, (except where under partitions, the sleeves shall be flush with the bottom of the partition) and after the installation of pipe shall be packed and made watertight with fire stopping sealant to maintain separations and fire ratings.
- E. Where pipes pass under footings and through exterior walls, sleeves shall be of galvanized steel pipe and shall be not less than 4" larger than the pipe being sleeved. Sleeves shall be made watertight where passing through waterproofed surfaces, exterior wall, and floor slabs on grade. Waterproofing shall be done by means of a steel slip on welding flange, continuously welded at the center of the sleeve and shall be painted with one coat of bitumastic paint inside and outside. The space between sleeve and pipe shall be packed with oakum to within 2" of each face of the wall; (to within 2" of the top of sleeve at floors). The remaining space shall be packed and made watertight with a waterproof mastic. Mechanical expansion type rubber seals such as manufactured by Calpico Ind. and Thunderline Corporation are acceptable as alternate method of water proofing piping penetrations.
- F. Sleeves through floors or interior masonry walls shall be of galvanized steel pipe or wrought iron pipe size except where located in concealed pipe spaces where they may be of 22 gauge galvanized sheet steel if fire rating is maintained.
- G. Sleeves through interior masonry partitions shall be of 22-gauge galvanized sheet steel.
- H. Sleeves for piping to receive insulation shall be large enough to allow continuous insulation through sleeves.
- I. Spacing between or location of pipe sleeves in floor slabs, structural beams or structural walls shall be subject to the Structural Engineer's approval.
- J. Where pipes pass under load bearing footings they shall pass through a coated steel pipe sleeve as described above and extend past a 45 degree line out from the bottom of the load bearing structure. Concrete shall be used as backfill in the portions of trench within the 45 degree pressure line.
- K. Escutcheons shall be provided around all exposed pipe passing through walls, partitions, ceilings and floors in finished spaces. Escutcheons shall be of sufficient outside diameter to cover the sleeve opening and shall fit snugly around the insulated or bare pipe and to the wall, partition, floor or ceiling.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify excavations are to required grade, dry, and not over-excavated.

3.2 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside, before assembly.

3.3 INSTALLATION - BURIED PIPING SYSTEMS

- A. Verify connection size, location, and invert are as indicated on Drawings.
- B. Establish elevations of buried piping with not less than two (2) feet of cover.
- C. Establish minimum separation from other services piping in accordance with code.
- D. Remove scale and dirt on inside of piping before assembly.
- E. Install pipe on prepared bedding.
- F. Route pipe in straight line.
- G. Install pipe to allow for expansion and contraction without stressing pipe or joints.
- H. Do not use lead bearing solder materials.
- I. Pipe Cover and Backfilling:
 - 1. After hydrostatic test, evenly backfill entire trench width by hand placing backfill material and hand tamping in four (4) inches compacted layers to 12 inches minimum cover over top of jacket. Compact to 95 percent maximum density.
 - 2. Evenly and continuously backfill remaining trench depth in uniform layers with backfill material.
 - 3. Do not use wheeled or tracked vehicles for tamping.
- J. Provide tracer wire for all piping routed below slab locate wire leads in accessible location for use in future line trouble shooting.

3.4 INSTALLATION - ABOVE GROUND PIPING

- A. Insulate all piping installed in exterior walls, above food service areas, and any area exposed to temperatures below 40 degrees Fahrenheit.
- B. Install non-conducting dielectric connections wherever jointing dissimilar metals.
- C. Insulate all domestic hot water supply and return lines.
- D. Install piping to maintain headroom without interfering with use of space or taking more space than necessary.
- E. Group piping whenever practical at common elevations.

- F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 22 05 16.
- G. Provide expansion tank for each domestic water heater, install per manufacturer's recommendations.
- H. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 22 05 29.
- I. Provide access where valves and fittings are not accessible. Coordinate size and location of access doors with Architect.
- J. Establish elevations of buried piping outside the building to obtain not less than one (1) foot of cover.
- K. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- L. Install water piping in accordance with ASME B31.9.
- M. Sleeve pipes passing through partitions, walls and floors.
- N. Install unions downstream of valves and at equipment or apparatus connections.
- O. Install valves with stems upright or horizontal, not inverted.
- P. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.
- Q. Install ball valves for shut-off and to isolate equipment at branch to each fixture bank and at each plumbing appliance or water heater.
- R. Provide check valves on discharge of all water circulating pumps.
- S. Install potable water protection devices on plumbing lines where contamination of domestic water may occur; on boiler feed water lines, janitor rooms, fire sprinkler systems, premise isolation, irrigation systems, flush valves, interior and exterior hose bibs.
- T. Pipe relief from valves, back-flow preventers and drains to nearest floor drain.
- U. Install water hammer arrestors complete with accessible isolation valve on hot and cold water supply piping to all equipment with solenoid valves.
- V. Route all domestic water piping inside building in climate controlled space not subject to freezing.
- W. Do not use lead bearing solder materials.
- X. In natatorium, including equipment rooms, all exposed plumbing piping shall be insulated and protected by a complete aluminum jacketing system. Refer to Section 23 07 16 for specification on jacketing. Provide color coded, printed pipe label 10' on center identifying pipe service type (gas, domestic water, storm water, etc.).

- Y. Lead Free.

3.5 INSTALLATION - SERVICE CONNECTIONS

- A. At each incoming water service line provide approved reduced pressure back-flow preventer.
- B. Provide a cast iron sleeve around service main to six (6) inches above floor and six (6) inches minimum below grade beam. Size for minimum of two (2) inches of loose batt insulation stuffing.

3.6 INSTALLATION - BACKFLOW PREVENTERS

- A. Provide at each make up connection to a hot water boiler, cooling tower, chilled water system, kitchen equipment, and at each piece of equipment requiring a make-up connection.
- B. Provide at water supply to fire protection system.
- C. Provide a floor drain within six (6) feet of each backflow preventer.
- D. Backflow preventer shall be certified by Contractor.
- E. Lead Free.

3.7 FIELD QUALITY CONTROL

- A. Pressure test all domestic water piping.
- B. After installation and prior to backfill or cover-up, rinse piping system of particulate contaminants, cap and subject to static water pressure of 125 psig for four (4) hours.
- C. Repair leaks and defects and re-test any portion of piping system that fails.
- D. Provide written test report including date and time of test, pass or fail indication, summary of remedial work required and date and time of each re-test.

END OF SECTION

SECTION 22 11 23

GAS PIPING

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SUMMARY

- A. Provide a complete natural gas piping system to all gas-burning appliances and all natural connectors.

1.2 SUBMITTALS

- A. Product Data:
 - 1. Piping: Submit data on pipe materials, fittings, and accessories.
 - 2. Valves: Submit manufacturers catalog information with valve data and ratings for each service.
 - 3. Piping Specialties: Submit manufacturers catalog information including capacity, rough-in requirements, and service sizes for the following:
 - a. Strainers.
 - b. Natural gas pressure regulators.
 - c. Natural gas pressure relief valves.
 - d. Tape form pipe coating.
- B. Test Reports: Indicate results of piping system pressure test.
- C. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.
- D. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within previous 12 months.

1.3 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of valves, piping system, and system components.
- B. Operation and Maintenance Data: Submit for valves and gas pressure regulators installation instructions, spare parts lists, and exploded assembly views.

1.4 QUALITY ASSURANCE

- A. Perform natural gas Work in accordance with NFPA 54.
- B. Perform Work in accordance with ASME B31.9 code for installation of piping systems and ASME Section IX for welding materials and procedures.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

- B. Protect piping and fittings from soil and debris with temporary end caps and closures. Maintain in place until installation. Furnish temporary protective coating on cast iron and steel valves.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Do not install underground piping when bedding is wet or frozen.

1.7 EXTRA MATERIALS

- A. Furnish two packing kits for each type and size valve.

PART 2 - PRODUCTS

2.1 NATURAL GAS PIPING, ABOVE GRADE

- A. Steel Pipe: ASTM A53 Schedule 40 black.
 - 1. Fittings: ASME B16.3, malleable iron, or ASTM A234/A234M forged steel welding type.
 - 2. Joints: NFPA 54, threaded through 2" max size or welded to ASME B31.9 above 2" size.

2.2 UNIONS AND COUPLINGS

- A. Ferrous pipe: 150 psi malleable iron threaded connections.
- B. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.3 VALVES

- A. Ball Valves:
 - 1. 1/4 inch to one (1) inch, MSS SP 110, 250 psi, two piece, threaded ends, bronze body, reinforced teflon seats, blow-out proof stem, lever handle, UL 842 listed for flammable liquids and LPG, full port. Nibco T-585-70-UL.

2.4 STRAINERS

- A. Manufacturers:
 - 1. O.C. Keckley Company or approved equal.
- B. Two (2) inch and Smaller: Screwed brass or iron body for 175 psig working pressure, Y pattern with 1/32 inch stainless steel perforated screen.
- C. 2-1/2 inch to four(4) inch: Flanged iron body for 175 psig working pressure, Y pattern with 3/64 inch stainless steel perforated screen.
- D. Five (5) inch and Larger: Flanged iron body for 175 psig working pressure, basket pattern with 1/8 inch stainless steel perforated screen.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify excavations are to required grade, dry, and not over-excavated.

3.2 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.
- D. Install plastic ribbon tape continuous over top of pipe buried six (6) inches below finish grade, above pipe line.

3.3 INSTALLATION - ABOVE GROUND PIPING SYSTEMS

- A. Install natural gas piping in accordance with NFPA 54.
- B. Provide rigid appliance connections for each gas-burning appliance in accordance with code.
- C. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- D. Provide an accessible, approved shut-off valve within three (3) feet of each gas appliance. Install such that appliance can be maintained and removed without removal of the shutoff valve.
- E. Install gas pressure regulator vent full size opening on regulator and terminate outdoors.
- F. Provide new gas service complete with gas meter and regulators. Gas service distribution piping to have initial minimum pressure of 5 psi. Provide regulators on each line serving gravity type appliances, sized in accordance with equipment.
- G. Install service pipe and set gas meters in accordance with Gas Company regulations.
- H. In natatorium, including equipment rooms, all exposed plumbing piping shall be insulated and protected by a complete aluminum jacketing system. Refer to Section 15083 for specification on jacketing. Provide color coded, printed pipe label 10' on center identifying pipe service type (gas, domestic water, storm water, etc.).
- I. Provide shut-off valves on both sides of all gas regulators for isolation of gas regulators.
- J. Provide a manual shut off valve on the appliance gas supply line in addition to the Kitchen Ansul unit automatic shut off.
- K. Provide a gas valve manifold to isolate kitchen gas appliances individually at one location.
- L. Provide separate gas valves on each fixture in labs.
- M. Provide a gas isolation valve on the lab controller unit.

- N. Install a test port of each side of all natural gas pressure regulators.
- O. Perform a pressure test of all replaced natural gas piping.

3.4 FIELD QUALITY CONTROL

- A. Pressure test natural gas piping in accordance with NFPA 54. Pressure test prior to backfill, minimum 50 psi for 24 hours.
- B. Defective joints or piping shall be replaced as required and the system shall then be re-tested.

END OF SECTION

SECTION 22 13 16

SANITARY WASTE AND VENT PIPING

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SUMMARY

- A. Provide a complete sanitary drainage system.

1.2 SUBMITTALS

- A. Product Data:
 - 1. Piping: Submit data on pipe materials, fittings, and accessories.
 - 2. Sanitary Drainage Specialties: Submit manufacturers catalog information, component sizes, rough-in requirements, service sizes, and finishes.
- B. Manufacturer's Installation Instructions: Submit installation instructions for material and equipment.
- C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.3 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of equipment and clean-outs.
- B. Operation and Maintenance Data: Submit frequency of treatment required for interceptors. Include spare parts lists, exploded assembly views for pumps and equipment.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with the plumbing code.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Do not install underground piping when bedding is wet or frozen.

PART 2 - PRODUCTS

2.1 SANITARY SEWER PIPING, ABOVE GRADE

- A. Manufacturers
 - 1. AB&I
 - 2. Charlotte Pipe and Foundry Co.
 - 3. Tyler Pipe/Soil Division

- B. Cast Iron Pipe: CISPI 301-99, CISPI 310, hub-less, service weight.
 - 1. Fittings: Cast iron.
 - 2. Joints: Neoprene gaskets and stainless steel clamp-and-shield assemblies.
 - a. Acceptable Clamp Manufacturers: Husky SD-4000 or Mifab MI-XHUB.
 - b. Acceptable Coupling Manufacturer: Mission Rubber Co., LLC Heavy Weight Couplings.
 - 3. All No-Hub clamps must have 4 bands minimum. Sizes 5" through 10" shall have six bands minimum.
 - 4. Provide Fernco "Pro-flex" shielded couplings Series 3000 with one piece neoprene gasket for all cast iron pipe transitions to Schedule 40 DWV pipe penetrations through slabs. Sizes 1-1/2" through 8" Series 3000.

- C. Cast Iron Pipe: ASTM A888 and CISPI 301, hub-less, service weight and marked with the collective trademark of the CISPI and listed by NSF International.
 - 1. Fittings: No hub cast iron fittings per CISPI 301 and ASTM A888.
 - 2. Joints: Neoprene gaskets and stainless steel clamp-and-shield assemblies conforming to ASTM D564. Heavy duty couplings are required on no-hub systems at the base of stack and vertical to horizontal offsets and shall conform to the requirements of ASTM C1540 and shall be type 304 stainless steel shielded couplings with stainless steel worm gear clamps, 15 psi working pressure.
 - a. Acceptable Manufacturers: Clamp-All High Torq 125 or Husky SD-4000.
 - 3. Joints: Neoprene gaskets and stainless steel clamp-and-shield assemblies conforming to ASTM D564. Medium duty couplings are required on no-hub systems excluding at the base of stack and vertical to horizontal offsets and shall conform to the requirements of ASTM C1540 and shall be type 304 stainless steel shielded couplings with stainless steel worm gear clamps, 15 psi working pressure.
 - a. Acceptable Manufacturers: Tyler Wide Body or Husky HD-2000.

2.2 VENT PIPING, ABOVE GRADE

- A. Manufacturers
 - 1. AB&I
 - 2. Charlotte Pipe and Foundry Co.
 - 3. Tyler Pipe/Soil Division

- B. Provide no-hub cast iron pipe and fittings.

- C. No-hub cast shall conform to requirements of ASTM A 74.

2.3 VENT PIPING, BELOW GRADE

- A. Use same as Sanitary Sewer Piping, Below Grade.

PART 3 - EXECUTION

3.1 FLOOR DRAINS

- A. Provide floor drain, including sanitary waste and vent piping, where indicated on drawings and at each toilet room containing two (2) or more water closets or a combination of one (1) water closet and one (1) urinal.

- B. Coordinate the exact location of all floor drains with Architectural Drawings prior to rough-in. Ensure drains are located at low points(s) of floor slope.

3.2 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Coordinate the exact location of all floor drains with architectural drawings prior to rough-in. Ensure drains are located at low point(s) of floor slope.
- C. Remove scale and dirt, on inside and outside, before assembly.

3.3 INSTALLATION - ABOVE GROUND PIPING

- A. Establish invert elevations, slopes for drainage to 1/4 inch per foot (two (2) percent) minimum. Maintain gradients.
- B. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Provide clearances at cleanout for snaking drainage system.
- C. Encase exterior cleanouts in concrete flush with grade.
- D. Install floor cleanouts at elevation to accommodate finished floor.
- E. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- F. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- G. Install piping to maintain headroom. Do not spread piping, conserve space.
- H. Group piping whenever practical at common elevations.
- I. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- J. Provide clearance in hangers and from structure and other equipment for installation of insulation.
- K. Provide access where valves and fittings are not accessible. Coordinate size and location of access doors with Architect.
- L. Install piping penetrating roofed areas to maintain integrity of roof assembly.
- M. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- N. Burred ends of all pipe and tubing shall be reamed to the bore of the pipe or tube and all chips shall be removed before installation.
- O. Install bell and spigot pipe with bell end upstream.

- P. Sleeve pipes passing through partitions, walls and floors.
- Q. Support cast iron drainage piping at every joint.
- R. Water test all piping per code.
- S. Insulate all above slab horizontal sanitary waste piping carrying air-conditioning condensate with minimum 1" fiberglass insulation with jacket from floor drain, including traps, all the way to change in direction to vertical.
- T. In natatorium, including equipment rooms, all exposed plumbing piping shall be insulated and protected by a complete aluminum jacketing system. Refer to Section 15083 for specification on jacketing. Provide color coded, printed pipe label 10' on center identifying pipe service type (gas, domestic water, storm water, etc.).
- U. Slope all vent piping to allow for drainage.
- V. Install a floor clean out every 80'.
- W. Provide and install a floor sink next to each HVAC air handling unit, pump, expansion tank, and every piece of HVAC equipment requiring condensate removal in every mechanical room.
- X. Drainage-waste-vent copper pipe and fittings for waste stub-outs for all fixture locations.

3.4 RODDING SEWERS

- A. All sanitary soil and waste lines, both in the building and out, shall be rodded out after completions of the installation.
- B. This Work shall be done, as part of the contract, to make certain that all lines are clear, and any obstruction that may be discovered shall be removed immediately. Rodding shall be accomplished by utilizing a rotary cutter, which shall be full size of pipe being cleaned. Rodding operations shall be witnessed by Owner's field representative. Submit a certificate of completion to owner.

3.5 FIELD QUALITY CONTROL

- A. Separate trenches for water lines, sanitary, storm, and gas piping.
- B. Piping shall be labeled along entire length; indicating size, class, material specification, manufacturers name, and country of origin.
- C. Piping and fittings resting on ground is unacceptable. Keep products covered. Provide temporary end caps and closures on piping and fittings.
- D. Foreign pipe and fittings unacceptable.
- E. Prior to cover up water pipe, sanitary pipe, and gas piping shall be pressure tested. Tests shall be witnessed by consultant and owner. Notify owner 48 hours prior to test. Test shall be witnessed by client plumbing technician.

- F. The inside of all sanitary lines shall be video recorded with a camera and witnessed by owner to first outside manhole. Provide tape and/or DVD upon closeout of project. If any obstructions are found they shall be removed and the line shall be videoed again to show the blockage has been cleared.
- G. For additions and renovations, use camera to locate routing of underslab lines.
- H. Upon completion of the sanitary piping system, the contractor shall notify engineer and owner to observe a smoke test of the system. Smoke testing shall be performed on sanitary piping system twice during construction.

END OF SECTION

SECTION 22 13 21

ACID WASTE AND VENT SYSTEMS

PART 1 - GENERAL

1.1 PLUMBING SYSTEMS DESIGN CRITERIA AND SCOPE OF WORK

A. SYSTEMS

1. Systems to be provided under the Plumbing design section shall be as listed below. The connection point for all systems from the site utilities shall be at 5'-0" from the exterior of the building unless specifically otherwise noted.
 - a. Acid waste and vent piping systems.
 - b. Acid neutralization tanks.

B. DESIGN STANDARDS

1. Plumbing systems shall be designed and installed in accordance with the requirements of the following codes, standards and design guides:
 - a. The International Plumbing Code, 2006 Edition, with most current State of Texas Amendments
 - b. The International Building Code, 2006 Edition, with most current State of Texas Amendments
 - c. Americans with Disabilities Act (ADA)
 - d. American Society of Plumbing Engineers (ASPE) Data Books
 - e. National Fire Protection Association (NFPA) Standards
 - 1) NFPA 30 - Flammable and Combustible Liquids Code
 - 2) NFPA 58 - Liquefied Petroleum Gases
 - f. Plumbing Drainage Institute (PDI)
 - g. Underwriters Laboratories Inc. (UL)
 - h. National Sanitation Foundation (NSF)
 - i. Local and State Fire Marshal requirements
 - j. Local Building and Inspection Department requirements
 - k. Local Health Department requirements

1.2 GENERAL REQUIREMENTS

- A. Division 1, General Requirements and Supplementary Conditions, are hereby made a part of this section as fully as if repeated herein.
- B. The scope of work required by this section of the specifications consists of furnishing all materials, labor, supervision, equipment, appurtenances, accessories, connections, permits and services to perform all plumbing work, complete and placed into approved operating condition, including all tests and adjustments, in strict accordance with these specifications and the Contract Drawings.
- C. The principal work under this section shall include, but not be limited to the following systems and equipment:

1. The Contractor shall furnish and install acid waste and vent piping and dilution basins as indicated on the drawings and/or included in this division of these specifications.
 2. Underground acid waste and vent piping including mains, branches, traps, connections to fixture and drains, and connections to stacks, piping to dilution tank; dilution tank(s) and piping connections from tank to designated outfall structure.
- D. The drawings and these specifications are complimentary each to the other, and any labor, or material called for by either, whether or not by both, shall be furnished and installed. The Contractor shall notify the Architect/Engineer of any discrepancies between the drawings and specifications regarding labor or materials prior to submitting bid.
- E. The drawings are diagrammatic in nature and indicate the various systems and piping required. All offsets, fittings, valves, devices and accessories which may be required are to be provided under this Contract. The plumbing subcontractor shall examine the entire set of Contract Documents and carefully investigate the structural and finish conditions affecting all his work and shall arrange such work accordingly for the complete satisfactory operation of all systems, providing such fittings, traps, valves, devices and accessories as may be required to meet such conditions. Particular attention shall be taken to avoid foundations, footing and other structural elements furnished under other sections of the specifications. Any adaptations, modifications, or additions are the responsibility of and shall be borne by this subcontractor and shall be approved by the Engineer before execution. All openings, blockouts or sleeves required for the execution of this subcontract are the responsibility of this subcontractor to coordinate.

1.3 RELATED WORK SPECIFIED ELSEWHERE

- A. Excavation and backfill for installation of the specified systems shall be done by this subcontractor.
- B. Core drilling, masonry work and painting incidental to the installation of the specified systems shall be included in the scope of work of this subcontractor.

1.4 REFERENCES

- A. Codes, Ordinances and Permits
 1. All work performed under this section of the Specifications shall conform to all codes, ordinances, and regulations of the City, County, State and/or other authorities having jurisdiction. All work shall conform to the 2000 Standard Plumbing Code with all local amendments as a minimum.
 2. This subcontractor shall give proper authorities all requisite notices, file all required plans relative to the work specified herein with proper authorities, and secure and pay for all permits, licenses and certificates relating to his work.
 3. If code or other requirements exceed the provisions shown on the Contract Documents, the Engineer shall be notified in writing. Where requirements of the Contract Documents exceed code requirements, work shall be furnished and installed in accordance with the Contract Documents. Any work done contrary to these requirements shall be removed and replaced at the Contractor's expense.

1.5 SUBMITTALS

A. Shop Drawings and Catalog Data

1. The Contractor shall prepare, submit, and obtain Engineer's review of manufacturers' submittals on the following equipment and systems prior to ordering, purchasing, or installation of any equipment or materials, and within 30 days from date of contract award. All required submittals shall be transmitted simultaneously in hard ring binders with the associated specification section and the item submitted clearly identified. Partial submittals will be returned without review unless previously agreed to by the Engineer.
 - a. Acid waste and vent piping.
 - b. Acid neutralization tank.
2. All shop drawing approvals required by any code or enforcement authority, insurance underwriter, etc. shall be obtained prior to being submitted to the Engineer.
3. Review of shop drawings by the Engineer does not relieve the Contractor from the responsibility for complying with all requirements of the Contract Documents. Furthermore, it shall be the responsibility of the Contractor to coordinate the requirements of all approved equipment with other trades and disciplines such as roof openings, wall openings, electrical characteristics, etc. Such coordination shall be clearly indicated on the shop drawings.
4. Shop drawings shall clearly indicate selection of model numbers, sizes, dimensions, electrical characteristics, etc. of the proposed equipment. Any deviations from specified equipment shall be clearly indicated on the submittal.

1.6 EQUIPMENT, MATERIAL BID BASIS

- A. Manufacturers' names, model numbers, etc. as specified on the drawings and herein are for the purpose of describing type, capacity, function and quality of equipment and materials required.
- B. Unless "approved equal" is specifically stated, bids shall be based on equipment named in specifications or on drawings as "base" products.
- C. Alternate "approved equal" items listed shall conform to specified base items and shall be substantially equal in quality, size, weight, construction and capacities. The alternate equipment and materials shall be submitted as full equivalent to the equipment and materials specified, with sufficient supportive documentation and technical literature to demonstrate quality, performance, and workmanship without doubt or question. The Engineer shall consider the use of the alternate equipment based on the supportive documentation and other information available to him, and shall approve or disapprove any alternates. The decision of the Engineer shall in all cases be final.

1.7 EXAMINATION OF PREMISES

- A. Prior to the ordering or purchasing of any plumbing equipment or materials or the layout or installation of any work, the Contractor shall examine the premises and verify any and all of the existing conditions under which he will be required to operate, or that will in any manner affect the work under this Contract.

1.8 EXISTING SERVICES

- A. If existing active services are encountered that require relocation, notify the Architect and relocate as directed. Do not prevent or disturb operation of active services that are to remain.

1.9 COORDINATION OF TRADES

- A. The plumbing subcontractor shall give full cooperation to other trades, and shall furnish all information necessary to permit the work of all trades to be installed satisfactorily and with least possible interference or delay.
- B. Piping and other plumbing equipment shall not be installed without first coordinating the installation of same with other trades. This subcontractor, at his own expense, shall relocate all uncoordinated piping and other plumbing equipment installed should they interfere with the proper installation and mounting of electrical, HVAC equipment, ceilings and other architectural or structural finishes.
- C. This subcontractor shall coordinate the elevations of all piping and equipment above ceilings and in exposed areas with the work of all other disciplines prior to installation.
- D. In areas where more than one trade is required to use common openings in beams, joists, chases, shafts and sleeves for the passage of conduits, raceways, piping, ductwork and other materials, this subcontractor must coordinate the positions of all piping and equipment to be furnished under this section so that all items including the materials and equipment of other trades may be accommodated within the space available.
- E. This subcontractor shall confirm that work installed under this section does not interfere with the clearances required for finished columns, pilasters, partitions, walls or other architectural or structural elements as shown on the Contract Documents.
- F. Plumbing work that is installed under this Contract which interferes with the architectural design or building structure shall be removed and relocated as required at no additional cost to the Contract.

1.10 OBTAINING AND GIVING INFORMATION

- A. Obtain detailed information from all manufacturers as to the proper method of installing and connecting same. Obtain all required information necessary to facilitate and complete the plumbing installation.
- B. Coordinate the shape, size and position of all openings required for materials and equipment under this section and give full information to other trades sufficiently in advance to allow proper access requirements. Provide all sleeves and supports necessary to complete the work specified under this section.
- C. In case of failure on the part of this subcontractor to give proper information as noted above, all necessary cutting and patching will be performed at this subcontractor's expense.
- D. The information to be furnished by this subcontractor shall include sleeve openings (sizes and locations) and all other pertinent information relative to the plumbing

installation. This subcontractor shall also furnish to other trades the dimensions and weights of all major pieces of mechanical equipment, and schedule with other trades the clearances that will be required throughout the building to allow for the passage of same through the building to their required installation locations.

1.11 PIPING IDENTIFICATION

- A. A marker showing the service and an arrow indicating the direction of flow shall be applied on the following piping installed under this section of the Specifications:
 - 1. Acid waste and vent piping
- B. Piping identification shall be applied on all piping systems in areas of exposed construction and in areas with accessible or lay-in ceilings. The piping shall be labeled at each wall and floor penetration (both sides), and at connections to equipment. In addition, straight runs of piping shall be labeled at intervals not greater than 25 feet.
- C. The letter size and background color shall conform to the Identification of Pipe System ANSI A-13-1. The vinyl plastic markers shall be as manufactured by Seton Name-Plate Company, W. H. Brady Company, or Westline products.

1.12 OPERATING INSTRUCTIONS

- A. This subcontractor shall give detailed instructions for a period of not less than one-half days to the responsible personnel designated by the Owner in the operation and maintenance of all equipment furnished under this Contract. A letter containing the name of the person or persons to whom the instructions were given and the dates of instruction period shall be submitted to the Engineer in the as-built submittal.
- B. Prior to final acceptance by the Owner, this subcontractor shall submit a complete as-built submittal to the Engineer for review, three (3) sets of operating and instructional manuals, spare parts lists, drawings, wiring diagrams, trouble shooting data, manufacturer's bulletins, and other pertinent data on all equipment furnished under this Contract. Each set shall be enclosed in a suitable hard cover binder.
- C. A complete set of reproducible as-built drawings shall be provided indicating the location of all concealed piping dimensionally located from a minimum of two column lines or major building structures. Drawings shall be a minimum of 1/8" scale.
- D. Provide name, address and telephone numbers of the manufacturer's representative and service company for each piece of equipment installed in the as-built submittal package.

1.13 GUARANTEE

- A. Guarantee for all work furnished and/or installed under this section shall be as specified in Division 1 or a minimum of one (1) year from final acceptance.

PART 2 - PRODUCTS

2.1 PIPING SYSTEMS

A. General

1. The various piping systems are classified as follows, and materials of construction shall be as specified unless otherwise noted on drawings.

B. Aboveground Pipe and Fittings

1. Pipe sizes 1-1/2" to 4": Polyvinylidene Fluoride (PVDF), flame retardant, schedule 80, DWV type, with recessed drainage fittings, ASTM "D" 4101 and ASTM-2657.
 - a. Joints shall be mechanical type.
 - b. Joints shall be electric heat fusion type.
2. Pipe sizes 1-1/2" to 4": ChemDrain Chlorinated Polyvinyl Chloride (CPVC-cwd), schedule 40, non-pressure DWV type conforming to ASTM F-2618.
 - a. Joints shall be solvent cemented per ASTM F2618.

C. Floor Drains

1. Corrosion resistant drain with sediment bucket and fiber-filled grate, Polyvinylidene Fluoride (PVDF), ASTM D4101, socket fusion or mechanical joint connection, Orion model AWFSTD or approved equal.

D. Floor Cleanout

1. Corrosion resistant floor cleanout with countersunk plug, ASTM-D-4101, round nickel bronze cover, AWCO (acid waste cleanout) cast in cover, Orion model FCO-SQ or approved equal.

E. Manufacturers

1. Provide acid waste and vent piping and dilution tanks from one of the following:
 - a. George Fischer Sloane
 - b. Zurn Industries
 - c. Charlotte Pipe
 - d. Spears Mfg.
 - e. Equal and owner approved

F. Acid Waste Drainage Piping Materials and Products

1. Provide piping materials and factory fabricated piping products of sizes, types, pressure ratings, and capacities as indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements. Provide sizes and types matching piping and equipment connections; provide fittings of materials which match pipe materials used in chemical drainage piping systems.
2. Where more than one type of material or product is indicated, selection is Installer's option, however, systems of piping must remain consistent in the type of materials and fittings utilized.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS

A. Waste, Vent and Indirect Waste Piping - General

1. Pipes shall be plumb and parallel to building walls, beams and columns unless otherwise indicated. All horizontal lines are to be evenly pitched and properly secured with iron or steel hangers, unless noted otherwise. A pitch of 1/4 inch per lineal foot shall be maintained on all soil, and waste lines, wherever possible. Where long runs of piping require less pitch due to space restrictions, a less pitch shall be allowed on main lines 4 inches and over in size, but in no event should any pipeline have a slope less than 1/8 inch per foot.
2. All soil and waste pipes shall be extended out full size through the roof or connected to a common vent as shown on the drawings.
3. The main ventilation stacks shall run parallel to the soil pipe stacks and shall connect to the vent continuation of the soil stack at least 3 feet above the rim of the highest plumbing fixtures on the stack. Vent stacks shall also be connected at the base or horizontal offset of the soil stack through a Y and 1/8 bend or an upright Y fittings. Offsets in vent pipe shall be made with 45 degree fittings wherever possible. Horizontal vent lines shall pitch toward a waste line.
4. Piping is to be run straight and plumb and all offsets shall be made at an angle of not less than 45 degrees.

3.2 TESTING OF PIPING SYSTEMS

A. General

1. All piping systems shall be subjected, before being insulated or concealed, to testing with water or air as noted and shall hold tight at the pressure head stated for the time interval required without adding air or water. While any system is being tested required head or pressure shall be maintained until all joints are inspected.
2. All tests shall be witnessed by the inspector having jurisdiction and the Owner's Representative, with 48 hours minimum notice given these authorities.
3. All equipment, material, labor and testing mediums required for testing any of the various systems or any part thereof shall be furnished by this subcontractor.
4. All connected equipment, accessories, etc. shall be isolated from piping systems prior to testing.

B. Acid Waste Piping Systems

1. Water test shall be applied to these drainage systems either in their entirety or in sections as required, after rough piping has been installed. If the system is tested in sections, each opening shall be tightly closed except the highest opening in the section under test. All sections shall be tested with a minimum of 10 feet head of water. In testing successive sections at least the upper 10 feet of the next preceding section shall be tested so that no joint of piping in the building except the uppermost 10 feet of the system shall be submitted to a test of less than a 10 foot of head water. The water shall be kept in the system for at least 30 minutes before inspection starts; the system shall then be made tight at all points.
2. Any points of the drainage systems to be tested with air instead of water shall be

made by attaching an air compressor testing apparatus to any suitable opening and after closing all other inlets or outlets, forcing air into the system until there is a minimum gauge pressure of 5 psi. This pressure shall be held without the introduction of additional air for a period of at least 30 minutes.

3. Exterior connections shall be tested as part of the interior systems.

C. Defective Work

1. If inspection or tests show defects, such defective work or material shall be replaced and inspection and tests shall be repeated. All repairs to piping shall be made with new material. Caulking of screwed joints or holes is not acceptable.

D. Additional Tests

1. Provide all additional tests such as smoke or pressure tests as required by the regulations or as directed by authorities making the inspection.
2. Provide for any repeated test as directed by the Owner's Representative, to make all systems tight as required.
3. Visual inspections of joints, valves, etc. shall be made as directed by the Engineer.

3.3 EXCAVATION AND BACKFILL

- A. The Contractor shall do all necessary excavations for all piping, equipment and apparatus under this section and shall backfill trenches by filling and tamping in not more than 6" layers after pipes have been installed, tested and approved. Care shall be taken not to excavate below depth necessary. If excessive excavation is made or pipes are installed in filled areas, fill soil shall be tamped to compaction as specified under the Division 2 specifications. Provide a layer of sand at least 6" deep under all plastic pipe installed in soil. Bell holes shall be excavated to ensure that the sewer pipe rests for its entire length upon a solid trench bottom.

3.4 FIXTURE CONNECTIONS AND SUPPORTS

- A. Wall fixtures shall be hung by means of wall hangers supported by at least four (4) 3/8" lag bolts and expansion shields.

3.5 SLEEVES

- A. Furnish and install pipe sleeves around all piping passing through masonry walls, floors, beams, etc. Sleeves shall be of such diameter as to allow pipe to pass through easily and permit expansion and contraction of pipe. Where pipes are insulated, the sleeves shall be of such diameter as to allow the insulated pipe to pass through easily. The sleeves shall be placed before the pouring of concrete and before construction of walls. Sleeves for vertical risers shall extend a minimum of 1" above the floor slab. Sleeves to outside walls below grade shall be caulked or provided with expansion type mechanical seals as required to make them waterproof.

3.6 INSTALLATION OF UNIONS

- A. Unions shall be located as shown on plans and as required by equipment so piping and equipment can be easily dismantled. Unions shall not be installed in any location where they are not readily accessible.

3.7 TRAPS

- A. All fixtures, drains, etc. shall be provided with traps, unless specifically shown or specified otherwise. Traps shall be set in an upright position, level and true, and shall be vented as shown and required. All exposed traps shall be provided with cleanout plugs.

3.8 CLEANOUT INSTALLATION

- A. Furnish and install cleanouts in soil and waste lines as required by Code and/or job conditions, as shown on the drawings and as follows: At or near the end of each branch and main drainage line, horizontal lines at intervals as required by code. All cleanouts shall be readily accessible, with plugs easily removable for cleanout lines. Cleanouts at the base of vertical piping shall be held within 2'-0" from finished floor unless otherwise indicated.

3.9 FLASHING INSTALLATION

- A. All pipes passing through roofs shall be flashed in an approved manner. Flashing shall be watertight.
- B. Roof connections shall meet the approval of the manufacturer of roofing material and shall comply with roof bond requirements.

3.10 EQUIPMENT AND MATERIAL PROTECTION

- A. During construction all equipment shall be properly protected against damage, defacing and freezing with shipping cartons, plastic sheeting, shipping covers.
- B. All open ends of piping and equipment shall be sealed with nipples and caps, plugs, test plugs until connection to system is made.

3.11 SPACE REQUIREMENTS

- A. Piping, apparatus and equipment shall fit into the space provided in the building or within the property and shall be installed at such time and in such manner as to avoid damage to the building structure or property as required by the job progress. Equipment, apparatus and accessories requiring normal servicing or maintenance shall be made easily accessible.

END OF SECTION

SECTION 22 40 00

PLUMBING FIXTURES

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SUMMARY

- A. Provide a complete system of plumbing fixtures and trim.
- B. All materials and equipment for the potable water system shall meet the latest mandates and requirements for lead free required by law that goes into effect January 2014.

1.2 SUBMITTALS

- A. Product Data: Submit catalog illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.
- B. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Accept fixtures on site in factory packaging. Inspect for damage.
- B. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

1.4 EXTRA MATERIALS

- A. Furnish two sets of faucet washers flush valve service kits lavatory supply fittings shower heads toilet seats.

PART 2 - PRODUCTS

2.1 SINKS

- A. Fixture Manufacturers:
 - 1. Elkay Mfg.
 - 2. Just
- B. Trim Manufacturers:
 - 1. Chicago Faucet Co.
 - 2. T & S Brass
 - 3. American Standard
- C. All sink faucets and trim shall meet the latest mandates and requirements for lead free required by law that goes into effect January 2014.
- D. Accessories: Chrome plated 17 gage brass P-trap with clean-out plug and arm with escutcheon, wheel handle screwdriver stop, rigid flexible supplies.

- E. Provide offset waste on all sinks.

2.2 EMERGENCY COMBINATION SHOWER WITH EYE AND FACE WASH

- A. Manufacturers:
 - 1. Encon Safety Products
 - 2. Haws Drinking Faucet Co.
 - 3. Laboratory Enterprises, Inc.
 - 4. Guardian Safety Equipment
- B. Barrier Free, all stainless steel construction, corrosion resistant, combination eye/face wash and shower safety station with stainless steel shower head, stainless steel bowl, stainless steel flag handle and floor flange, 1 ¼" IPS Schedule 40 stainless steel pipe and fittings, 1" IPS and ½" IPS U.S. made stainless steel stay open ball valves, and polished stainless steel pull rod. Unit shall have (4) polypropylene 'GS Plus' spray heads with integral "flip-top" dust covers, filters, and 1.8-GPM flow control orifices mounted on a stainless steel head assembly. Unit shall include ANSI compliant sign.
- C. Performance: Unit complies with ADA requirements for accessibility by handicapped persons. Unit shall meet or exceed ANSI Z358.1 – 2004, and come with a full 2-year warranty.
- D. Fixture: Guardian Equipment GBF1994
- E. Supply and Waste Piping: 1-1/4 inch galvanized steel pipe pedestal with floor flange.
- F. Furnish universal emergency sign.

2.3 FLOOR DRAINS

- A. Manufacturers:
 - 1. Josam Mfg.,
 - 2. Jay R. Smith Mfg.,
 - 3. Wade Spec. Products
 - 4. Zurn Industries
 - 5. Mifab
 - 6. Watts
- B. Floor Drain (FD-1): ASME A112.21.1; lacquered cast iron two piece body with double drainage flange, weep holes, reversible clamping collar, and round, adjustable nickel-bronze strainer. Jay R. Smith Model 2005-A06NB-P
- C. Floor Drain (FD-2): ASME A112.21.1; lacquered cast iron two piece body with double drainage flange, weep holes, reversible clamping collar, and round, adjustable square nickel-bronze strainer with removable perforated sediment bucket. Jay R. Smith Model 2005-B06NB-P-B.
- D. Floor Drain (FD-3): ASME A112.21.1; lacquered cast iron two piece body with double drainage flange, weep holes, reversible clamping collar, and round, adjustable nickel-bronze strainer with nickel bronze funnel. Jay R. Smith Model 3510-F11-06NB-P
- E. Floor Drain (FD-4): ASME A112.21.1; lacquered cast iron two piece body with double drainage flange, weep holes and round adjustable ductile iron extra heavy duty grate. Jay R. Smith Model 2120-M-P

- F. Hubdrain (HD-1): Jay R. Smith 2270 Series.
- G. Hubdrain (HD-2): Stainless Steel. Jay R. Smith 9700 Series.

2.4 CLEANOUTS

- A. Cleanouts shall be provided where indicated on Drawings and elsewhere as required by code.
 - 1. Cleanouts in pipelines shall consist of cast iron ferrule and heavy duty cleanout plug with square head as scheduled on the Drawings. Where piping is concealed in floors or walls cleanouts shall be installed in or near surface of floor or walls and have countersunk plugs with covers
- B. Cleanouts shall be provided at the base of the stack on all sanitary, waste and drainage stacks. Base of stack cleanouts on piping located within walls or partitions shall be cast iron cleanout tee with countersunk plug and chromium-plated round access cover, J.R. Smith figure or approved equal.
- C. Manufacturers:
 - 1. Josam Mfg.
 - 2. Jay R. Smith Mfg.
 - 3. Wade Spec. Products
 - 4. Zurn Industries
 - 5. Mifab
 - 6. Watts
- D. Floor, Outdoors: Coated cast iron body with gasket seal ABS plug and round cast iron scoriated non-skid cover. Jay R. Smith, Model 4220.
- E. Floor, Indoors (CO): Coated cast iron body with gasket seal ABS plug, threaded top assembly with round nickel bronze scoriated cover in service areas. Jay R. Smith, Model 4020.
- F. Wall Cleanout (WCO): Line type with lacquered cast iron body with bronze taper thread plug and round stainless steel access cover secured with vandal proof screw. Jay R. Smith Model 4420.
- G. Floor, Stainless Steel Indoors (CO): Coated cast iron body with gasket seal ABS plug, threaded top assembly with round stainless steel scoriated cover in service areas. Jay R. Smith Model 9760 Series.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 31 13 - Administrative Requirements: Coordination and project conditions.
- B. Verify walls and floor finishes are prepared and ready for installation of fixtures.
- C. Verify electric power is available and of correct characteristics.

- D. Confirm millwork is constructed with adequate provision for installation of counter top lavatories and sinks.

3.2 PREPARATION

- A. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

3.3 INSTALLATION

- A. Install each fixture with trap, easily removable for servicing and cleaning.
- B. Provide chrome plated rigid or flexible supplies to fixtures with loose key or screwdriver stops, reducers, and escutcheons.
- C. Install components level and plumb.
- D. Install and secure fixtures in place with wall supports wall carriers and bolts.
- E. Seal fixtures to wall and floor surfaces with sealant, color to match fixture.
- F. For ADA accessible water closets, install flush valve with handle to wide side of stall.
- G. Emergency Shower: Provide a floor drain at each shower installation. Jay R. Smith Model 2005-A07NB-P.
- H. Provide power wiring, including control power transformers as required for all sensor type fixtures.
- I. Bolt carriers to the floor.
- J. All sinks shall have an offset rear centered drain.

3.4 INTERFACE WITH OTHER PRODUCTS

- A. Review millwork shop-drawings. Confirm location and size of fixtures and openings before rough in and installation.

3.5 ADJUSTING

- A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

3.6 CLEANING

- A. Clean plumbing fixtures and equipment.

3.7 PROTECTION OF INSTALLED CONSTRUCTION

- A. Do not permit use of fixtures before final acceptance.

END OF SECTION

SECTION 22 66 59

LABORATORY SAFETY DEVICE SYSTEM

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes furnishing and installation of the Laboratory Safety Device System as shown on the Drawings, as herein specified.

1.2 CODES AND REGULATIONS

- A. NFPA 70, National Electrical Code
- B. NFPA 72, National Fire Alarm Code
- C. NFPA 90A, Installation of Air Conditioning and Ventilation Systems).
- D. Americans with Disabilities Act
- E. Local and State Building Codes
- F. NFPA 54 Natural Gas Code.
- G. UL508A

1.3 SUBMITTALS

- A. Product Data: Submit complete manufacturer's specification pages for each piece of equipment. Submit electrical characteristics and connection locations.
- B. Manufacturer's Installation Instructions: Submit mounting and support requirements.
- C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- D. Shop drawings:
 - 1. Include plans, elevations, sections, and mounting details.
 - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include diagrams for power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.
- B. Operation and maintenance data.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Accept all equipment on site in original labeled cartons. Inspect for damage.

1.6 WARRANTY

- A. Warranty: Manufacturer agrees to repair or replace any and all components of lab panel that fail(s) in materials or workmanship within specified warranty period.
- B. Warranty Period: Two year(s) from date of Substantial Completion.

PART 2 – PRODUCTS

2.1 UTILITY CONTROLLER SYSTEM

- A. General: It is the intent of this specification to provide a complete and operational system, to include all necessary products and devices, power and controls wiring installed in accordance with Division 26, and all necessary interlocks
- B. Acceptable Manufacturers: Subject to compliance with requirements, provide one of the following:
 - 1. Lab Automation Control Systems (LACS) by E&I.

A.1 Lab Control Panel:

A. At each science classroom as shown on Drawings, provide a LACS by EI Series Lab Control Panel (LCP). Panel shall be UL Certified 508A and NEMA 1 flush mounted with concealed wall box. System shall include Power Supply 120VAC with circuit protection. Wiring to the input power terminals shall be per the drawings. Panel shall also consist of Green ON Pilot Light (Gas/Cold Water/Hot Water, Electric), Power ON Selector Switch. Switch located in an internal junction box with removable cover, Discrete Inputs, Relay Outputs, Terminal Blocks with Ground TB. System shall also include (2) 2 position keyed selector switch to enable, disable, system power. Additional circuits will be provided for monitoring of alarms as per drawings.

B. Panel shall have integral micro controller with Siemens Smart logic (logo power) device to provide relay output circuits to activate utilities as shown on drawings to include gas, hot and cold water, and electric output circuits located at the student work stations and as indicated on drawings; system shall also have the ability to shut down all utilities upon activation of the fire alarm. Lab Control Panel shall have provisions for each student and teacher area by a means of a normally open contact within the Lab Control Panel. Activation shall be enabled only by switch ON and then enabling each utility service button.

C. The Panel shall be equipped with an illuminated switch for each output circuit and a momentary enabling key switch. Deactivation of output circuits' shall not require engagement of enabling key. Panel shall be provided with N/O push/pull emergency operator to deactivate output circuits in case of emergency and shall include a clear drop down non keyed cover to prevent student tampering. Reset after panic shall occur by re-keying. Wiring connections shall be provided by Division 26 contractor.

A.2 Solenoid Panels

A. LACS by E&I (VP)

Furnish and install Valve Panel (VP) as indicated per drawings. The panel shall be NEMA 1 white powder coated with a concealed wall box provided. All Solenoid Valves shall be ASCO Red Hat “Next Generation” series normally closed general service, zero differential solenoids as indicated on drawings, line size as shown on drawings. Gas Solenoid Valve shall be aluminum body and rated for gas service. Solenoid coil shall be 120VAC. Solenoids and ball valves shall be UL listed and approved for services intended. Solenoids shall close upon loss of operating power or alarm and require re-keying for reactivation of service. Wye Strainers shall be included on all water services and located in piping within the panel. Wiring connections shall be provided by Division 26 Contractor.

A.3 Electric Contactor Panels

A. LACS by E&I (ECP)

Furnish and install UL508A Electrical Contactor Panel (ECP) as indicated per drawings. The panel shall be NEMA 1 Gray Powder Coated and located as shown on drawings. The panel shall consist of all required 4 pole contactors and required wiring to enable/disable all electrical outlets as indicated on drawings. All Circuits shall Close upon loss of operating power and require re-keying for reactivation of service. Wiring connections shall be provided by Division 26 Contractor.

A.4 Remote Emergency Operator:

A. LACS by E&I (REO)

Furnish and install a line of sight Remote Emergency Operator (REO). Operator shall be provided with N/O push/pull mushroom button assembly to deactivate output circuits in case of emergency. Remote operator shall also be provided with a clear cover to prevent accidental operation. Wiring connections shall be provided by Division 26 Contractor.

3.01 INSTALLATION:

- A. Install in accordance with manufacturer’s recommendations and instructions. Verify manufacturer’s mounting heights to comply with ADA or other standards.
- B. Furnish and install all devices as shown on Drawings and as specified herein.
- C. Furnish, install and make final connections to monitoring and remote panic assembly panels. Ensure proper integration with the Energy Management Control and fire alarms if present.

3.02 CONDUIT:

- A. Provide conduits for control and integration wiring from point of connection to each device to accessible point above ceiling. Provide separate conduit for each device that is controlled and integrated with Controller. Conduits for monitoring panels, arrays and panic assemblies shall be separate from line voltage, control wiring and integrated systems wiring.

3.03 WIRING

- A. Operating Power: Shall be provided by Division 26.
- B. Wiring:
Provide wiring from Lab Control Panel (LCP) to each controlled utility or device. Make connections at controlled device and terminate at output terminal on control panel.

- C. Integrated Systems:
Provide wiring for integration to other systems as shown on Drawings. Verify voltage and wire sizes to comply with requirements of each system.
- D. System Monitoring Panels and Arrays:
Provide wiring from Lab Control Panel (LCP) to each monitoring panel or array. Make connections at monitoring device and terminate at output terminal on control panel.
- E. Remote Emergency Operator:
Provide control wiring from Lab Control Panel (LCP) to each Remote Emergency Operator within the classroom. Where Drawings indicate two or more operators, connect each in parallel.

3.04 SYSTEM TEST AND START-UP

- A. Prior to placing the Lab Control Panel System into service, a Certified Start-up must be performed by an authorized LACSS' start-up agent.
- B. Verify that all components and control devices comply with manufacturer's requirements and recommendations, and that all devices and installations conform to Drawings and Specification requirements.
 - 1. Verify that all piping systems have been thoroughly cleaned.
 - 2. Verify that all controlled devices and circuits are ON.
 - 3. Verify that connections to all integrated systems are complete.
 - 4. Verify that all monitoring systems respond to Panic.
 - 5. Verify that remote panic assemblies activate the Panic State.
 - 6. Verify that service to emergency showers and eyewashes are not affected by operation of system if applicable.
- C. Upon completion of ALL Start-up tests, place the system into service. Complete all warranty registration documents. Submit originals with other project related closeout and O & M documentation. Review all operating procedures and maintenance schedules with a representative of the Owner. Provide all System keys (2 Sets) to the Owner's representative.

END OF SECTION 22 66 59

SECTION 23 01 30.51

HVAC AIR DUCT CLEANING

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 cleaning HVAC air-distribution equipment, ducts, plenums, and system components.

1.3 DEFINITIONS

- A. ASCS: Air systems cleaning specialist.
- B. NADCA: National Air Duct Cleaners Association.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For an ASCS.
- B. Strategies and procedures plan.
- C. Cleanliness verification report.

1.5 QUALITY ASSURANCE

- A. ASCS Qualifications: A certified member of NADCA.
 - 1. Certification: Employ an ASCS certified by NADCA on a full-time basis.
 - 2. Supervisor Qualifications: Certified as an ASCS by NADCA
- B. UL Compliance: Comply with UL 181 and UL 181A for fibrous-glass ducts.
- C. Cleaning Conference: Conduct conference at Project site.
 - 1. Review methods and procedures related to HVAC air-distribution system cleaning including, but not limited to, review of the cleaning strategies and procedures plan.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine HVAC air-distribution equipment, ducts, plenums, and system components to determine appropriate methods, tools, and equipment required for performance of the Work.
- B. Perform "Project Evaluation and Recommendation" according to NADCA ACR 2006.
- C. Prepare written report listing conditions detrimental to performance of the Work.
- D. Proceed with work only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare a written plan that includes strategies and step-by-step procedures. At a minimum, include the following:
 - 1. Supervisor contact information.
 - 2. Work schedule including location, times, and impact on occupied areas.
 - 3. Methods and materials planned for each HVAC component type.
 - 4. Required support from other trades.
 - 5. Equipment and material storage requirements.
 - 6. Exhaust equipment setup locations.
- B. Use the existing service openings, as required for proper cleaning, at various points of the HVAC system for physical and mechanical entry and for inspection.
- C. Comply with NADCA ACR 2006, "Guidelines for Constructing Service Openings in HVAC Systems" Section.

3.3 CLEANING

- A. Comply with NADCA ACR 2006.
- B. Remove visible surface contaminants and deposits from within the HVAC system.
- C. Systems and Components to Be Cleaned:
 - 1. Air devices for supply and return air.
 - 2. Air-terminal units.
 - 3. Ductwork:
 - a. Supply-air ducts, including turning vanes and reheat coils, to the air-handling unit.
 - b. Return-air ducts to the air-handling unit.
 - c. Exhaust-air ducts.
 - 4. Air-Handling and Fan Coil Units:

- a. Interior surfaces of the unit casing.
 - b. Coil surfaces compartment.
 - c. Condensate drain pans.
 - d. Fans, fan blades, and fan housings.
5. Filters and filter housings.
- D. Collect debris removed during cleaning. Ensure that debris is not dispersed outside the HVAC system during the cleaning process.
- E. Particulate Collection:
1. For particulate collection equipment, include adequate filtration to contain debris removed. Locate equipment downwind and away from all air intakes and other points of entry into the building.
 2. HEPA filtration with 99.97 percent collection efficiency for particles sized 0.3 micrometer or larger shall be used where the particulate collection equipment is exhausting inside the building,
- F. Control odors and mist vapors during the cleaning and restoration process.
- G. Mark the position of manual volume dampers and air-directional mechanical devices inside the system prior to cleaning. Restore them to their marked position on completion of cleaning.
- H. System components shall be cleaned so that all HVAC system components are visibly clean. On completion, all components must be returned to those settings recorded just prior to cleaning operations.
- I. Clean all air-distribution devices, registers, grilles, and diffusers.
- J. Clean visible surface contamination deposits according to NADCA ACR 2006 and the following:
1. Clean air-handling units, airstream surfaces, components, condensate collectors, and drains.
 2. Ensure that a suitable operative drainage system is in place prior to beginning wash-down procedures.
 3. Clean evaporator coils, reheat coils, and other airstream components.
- K. Duct Systems:
1. Create service openings in the HVAC system as necessary to accommodate cleaning.
 2. Mechanically clean duct systems specified to remove all visible contaminants so that the systems are capable of passing the HVAC System Cleanliness Tests (see NADCA ACR 2006).
- L. Debris removed from the HVAC system shall be disposed of according to applicable Federal, state, and local requirements.
- M. Mechanical Cleaning Methodology:
1. Source-Removal Cleaning Methods: The HVAC system shall be cleaned using source-removal mechanical cleaning methods designed to extract contaminants from within the HVAC system and to safely remove these contaminants from the facility. No cleaning

method, or combination of methods, shall be used that could potentially damage components of the HVAC system or negatively alter the integrity of the system.

- a. Use continuously operating vacuum-collection devices to keep each section being cleaned under negative pressure.
- b. Cleaning methods that require mechanical agitation devices to dislodge debris that is adhered to interior surfaces of HVAC system components shall be equipped to safely remove these devices. Cleaning methods shall not damage the integrity of HVAC system components or damage porous surface materials such as duct and plenum liners.

2. Cleaning Mineral-Fiber Insulation Components:

- a. Fibrous-glass thermal or acoustical insulation elements present in equipment or ductwork shall be thoroughly cleaned with HEPA vacuuming equipment while the HVAC system is under constant negative pressure and shall not be permitted to get wet according to NADCA ACR 2006.
- b. Cleaning methods used shall not cause damage to fibrous-glass components and will render the system capable of passing the HVAC System Cleanliness Tests (see NADCA ACR 2006).
- c. Fibrous materials that become wet shall be discarded and replaced.

N. Coil Cleaning:

1. Measure static-pressure differential across each coil.
2. See NADCA ACR 2006, "Coil Surface Cleaning" Section. Type 1, or Type 1 and Type 2, cleaning methods shall be used to render the coil visibly clean and capable of passing Coil Cleaning Verification (see applicable NADCA ACR 2006).
3. Coil drain pans shall be subject to NADCA ACR 2006, "Non-Porous Surfaces Cleaning Verification." Ensure that condensate drain pans are operational.
4. Electric-resistance coils shall be de-energized, locked out, and tagged before cleaning.
5. Cleaning methods shall not cause any appreciable damage to, cause displacement of, inhibit heat transfer, or cause erosion of the coil surface or fins, and shall comply with coil manufacturer's written recommendations when available.
6. Rinse thoroughly with clean water to remove any latent residues.

O. Antimicrobial Agents and Coatings:

1. Apply antimicrobial agents and coatings if active fungal growth is reasonably suspected or where unacceptable levels of fungal contamination have been verified. Apply antimicrobial agents and coatings according to manufacturer's written recommendations and EPA registration listing after the removal of surface deposits and debris.
2. When used, antimicrobial treatments and coatings shall be applied after the system is rendered clean.
3. Apply antimicrobial agents and coatings directly onto surfaces of interior ductwork.
4. Sanitizing agent products shall be registered by the EPA as specifically intended for use in HVAC systems and ductwork.

3.4 CLEANLINESS VERIFICATION

- A. Verify cleanliness according to NADCA ACR 2006, "Verification of HVAC System Cleanliness" Section.

- B. Verify HVAC system cleanliness after mechanical cleaning and before applying any treatment or introducing any treatment-related substance to the HVAC system, including biocidal agents and coatings.
- C. Perform visual inspection for cleanliness. If no contaminants are evident through visual inspection, the HVAC system shall be considered clean. If visible contaminants are evident through visual inspection, those portions of the system where contaminants are visible shall be re-cleaned and subjected to re-inspection for cleanliness.
- D. Additional Verification:
 - 1. Perform surface comparison testing or NADCA vacuum test.
 - 2. Conduct NADCA vacuum gravimetric test analysis for nonporous surfaces.
- E. Verification of Coil Cleaning:
 - 1. Measure static-pressure differential across each coil.
 - 2. Coil will be considered clean if cleaning restored the coil static-pressure differential within 10 percent of .05 inches wg, the differential measured when the coil was first installed.
 - 3. Coil will be considered clean if the coil is free of foreign matter and chemical residue, based on a thorough visual inspection.
- F. Prepare a written cleanliness verification report. At a minimum, include the following:
 - 1. Written documentation of the success of the cleaning.
 - 2. Site inspection reports, initialed by supervisor, including notation on areas of inspection, as verified through visual inspection.
 - 3. Surface comparison test results if required.
 - 4. Gravimetric analysis (nonporous surfaces only).
 - 5. System areas found to be damaged.

3.5 RESTORATION

- A. Restore and repair HVAC air-distribution equipment, ducts, plenums, and components according to NADCA ACR 2006, "Restoration and Repair of Mechanical Systems" Section.
- B. Restore service openings capable of future reopening. Comply with requirements in Section 23 31 13 "Metal Ducts." Include location of service openings in Project closeout report.
- C. Replace fibrous-glass materials that cannot be restored by cleaning or resurfacing. Comply with requirements in Section 23 31 13 "Metal Ducts".
- D. Replace damaged insulation according to Section 23 07 13 "Duct Insulation."
- E. Ensure that closures do not hinder or alter airflow.
- F. New closure materials, including insulation, shall match opened materials and shall have removable closure panels fitted with gaskets and fasteners.

END OF SECTION

SECTION 23 05 00

COMMON WORK RESULTS FOR HVAC

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SUMMARY

- A. Provide all work for mechanical, plumbing and fire protection systems required in the project to be properly installed, tested and performing their intended function.
- B. Phased Construction:
 - 1. This project consists of work that must be accomplished in a specific sequence on premium time to avoid interruption of services to existing portions of the buildings and mechanical, plumbing and fire protection systems that must remain operational.
 - 2. Contractor shall include any and all temporary services required to keep the Owner occupied portions of the buildings operation without interruption of HVAC, plumbing and fire protection services for the duration of the project.
 - 3. Refer to Architectural drawings for description of phasing, stage all mechanical, plumbing and fire protection work accordingly.

1.2 QUALITY ASSURANCE

- A. Perform all work in accordance with the latest edition of the applicable codes, specifications, local ordinances, industry standards, utility company regulations, nationally accepted codes.
- B. All materials and distribution, and utilization equipment shall be UL Listed.
- C. All equipment and materials shall be new, unused and of United States Domestic manufacture unless approved otherwise by engineer or owner.
- D. Eliminate any abnormal sources of noise that are considered by the Architect or Engineer not to be an inherent part of the systems as designed without additional cost to the Owner.

1.3 COORDINATION WITH OTHER TRADES

- A. Coordinate the work of this division with all other divisions to ensure that all components of the mechanical, plumbing and fire protection system will be installed at the proper time and fit the available space.
- B. Locate and size all openings in work of other trades required for the proper installation of the mechanical, plumbing and fire protection system components.
- C. Make all mechanical, plumbing and fire protection connections to all equipment furnished by this division and as required by any other division.

- D. Electrical wiring, control equipment and motor starters indicated on the electrical drawings, except items otherwise specifically noted, shall be furnished and installed by the electrical trades. Items of electrical control equipment specifically mentioned to be furnished by the mechanical trades, either in these specifications or on the mechanical drawings, shall be furnished, mounted and wired by this trade unless where otherwise specified in Division 26 or noted on the electrical drawings to be by the electrical trades. All wiring shall be in accordance with all requirements of the electrical Sections of these specifications.
- E. Any changes or additions required by specific equipment furnished shall be the complete responsibility of the Contractor furnishing the equipment. All controllers furnished with mechanical equipment shall have overload protection in all phases. It shall be the responsibility of each subcontractor furnishing motors and devices to advise Electrical Contractor of exact function of systems to assure proper type of starter with correct number auxiliary contacts for proper operation of the system.
- F. The mechanical trades shall coordinate with the electrical to ensure that all required components of control work are included and fully understood. No additional cost shall accrue to the Owner as a result of lack of such coordination.
- G. The design of the electrical systems is based on the mechanical equipment scheduled and shown on the drawings. Where changes or substitutions are made that involve additional electrical work (larger-size motors, larger number of motors, additional wiring of equipment, etc.), the mechanical trades shall pay the electrical trades for the cost of the additional work, except for changes by addendum.
- H. Motor control equipment which is furnished loose under Division 23 shall be delivered to the Electrical Contractor at the site for custody, erection in place, and wiring as specified.
- I. Smoke detection systems will be furnished and installed under Division 26 – electrical. Coordinate locations with Electrical Contractor.

1.4 DRAWINGS

- A. The drawings are schematic in nature, but show the various components of the systems approximately to scale and attempt to indicate how they are to be integrated with other parts of the building. Determine exact locations by review of equipment manufacturer's data, by job site measurements, by checking the requirements of other trades, and by reviewing all Contract Documents. The size of the mechanical, plumbing and fire protection equipment indicated on the Drawings may be based on the dimensions of a particular manufacturer. While other listed manufacturers may be acceptable, it is the responsibility of the Contractor to determine if the equipment that the Contractor proposes to furnish will fit in the space. The drawings are not intended to show exact locations of pipes and ducts, or to indicate all offsets and fittings or supports, but rather to indicate approximate layout.
- B. The mechanical, plumbing and fire protection Drawings are necessarily diagrammatic in character and cannot show every connection in detail in its exact location. These details are subject to the requirements of ordinances and also structural and architectural conditions. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades in order to avoid interference between the various phases of work. Work shall be laid out so that it will be concealed in furred chases and suspended ceilings, etc., in finished portions of the building, unless specifically noted to

be exposed. Work shall be installed to avoid crippling of structural members. All exposed work shall be installed parallel or perpendicular to the lines of the building unless otherwise noted.

- C. When the mechanical, electrical, plumbing and fire protection Drawings do not give exact details as to the elevation of pipe, conduit and ducts, physically arrange the systems to fit in the space available at the elevations intended with the proper grades for the functioning of the system involved. Exposed piping and ductwork is generally intended to be installed true and square to the building construction, and located as high as possible against the structure in a neat and workmanlike manner. The Drawings do not show all required offsets and their location details. Work shall be concealed in all finished areas.

1.5 SUBMITTALS

- A. Provide shop drawings and complete product data as indicated in each specification section.
- B. Coordination Drawings: Using the mechanical ductwork shop drawings as a basis, provide a composite set of AutoCAD drawings in which the major mechanical, plumbing and fire protection equipment, ductwork and piping are superimposed on the architectural reflected ceiling plan and structural framing plan. Include spot elevations of bottom of steel along with finished ceiling height. Prepare at 1/8 inch scale or larger, one drawing per building area. Provide 1/4 inch scale enlargements of locations where special attention to rough-in dimensions as required to ensure all systems will fit within the available space. Obtain approval of coordination drawings prior to duct fabrication and mechanical system hanger rough-ins.
- C. Shop Drawings will be reviewed and returned to the Contractor with one of the following categories:
1. **Reviewed:** No further submittal action is required. Submittal to be included in O & M Manual.
 2. **Revise and Resubmit:** Contractor to resubmit submittal as indicated in comments section of Engineer's Submittal Cover Letter.
 3. **Rejected:** Contractor to resubmit new submittal when alternate or substitution is not approved and be required to furnish product named in Specification and or Drawings.
 4. **Furnish as Corrected:** Contractor to submit letter verifying that required corrections noted on Engineer's Submittal Cover Letter have been received and complied with by manufacturer. If equipment on site is not in compliance with corrections noted, contractor shall be responsible for the cost of removing and replacing equipment.
- D. Materials and equipment which are purchased or installed without Submittal review and approval will be removed and replaced with specified equipment at Contractor's expense.
- E. Provide a specification review that consists of a copy of related specification section with notations indicating compliance or deviation with each element of specification.

1.6 CLOSEOUT SUBMITTALS

- A. Submit in accordance with Division 1 - General Requirements and each specification section.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- B. Contractor shall adequately protect equipment such as but not limited to: Chillers, Air Handling Units, Fan coil Units, Roof top Units, Air Terminal Units, Boilers, Pumps, Air Devices, exhaust fans, variable frequency drives, ductwork, duct insulation, piping insulation, hydronic piping, air duct accessories, unit heaters, etc. from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, water, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging; original factory packaging shall not be deemed as acceptable protection of equipment.
- C. Do not deliver equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the Contractor is obligated to furnish new equipment of a like kind at no additional cost to the Owner. Limit shipment of bulk and multiple-use materials to quantities needed for immediate installation.

1.8 INTERFERENCE DRAWINGS

- A. Where field conditions prohibit the installation of the mechanical, plumbing or fire protection system components within the available space as indicated on drawings, the Contractor shall prepare a sketch to the minimum 1/8 inch scale, clearly depicting the conflict along with an alternate installation arrangement that satisfies the design intent of the documents without incurring additional cost.
- B. Obtain written approval of proposed interference resolution prior to proceeding with alternate installation.

1.9 EXISTING CONDITIONS

- A. The Contractor shall be familiar with the required scope of work to accomplish the work required by these documents. All demolition work implied or required shall be included in the scope of this contract.
- B. Outages of services are required by the new installation will only be permitted at a time approved by the Owner. The contractor shall allow the Owner a 2 week window in order to schedule required outages. The time allowed for outages will not be during normal operating hours unless otherwise approved by the Owner. All costs for outages, including overtime charges, shall be included in the contract amount.
- C. Work Sequence, Timing, Coordination with Owner:

1. During the construction of this project, normal facility activities will continue in existing buildings until new buildings or renovated areas are completed. Plumbing, fire protection, lighting, electrical, communications, heating, air conditioning, and ventilation systems will have to be maintained in service within the occupied spaces of the existing building.

D. Demolition and Work within Existing Buildings:

1. In the preparation of these documents every effort has been made to show the approximate locations of, and connections to the existing piping, duct, equipment and other apparatus related to this phase of the work. However, the Contractor shall be responsible for verifying all existing conditions. The Contractor shall visit the existing site to inspect the facilities and related areas. The Contractor shall inspect and verify all details and requirements of all the Contract Documents, prior to the submission of a proposal. All discrepancies between the Contract Documents and actual job-site conditions shall be resolved by his contractor, who shall produce drawings which shall be submitted to the Architect/Engineer for review. All labor and materials required to perform the work described shall be part of this Contract.
2. All equipment and/or systems noted on the Drawings "To Remain" shall be inspected and tested on site to certify working condition. A written report on the condition of all equipment to remain, including a copy of the test results and recommended remedial actions and costs shall be made by this Contractor to the Architect/Engineer for review.
3. All equipment and/or systems noted on the Drawings "To Be Removed" shall be removed including associated system connections. Where duct or pipe is to be capped for future extension or end of line use, it shall be properly tagged with its function or service appropriately identified. Where existing equipment is to be removed or relocated and has an electric connection, the Electrical Contractor shall disconnect equipment and remove wiring back to panel or disconnect switch. Contractor shall remove or relocate equipment and associated disconnect.
4. During the construction and remodeling, portions of the Project shall remain in service. Construction equipment, material tools, extension cords, etc., shall be arranged so as to present minimum hazard or interruption to the occupants of the building. None of the construction work shall interfere with the proper operation of the existing facility or be so conducted as to cause harm or danger to persons on the premises. All fire exits, stairs or corridors required for proper access, circulation or exit shall remain clear of equipment, materials or debris. The General Contractor shall maintain barricades separating work area from occupied areas.
5. Certain work during the demolition and construction phases of construction may require temporary evacuation of the occupants. Coordinate and schedule all proposed evacuation with the Project Administrator at least seventy-two (72) hours in advance in writing.
6. Any salvageable equipment as determined by the Owner, shall be delivered to the Owner, and placed in storage at the location of his choice. All other debris shall be removed from the site immediately.

7. Equipment, piping or other potential hazards to the occupants of the building shall not be left overnight outside of the designated working or construction area.
8. Make every effort to minimize damage to the existing building and the owner's property. Repair, patch or replace as required any damage which might occur as a result of work at the site. Care shall be taken to minimize interference with the Owner's activities during construction and to keep construction disrupted areas to a minimum. Coordinate with the Owner and other trades in scheduling and performance of the work.
9. Include in the contract price all rerouting of existing pipe, duct, etc., and the reconnecting of the existing equipment and plumbing fixtures as necessitated by field conditions to allow the installation of the new systems regardless of whether or not such rerouting, reconnecting or relocating is shown on the drawings. Furnish all temporary pipe, duct, controls, etc., as required to maintain heating, cooling, and ventilation and plumbing services for the existing areas.
10. All existing plumbing fixtures, pipe, duct, materials, equipment, controls and appurtenances not included in the remodel or alteration areas are to remain in place.
11. Pipe, duct, equipment and controls that are disconnected to perform remodeling work, shall be reconnected in such a manner as to leave systems in proper operating condition.
12. No portion of the fire protection systems shall be turned off, modified or changed in any way without the express knowledge and written permission of the Owner's representative in order to protect systems that shall remain in service.
13. It is the intention of this Section of the Specifications to outline minimum requirements to furnish the Owner with a turn-key and operating system in cooperation with other trades with a minimum of disruption or downtime.
14. Refer to Architectural "Demolition and/or Alteration" plans for actual location of walls, ceiling, etc., being removed and/or remodeled.

1.10 DELIVERY, STORAGE, AND HANDLING

- D. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- E. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.
- F. Do not deliver items to project before time of installation. Limit shipment of bulk and multiple-use materials to quantities needed for immediate installation.

1.11 GENERAL ELECTRICAL REQUIREMENTS

- A. Provide electric motors, control panels, certain control and safety devices and control wiring when specified or required for proper operation of electrical systems associated with mechanical equipment specified in Division 23.

- B. Electrical materials and work provided shall be in accordance with Division 26.
- C. Notify Architect/Engineer in writing 14 days before bids are due if it is necessary to increase horsepower of any motors or change any electrical requirements listed or shown. After this period, costs incurred because of changes shall be assumed by the responsible Contractor.

1.12 ELECTRICAL REQUIREMENTS FOR MECHANICAL EQUIPMENT

- A. Mechanical equipment with factory assembled and/or attached electric equipment shall be Underwriters' Laboratories (UL) listed as an assembly when such listing is available from UL, and shall meet the latest edition of the National Electrical Code.
- B. Unless otherwise specified, the electrical supply being furnished is a 460 volt, 3 phase, 3 wire, 60 hertz source. No neutral connection is available from the 460 volt source. The manufacturer shall include any transformers for equipment requiring other voltages (220 volt, 120 volt, 24 volt, etc.).
- C. Electric Motors:
 - 1. For each piece of equipment requiring electric drive, provide a motor having starting and running characteristics consistent with torque and speed requirements of the driven machine.
 - 2. Manufacturers furnishing motors shall verify motor horsepower with the characteristic power curves of driven equipment on shop drawings.
 - 3. Each motor shall be furnished in accordance with Section 23 05 13 - Common Motor Requirements for HVAC Equipment.
 - 4. Contractor shall verify electrical characteristics of each motor with electrical drawings.
 - 5. Motors which are shipped loose from equipment shall be set by supplying subcontractor.
 - 6. Alignment of motors factory coupled to equipment and motors field coupled to equipment shall be rechecked by millwright after all connections (belt drives, gear drives, impellers, piping, etc.) have been completed and again after 48 hours of operation in designed service.
 - 7. Where possible, motors shall be factory mounted.

PART 2 – PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 EXISTING WORK

- A. Disconnect mechanical, plumbing and fire protection systems in walls, floors, and ceilings scheduled for removal.
- B. Provide all required connections to maintain existing systems in service during construction.

- C. When performing work on operating systems use personnel experienced and trained in similar operations.
- D. Remove, relocate, and extend existing installations to accommodate new construction.
- E. Repair adjacent construction and finishes damaged during demolition and extension work.
- F. Normal facility activities will continue in existing areas. MEP systems servicing existing occupied spaces will have to be maintained in service. Schedule any required outages and system service interruptions with Owner and Architect. Submit a written request indicating service(s) to be interrupted along with proposed duration and summary of work to be performed during downtime.
- G. Removed Equipment:
 - 1. Store removed items at site; Owner retains rights to all removed items.
 - 2. Allow Owner ample time to review removed items and to designate which items to be kept by Owner.
 - 3. Dispose properly, off-site, all items Owner chooses not to keep.

3.2 DEMOLITION AND EXTENSION OF EXISTING MECHANICAL WORK

- A. Remove, relocate and extend existing installations to accommodate new construction.
- B. Remove abandoned piping to source of supply.
- C. Remove exposed abandoned piping systems, including abandoned systems above accessible ceiling finishes. Cut systems flush with walls and floors, and patch surfaces.
- D. Repair adjacent construction and finishes damaged during demolition and extension work.
- E. Maintain access to existing installations which remain active. Modify installation or provide access panels as appropriate.
- F. Extend existing installations using materials and methods compatible with existing installations, or as specified.

3.3 CLEANING AND REPAIR

- A. Clean and repair existing materials and equipment which remain or are to be reused.

3.4 INSTALLATION

- A. Install relocated materials and equipment.

3.5 REMOVAL OF MATERIALS

- A. The Contractor shall modify, remove, and/or relocate all materials and items so indicated on the drawings or required by the installation of new facilities. All removals and/or

dismantling shall be conducted in a manner as to produce maximum salvage. Salvage destination as directed by the Owner. Materials and/or items scheduled for relocation and which are damaged during dismantling or reassembly operations shall be repaired and restored to good operative condition. The contractor may, at his discretion and upon the approval of the Owner, substitute new materials and/or items of like design and quality in lieu of materials and/or items to be relocated.

- B. All items which are to be relocated shall be carefully removed in reverse to original assembly or placement and protected until relocated. The Contractor shall clean and repair and provide all new materials, fittings, and appurtenances required to complete the relocations and to restore to good operative order. All relocations shall be performed by workmen skilled in the work and in accordance with standard practice of the trades involves.
- C. When items scheduled for relocation are found to be in damaged condition before work has been started on dismantling, the contractor shall call the attention of the Owner to such items and receive further instructions before removal. Items damaged in repositioning operations are the contractor's responsibility and shall be repaired or replaced by the contractor as approved by the Owner, at no additional cost to the Owner.
- D. Service lines and wiring to items to be removed, salvaged, or relocated shall be removed to points indicated on the drawings, specified, or acceptable to the Owner. Service lines and wiring not scheduled for reuse shall be removed to the points at which reuse is to be continued or service is to remain. Such services shall be sealed, capped, or otherwise tied-off or disconnected in a safe manner acceptable to the Owner. All disconnections or connections into the existing facilities shall be done in such a manner as to result in minimum interruption of services to adjacent occupied areas. Services to existing areas or facilities which must remain in operation during the construction period shall not be interrupted without prior specific approval of the Owner as hereinbefore specified.
- E. Include in the contract price all rerouting of existing conduits, wiring, outlet boxes, fixtures, etc., and the reconnecting of existing fixtures as necessitated by field conditions to allow the installation of the new systems. Furnish all temporary conduit, wiring, boxes, etc., as required to maintain lighting and power service for the existing areas with a minimum of interruption. Remove wire and conduit back to nearest accessible active junction box and extend to existing homeruns as required.
- F. The Contractor shall be responsible for loss or damage to the existing facilities and shall be responsible for repairing such loss or damage. The Contractor shall send proper notices, make necessary arrangements, and perform other services required for the care, protection and operational maintenance of all electrical services for the new and existing facilities, The Contractor shall erect temporary barricades, with necessary safety devices, as required to protect personnel from injury, removing all such temporary protection upon completion of the work.
- G. Where existing construction is removed to provide working and extension access to existing utilities, Contractor shall remove doors, piping, conduit, outlet boxes, wiring, light fixtures, air conditioning ductwork and equipment, etc., to provide this access and shall reinstall same upon completion of work in the areas affected.
- H. Where partitions, walls, floors, or ceilings of existing construction are being removed, all contractors shall remove and reinstall in locations approved by the Architect all devices required for the operation of the various systems installed in the existing construction.

3.6 OWNER INSTRUCTION – GENERAL

- A. Installing Contractor shall coordinate and provide on-site Owner training for all new equipment by factory trained specialists for all Mechanical and Plumbing equipment in two (2) separate training meetings. One (1) training session shall be prior to Owner's acceptance and occupancy, and the other training session shall occur (30) thirty days later. Sign-in sheets are required for both meetings and shall be included in close out submittals.
- B. Use Operation and Maintenance manuals and actual equipment installed as basis for instruction.
- C. At conclusion of on-site training program have Owner personnel sign written certification they have completed training and understand equipment operation. Include copy of training certificates in final Operation and Maintenance manual submission.
- D. Refer to individual equipment specifications for additional training requirements.

END OF SECTION

SECTION 23 05 13

COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

GENERAL CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes single and three phase motors for application on equipment provided under other sections and for motors furnished loose to Project.
- B. General: Provide motors for all equipment. Select for starting torque and starting current suitable for equipment loads and starting equipment. Horsepower rating shown on drawings are required, but motor must not be loaded more than 1.0 x nameplate horsepower. Provide larger motor if required to stay within this limitation, and include all costs for any required increases in electrical system.
- C. Electrical Characteristics: Provide nameplate ratings same as circuit voltage indicated on electrical drawings. Coordinate to give proper operation with starting equipment scheduled. See Division 26.

1.2 REFERENCES

- A. American Bearing Manufacturers Association:
 - 1. ABMA 9 – Load Ratings and Fatigue Life for Ball Bearings.
- B. National Electrical Manufacturers Association:
 - 1. NEMA MG 1 – Motors and Generators.
- C. All motors furnished shall be designed, manufactured, and tested in accordance with the latest applicable standards of NEMA, ANSI, IEEE, and ASTM. As a minimum requirement, all motors shall conform to the latest applicable sections of NEMA Standard No. MG-1. Motors must meet or exceed the rebate levels for premium efficiency Motors established by the Consortium for Energy Efficiency (CEE).

1.3 SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Product Data: Submit catalog data for each motor furnished loose. Indicate nameplate data, standard compliance, electrical ratings and characteristics, and physical dimensions, weights, mechanical performance data, and support points.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Lift only with lugs provided. Handle carefully to avoid damage to components, enclosure, and finish.

- B. Protect products from weather and moisture by covering with plastic or canvas and by maintaining heating within enclosure.
- C. For extended outdoor storage, remove motors from equipment and store separately.

PART 2 - PRODUCTS

2.1 ELECTRIC MOTORS

- A. Manufacturers:
 - 1. Baldor
 - 2. Marathon
 - 3. General Electric
 - 4. Weg
 - 5. A.O. Smith
- B. Motors 3/4 hp and Larger: Three-phase motor as specified below.
- C. Motors Smaller Than 3/4 hp: Single-phase motor as specified below, except motors less than 250 watts or 1/4 hp may be equipment manufacturer's standard.
- D. All motors controlled by a Variable Frequency Drive shall be NEMA MG-1 Section 31 Inverter-Fed Rated.
- E. Three-phase Motors: NEMA MG-1, Design B, class H premium, energy-efficient squirrel-cage induction motor, with windings to accomplish starting methods and number of speeds as indicated on Drawings.
 - 1. Service Factor: 1.15
 - 2. Enclosure: Concealed Indoor: ODP, Exposed Indoor: Guarded ODP, Outdoor: Type II TEFC, Outdoor Weather Protected: Type I TEAO.
 - 3. Design for continuous operation in 40 degrees C environment, with temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.
 - 4. Insulation System: NEMA Class F.
 - 5. Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.
 - 6. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for re-lubrication, rated for minimum ABMA 9, L-10 life of 40,000 hours. Calculate bearing load with NEMA standard shaft extension. Stamp bearing sized on nameplate.
 - 7. Sound Power Levels: Conform to NEMA MG 1.

- 8. Factory finish starters shall be provided with integral phase failure protection to shut down motor upon loss of an electrical phase and automatically reset upon return of 3 phase power.
- F. Single Phase Motors:
 - 1. Permanent split-capacitor type where available, otherwise use split-phase start / capacitor run or capacitor start / capacitor run motor.
 - 2. Service Factor: 1.35.
- G. Wiring Terminations: Furnish terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated.

2.2 SOURCE QUALITY CONTROL

- A. General: All motor starters and magnetic contactors are specified in Division 26, except as follows:
 - 1. Starters and motors specified as part of a packaged piece of equipment.
 - 2. Centrifugal chillers which are provided with remote mounted starters under the chiller specification.
 - 3. Variable speed controllers for variable volume air handling units and cooling towers.
- B. Provide a tabulation of motors with all pertinent information required for properly rated motor controllers to be provided under Division 26.
- C. Provide a tabulation of matched motors and starters provided under Division 23.
- D. Variable speed motors controlled by variable frequency drives in general shall be of standard design called out in this specification. The manufacturer shall be notified on the requisition that the motor will be used in conjunction with a variable frequency drive and its type of frequency generation. It shall be the responsibility of the motor manufacturer to ensure that this motor will be capable of operating under the torque requirements and speed range within temperature specifications. The normal speed range shall be 4 to 1 ratio. The motor / drive system shall be capable of maintaining full torque throughout. The motors specified for variable speed application shall be capable of operating at 90 hertz maximum frequency as a minimum requirement but at reduced torque's above 60 HZ.
- E. Efficiency: Minimum full load efficiency shall be as follows:

Open Drip-Proof (ODP)				Totally Enclosed Fan Cooled (TEFC)			
	1200 RPM	1800 RPM	3600 RPM		1200 RPM	1800 RPM	3600 RPM
HP	Minimum Efficiency	Minimum Efficiency	Minimum Efficiency	HP	Minimum Efficiency	Minimum Efficiency	Minimum Efficiency

1	82.5	85.5	77.0	1	82.5	85.5	77.0
1.5	86.5	86.5	84.0	1.5	87.5	86.5	84.0
2	87.5	86.5	85.5	2	88.5	86.5	85.5
3	88.5	89.5	85.5	3	89.5	89.5	86.5
5	89.5	89.5	86.5	5	89.5	89.5	88.5
7.5	90.2	91.0	88.5	7.5	91.0	91.7	89.5
10	91.7	91.7	89.5	10	91.0	91.7	90.2
15	91.7	93.0	90.2	15	91.7	92.4	91.0
20	92.4	93.0	91.0	20	91.7	93.0	91.0
25	93.0	93.6	91.7	25	93.0	93.6	91.7
30	93.6	94.1	91.7	30	93.0	93.6	91.7
40	94.1	94.1	92.4	40	94.1	94.1	92.4
50	94.1	94.5	93.0	50	94.1	94.5	93.0
60	94.5	95.0	93.6	60	94.5	95.0	93.6
75	94.5	95.0	93.6	75	94.5	95.4	93.6
100	95.0	95.4	93.6	100	95.0	95.4	94.1
125	95.0	95.4	94.1	125	95.0	95.4	95.0
150	95.4	95.8	94.1	150	95.8	95.8	95.0
200	95.4	95.8	95.0	200	95.8	96.2	95.4

PART 3 - EXECUTION

3.1 REQUIREMENTS

- A. All equipment shall be installed in accordance with the manufacturer's recommendations and printed installation instructions.
- B. All items required for a complete and proper installation are not necessarily indicated in the plans or in the specifications. Contractor's price shall include all items required as per manufacturer's requirements.

3.2 INSTALLATION

- A. General: Install in a professional manner. Any part of parts not meeting this requirement shall be replaced or rebuilt without extra expense.
- B. Install rotating equipment in static and dynamic balance.
- C. Provide foundations, supports, and isolators properly adjusted to allow minimum vibration transmission within the building. Refer to Section 23 05 48.
- D. Correct objectionable noise or vibration transmission in order to operate equipment satisfactorily as determined by the Engineer.

END OF SECTION

SECTION 23 05 14

VARIABLE FREQUENCY DRIVES

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This specification is to cover a complete Variable Frequency motor Drive (VFD) consisting of a pulse width modulated (PWM) inverter designed for use on a standard NEMA Design B induction motor. The drive shall be designed specifically for variable torque applications. It is required that the drive manufacturer has an existing independent service organization.
- B. The drive and all necessary controls as herein specified shall be supplied by the drive Manufacturer. The manufacturer shall have been engaged in the production of this type of equipment for a minimum of ten (10) years.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. Institute of Electrical and Electronic Engineers (IEEE)
 - a. Standard 519-1992, IEEE Guide for Harmonic Content and Control.
 - 2. Underwriters laboratories
 - a. UL508C
 - 3. National Electrical Manufacturer's Association (NEMA)
 - a. ICS 7.0, AC Adjustable Speed Drives
 - 4. IEC 16800 Parts 1 and 2
- B. Testing:
 - 1. All printed circuit boards shall be completely tested and burned-in before being assembled into the completed VFD. The VFD shall then be subjected to a computerized systems test (cold), burn-in, and computerized systems test (hot). The burn-in shall be at 104 degrees Fahrenheit at full rated load, on a motor. Drive input power shall be continuously cycled for maximum stress and thermal variation.
 - 2. All testing and manufacturing procedures shall be ISO 9001 certified.
- C. Failure Analysis:
 - 1. VFD manufacturer shall have an analysis laboratory to evaluate the failure of any component. The failure analysis lab shall allow the manufacturer to perform complete electrical testing, x-ray of components, and decap or delaminate of components and analyze failures within the component.

- D. Qualifications:
 - a. VFD's and options shall be UL listed as a complete assembly. VFD's that require the customer to supply external fuses for the VFD to be UL listed are not acceptable.

1.3 SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Submit VFD's only after coordination with approved Air Handling Units, Pumps, and Cooling Tower Submittals (If applicable).
- C. All Variable Frequency Drives serving various equipment such as but not limited to: Air handling Units, Pumps and Cooling towers shall be supplied by the same manufacturer.
- D. Submittals shall include, as a minimum, the following information:
 - 1. Outline Dimensions
 - 2. Weight
 - 3. Compliance to IEEE 519 - harmonic analysis for particular job site including total harmonic voltage distortion and total harmonic current distortion.
 - a. The VFD manufacture shall provide calculations, specific to the installation, showing total harmonic voltage distortion is less than five (5) percent. Input line filters shall be sized and provided as required by the VFD manufacturer to ensure compliance with IEEE standard 519 (latest version), guide for Harmonic Control and Reactive Compensation for Static Power Converters. The acceptance of this calculation must be completed prior VFD installation.
 - b. If the voltage THD exceeds five (5) percent the VFD manufacturer is to recommend the additional equipment required to reduce the voltage THD to an acceptable level.

1.4 WARRANTY

- A. Warranty shall be (2) two years and shall begin from date of Certificate of Substantial Completion. The warranty shall include all parts, labor, travel time and expenses to provide on-site warranty.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver equipment in manufacturer's original, unopened containers with identification labels intact.
- B. Contractor shall adequately protect equipment from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is

in addition to the manufacturer’s original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.

- C. Do not deliver equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

1.6 MANUFACTURERS

- A. Acceptable Manufacturers:
 - 1. ABB
 - 2. Danfoss
 - 3. Yaskawa

PART 2 - PRODUCTS

2.1 ADJUSTABLE FREQUENCY DRIVES

- A. The adjustable frequency drives (VFD’s) shall be solid state, with a Pulse Width Modulated (PWM) output. The VFD package as specified herein shall be enclosed in a NEMA 1 enclosure (NEMA 4X if outdoors or unconditioned space), completely assembled and tested by the manufacturer. The VFD shall employ a full wave rectifier (to prevent input line notching), Integral Line Reactor(s), Capacitors, and Insulated Gate Bipolar Transistors (IGBT’s) as the output switching device. The drive efficiency shall be 97 percent or better at full speed and full load. Fundamental power factor shall be 0.98 at all speeds and loads.
 - 1. Input 480 VAC +/- 10 percent, 3 phase, 48-63 Hz. The overvoltage trip level shall be 30 percent over the nominal, and the under voltage trip level shall be 35 percent over the nominal voltage as a minimum.
 - 2. Output Frequency 0 to 250 Hz. Operation above 60 Hz shall require programming changes to prevent inadvertent high-speed operation.
 - 3. Environmental operating conditions: 0 to 104 Degree Fahrenheit, 0 to 3300 feet above sea level, less than 95 percent humidity, non-condensing.
 - 4. Conditioned indoors enclosure shall be rated NEMA 1 and shall be UL listed as a plenum rated drive. Drives without this rating are not acceptable.
 - 5. VFD’s located in un-conditioned spaces or outdoors shall have rated NEMA 4X enclosure and shall be UL listed as a plenum rated drive. Drives without this rating are not acceptable.
- B. All VFD’s shall have the following features:
 - 1. All VFD’s shall have the same customer interface, including digital display, and keypad, regardless of horsepower rating. The keypad is to be used for local control, for setting all parameters, and for stepping through the displays and menus. The keypad shall be removable, capable of remote mounting, and shall

have its own non-volatile memory. The keypad shall allow for uploading and downloading of parameter settings as an aid for start-up of multiple VFD's.

2. The keypad shall include Hand-Off-Auto membrane selections. When in "Hand", the VFD will be started and the speed will be controlled from the up/down arrows. When in "Off", the VFD will be stopped. When in "Auto", the VFD will start via an external contact closure and the VFD speed will be controlled via an external speed reference. The drive shall incorporate "bump less transfer" of speed reference when switching between "Auto" and "Hand" modes and vice-versa.
3. The VFD's shall utilize pre-programmed application macros specifically designed to facilitate start-up. The Application Macros shall provide one command to ACS400-US-reprogram all parameters and customer interfaces for a particular application to reduce programming time.
4. The VFD shall have the ability to automatically restart after an over current, overvoltage, under voltage, or loss of input signal protective trip. The number of restart attempts, trial time, and time between reset attempts shall be programmable.
5. The VFD shall be capable of starting into a rotating load (forward or reverse) and accelerate or decelerate to setpoint without safety tripping or component damage (flying start). The VFD shall also be capable of DC injection braking at start to stop a reverse spinning motor prior to ramp.
6. The VFD shall be equipped with an automatic extended control power loss ride-through circuit, which will utilize the inertia of the load to keep the drive powered. Minimum power loss ride-through shall be one-cycle, based on full load and no inertia. Typical control power loss ride-through for a fan load shall be 2 seconds minimum.
7. If the input reference (4-20mA or 2-10V) is lost, the VFD shall give the user the option of either (1) stopping and displaying a fault, (2) running at a programmable preset speed, (3) hold the VFD speed based on the last good reference received, or (4) cause a warning to be issued, as selected by the user. The drive shall be programmable to signal this condition via a keypad warning, relay output and/or over the serial communication bus.
8. The customer terminal strip shall be isolated from the line and ground.
9. The drive shall employ current limit circuits to provide trip free operation:
 - a. The Slow Current Regulation limit circuit shall be adjustable to 150 percent (minimum) of the VFD's normal duty current rating. This adjustment shall be made via the keypad, and shall be displayed in actual amps, and not as percent of full load.
 - b. The Current Switch-off limit shall be fixed at 350 percent (minimum, instantaneous) of the VFD's normal duty current rating.
10. The overload rating of the drive shall be 110 percent of its normal duty current rating for one (1) minute in every ten (10) minutes. The minimum FLA rating shall meet or exceed the values in the NEC/UL table 430-150 for 4-pole motors.

11. The VFD shall have an integral Line Reactor(s) to reduce the harmonics to the power line and to increase the fundamental power factor. The minimum impedance shall be three (3) percent.
12. The VFD shall be capable of sensing a loss of load (broken belt / broken coupling) and signal the loss of load condition. The drive shall be programmable to signal this condition via a keypad warning, relay output and/or over the serial communications bus. Relay outputs shall include programmable time delays that will allow for drive acceleration from zero speed without signaling a false under load condition.
13. The VFD shall have programmable "Sleep" and "Wake up" functions to allow the drive to be started and stopped from the level of a process feedback signal.
14. A complete factory wired and tested bypass system consisting of an output contactor and bypass contactor. Overload protection shall be provided in both drive and bypass modes.
15. The following operators shall be provided:
 - a. Bypass Hand-Off-Auto
 - b. Drive mode selector
 - c. Bypass mode selector
 - d. Bypass fault reset
16. The following indicating lights (LED type) shall be provided:
 - a. Power-on
 - b. External fault
 - c. Drive mode selected
 - d. Bypass mode selected
 - e. Drive running
 - f. Bypass running
 - g. Drive fault
 - h. Bypass fault
 - i. Automatic transfer to bypass selected
17. Customer Interlock Terminal Strip: Provide a separate terminal strip for connection of freeze, fire, smoke contacts, and external start command. All external safety interlocks shall remain fully functional whether the system is in Hand, Auto, or Bypass modes.
18. The following relay (form C) outputs from the bypass shall be provided.

- a. Drive run
 - b. Bypass run
 - c. Drive fault Bypass fault (motor overload or under load (broken belt))
19. Automatic or manual bypass (field selectable)
 20. Manual or automatic bypass fault (field selectable)
 21. Dedicated digital input that will transfer motor from VFD mode to bypass mode upon dry contact closure.
 22. Door interlocked pad lockable circuit breaker which will disconnect all input power from the drive and all internally mounted options.
 23. Fast acting semi-conductor fuses exclusive to the VFD - fast acting semi-conductor fuses allow the VFD to disconnect from the line prior to clearing upstream branch circuit protection, maintaining bypass capability. Bypass designs which have no such fuses, or that incorporate fuses common to both the VFD and the Bypass will not be accepted.
 24. Class 10 or 20 (selectable) electronic motor overload protection shall be included in the microprocessor bypass to protect the motor in bypass mode.
- C. All VFD's to have the following adjustments:
1. Two (2) programmable critical frequency lockout ranges to prevent the VFD from operating the load continuously at an unstable speed.
 2. PID Setpoint controller shall be standard in the drive, allowing a pressure or flow signal to be connected to the VFD, using the microprocessor in the VFD for the closed loop control. The VFD shall have 250 mA of 24 VDC auxiliary power and be capable of loop powering a transmitter supplied by others. The auxiliary power supply shall have overload and over current protection. The PID setpoint shall be adjustable from the VFD keypad, analog inputs, or over the communications bus.
 3. Two (2) programmable analog inputs shall accept a current or voltage signal for speed reference or for reference and actual (feedback) signals for PID controller. Analog inputs shall include a filter; programmable from 0.01 to 10 seconds to remove any oscillation in the input signal. The minimum and maximum values (gain and offset) shall be adjustable within the range of 0 - 20 ma and 0 - 10 Volts. Additionally, the reference must be able to be scaled so that maximum reference can represent a frequency less than 60 Hz, without lowering the drive maximum frequency below 60 Hz. Process variables shall be modifiable by math functions such as multiplication and division between the two signals (fan tracking), high/low select, as well as inverted follower.
 4. Five (5) programmable digital inputs for maximum flexibility in interfacing with external devices. One digital input is to be utilized as a customer safety connection point for fire, freeze, and smoke interlocks (Enable). Upon remote, customer reset (reclosure of interlock) drive is to resume normal operation.

5. One (1) programmable analog output proportional to Frequency, Motor Speed, Output Voltage, Output Current, Motor Torque, Motor Power (kW), DC Bus voltage, Active Reference, and other data.
 6. Two (2) programmable digital relay outputs. The relays shall be rated for maximum switching current 8 amps at 24 VDC and 0.4 A at 250 VAC; Maximum voltage 300 VDC and 250 VAC; Continuous current rating 2 amps RMS. Outputs shall be true form C type contacts; open collector outputs are not acceptable. Relays shall be capable of programmable on and off delay times.
 7. Seven (7) programmable preset speeds.
 8. Two independently adjustable accel and decel ramps. These ramp times shall be adjustable from 1 to 1800 seconds.
 9. The VFD shall Ramp or Coast to a stop, as selected by the user.
- D. The following operating information displays shall be standard on the VFD digital display. All applicable operating values shall be capable of being displayed in engineering (user) units. A minimum of two operating values from the list below shall be capable of being displayed at all times. The display shall be in complete English words (alpha-numeric codes are not acceptable):
1. Output Frequency
 2. Motor Speed (RPM, percent, or Engineering units)
 3. Motor Current
 4. Calculated Motor Torque
 5. Calculated Motor Power (kW)
 6. DC Bus Voltage
 7. Output Voltage
 8. Heat sink Temperature (0°F)
 9. Analog Input Values
 10. Analog Output Value
 11. Keypad Reference Values
 12. Elapsed Time Meter (resettable)
 13. kWh meter (resettable)
 14. mWh meter
 15. Digital input status
 16. Digital output status

- E. The VFD shall have the following protection circuits. In the case of a protective trip, the drive shall stop, and announce the fault condition in complete words (alphanumeric codes are not acceptable).
1. Over current trip 350 percent instantaneous (170 percent RMS) of the VFD's variable torque.
 2. Current rating.
 3. Overvoltage trip 130 percent of the VFD's rated voltage.
 4. Under voltage trip 65 percent of the VFD's rated voltage.
 5. Over temperature +90 degrees Celsius.
 6. Ground Fault either running or at start.
 7. Adaptable Electronic Motor Overload (I 2 t). The Electronic Motor Overload protection shall protect the motor based on speed, load curve, and external fan parameter. Circuits, which are not speed dependant, are unacceptable. The electronic motor overload protection shall be UL approved for this function.
- F. Speed Command Input shall be via:
1. Keypad.
 2. Two Analog inputs, each capable of accepting a 0-20mA, 4-20mA, 0-10V, 2-10V signal.
 3. Floating point input shall accept a three-wire input from a Dwyer Photohelic (or equivalent type) instrument.
 4. Serial Communications
- G. Serial Communications
1. The VFD shall have an RS-485 port as standard. The standard protocol shall be BACnet. Optional protocols that must be available are: Johnson Controls N2 bus, Siemens Building Technologies FLN, LonWorks, Profibus and DeviceNet.
 2. Serial communication capabilities shall include, but not be limited to, run-stop control; speed set adjustment, proportional/integral/derivative PID control adjustments, current limit, and accel/decel time adjustments. The drive shall have the capability of allowing the DDC to monitor feedback such as process variable feedback, output speed/frequency, current (in amps), percent torque, power (kW), kilowatt hours (resettable), operating hours (resettable), relay outputs, and diagnostic warning and fault information. Additionally, remote (LAN) VFD fault reset shall be possible. A minimum of 15 field parameters shall be capable of being monitored.
 3. The VFD shall allow the DDC to control the drive's digital and analog outputs via the serial interface. The serial communications interface shall allow for DO (relay) control and AO (analog) control. In addition, all drive digital and analog inputs shall be capable of being monitored by the DDC system.

PART 4 - EXECUTION

3.1 INSTALLATION

- A. Installation shall be the responsibility of the mechanical contractor. The contractor shall install the drive in accordance with the recommendations of the VFD manufacturer as outlined in the installation manual.
- B. Power wiring shall be completed by the electrical contractor. The contractor shall complete all wiring in accordance with the recommendations of the VFD manufacturer as outlined in the installation manual.

3.2 START-UP

- A. Certified factory start-up shall be provided for each drive by a factory authorized service center. A certified start-up form shall be filled out for each drive with a copy provided to the owner, and a copy kept on file at the manufacturer.

3.3 PRODUCT SUPPORT

- A. Factory trained application engineering and service personnel that are thoroughly familiar with drive products offered shall be locally available at both the specifying and installation locations.

END OF SECTION

SECTION 23 05 29

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

1. Pipe hangers and supports.
2. Hanger rods.
3. Inserts.
4. Flashing.
5. Equipment roof curbs and support rails.
6. Sleeves.
7. Mechanical sleeve seals.
8. Formed steel channel and angle.
9. Equipment bases and supports.
10. Portable roof pipe supports.
11. Portable duct supports.
12. Crossover Bridge with Stairs.
13. Modular four bar safety rail system.

- B. Related Sections:

1. Section 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment.
2. Division 7 - Thermal and Moisture Protection.

1.3 ACTION SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Product Data: For each type of product indicated.
- C. Shop Drawings: Show fabrication and installation details and include calculations for the following; include Product Data for components:
 1. Trapeze pipe hangers.
 2. Metal framing systems.
 3. Pipe stands.
 4. Equipment supports.

- D. Design Data: Indicate load carrying capacity of trapeze, multiple pipe and riser support hangers. Indicate calculations used to determine load carrying capacity of trapeze, multiple pipe, and riser support hangers.
- E. Manufacturer's Installation Instructions:
 - 1. Hangers and Supports: Submit special procedures and assembly of components.
- F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- B. Protect from weather, construction traffic, dirt, water, chemical, and mechanical damage.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply Firestopping materials when temperature of substrate material and ambient air is below 60 degrees Fahrenheit.
- B. Maintain this minimum temperature before, during, and for minimum 3 days after installation of Firestopping materials.
- C. Provide ventilation in areas to receive solvent cured materials.

1.8 WARRANTY

- A. Furnish one (1) year manufacturer warranty for pipe hangers and supports.

PART 2 - PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

- A. Manufacturers:
 - 1. Carpenter & Paterson Inc.
 - 2. Flex-Weld, Inc.
 - 3. Globe Pipe Hanger Products Inc.
 - 4. Michigan Hanger Co.
 - 5. B-Line Systems

6. Carpenter & Patterson Inc.
7. Anvil International
8. Piping Technology & Products
9. Grinnell

B. Hydronic Piping:

1. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Carbon steel, adjustable swivel, split ring.
2. Hangers for Cold Pipe Sizes two (2) inches and larger: Carbon steel, adjustable, clevis.
3. Hangers for Hot Pipe Sizes 2 inches to 4 inches: Carbon steel, adjustable, clevis.
4. Hangers for Hot Pipe Sizes six (6) inches and larger: Adjustable steel yoke, cast iron roll, double hanger.
5. Multiple or Trapeze Hangers: Galvanized Steel channels with welded spacers and hanger rods.
6. Multiple or Trapeze Hangers for Hot Pipe Sizes six (6) inches and larger: Galvanized Steel channels with welded spacers and hanger rods, cast iron rollers.
7. Wall Support for Pipe Sizes three (3) inches and smaller: Cast iron hooks.
8. Wall Support for Pipe Sizes four (4) inches and larger: Welded galvanized steel bracket and wrought steel clamp.
9. Wall Support for Hot Pipe Sizes six (6) inches and larger: Welded galvanized steel bracket and wrought steel clamp with adjustable steel yoke and cast iron roll.
10. Vertical Support: galvanized Steel riser clamp.
11. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
12. Floor Support for Hot Pipe Sizes four (4) Inches and smaller: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
13. Floor Support for Hot Pipe Sizes six (6) inches and larger: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
14. Copper Pipe Support: Copper-plated, carbon steel ring.
15. Hydronic Piping shall not have support brackets welded to hydronic piping.

C. Roof Mounted Hydronic Piping:

1. Refer to Division 7 –for hanger requirements and approved manufacturers.

2.2 HANGER RODS

- A. Hanger Rods: Hot dipped galvanized, mild steel threaded both ends, threaded on one end, or continuous threaded.

2.3 INSERTS

- A. Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.4 FLASHING

- A. In accordance with Division 7 - Thermal and Moisture Protection.

2.5 EQUIPMENT ROOF CURBS AND SUPPORT RAILS

- A. Equipment roof curbs and support rails must be coordinated with roof type specified under Division 7.
- B. Roof mounted exhaust fans, intake hoods, relief hoods and supply fans shall be set on equipment manufacturers 12" high fabricated welded 18 gauge galvanized steel shell and base, mitered three (3) inch cant if required by roofing type, variable step to match roof insulation, 1-1/2 inch thick curb insulation, factory installed treated wood nailer. Curb shall set level on roof without the need for blocking.
- C. Roof mounted unitary air conditioning units shall be set on a structural type curb or equipment support rail. Curb or support rail shall be compatible with required vibration isolation specified under Section 23 05 48. Curb or support rail shall be 12" high welded 18 gauge galvanized steel shell and base, mitered three (3) inch cant if required by roofing type, variable step to match roof insulation, 1-1/2 inch thick insulation, 3 lb density, factory installed wood nailer and stainless steel cap. Curb shall set level on roof without the need for blocking. Field bolted curbs are not acceptable.
 - 1. Approved Manufacturers:
 - a. The Pate Co.
 - b. Custom Curb, Inc.
 - c. Roof Products, Inc.
- D. Refer to Division 7 - Thermal and Moisture Protection for additional requirements.

2.6 SLEEVES

- A. Sleeves for Pipes through fire rated or non-fire rated Floors: 18 gage thick galvanized steel.
- B. Sleeves for Pipes through Rated or Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage thick galvanized steel.
- C. Sleeves for Round Ductwork: Galvanized steel.
- D. Sleeves for Rectangular Ductwork: Galvanized steel.

- E. Sealant: Refer to Section 07 92 00 - Building Sealants.

2.7 MECHANICAL SLEEVE SEALS

- A. Manufacturers:
 - 1. Thunderline Link-Seal, Inc.
 - 2. NMP Corporation
- B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.8 FORMED STEEL CHANNEL AND ANGLE

- A. Manufacturers:
 - 1. Allied Tube & Conduit Corp.
 - 2. B-Line Systems
 - 3. Midland Ross Corporation, Electrical Products Division
 - 4. Unistrut Corp.
- B. Product Description: Galvanized 14 gage thick steel angle and galvanized 12 gage thick steel channel with holes 1-1/2 inches on center. Metal framing system for equipment support.
- C. All channel members and angles shall be hot-dipped galvanized and fabricated from structural grade steel and conform to applicable ASTM specifications.
- D. Structural members to be loaded within manufacturers design limitations and published data.

2.9 EQUIPMENT BASES AND SUPPORTS

- A. In accordance with Division 3 – Concrete
- B. Provide concrete equipment pads, reinforced with 6 inch x 6 inch welded wire mesh, chamfered edges and to be six (6) inches larger than base of equipment. Pad heights as follows:
 - 1. Hot Water Boilers: four (4) inches.
 - 2. Floor Mounted Pumps: four (4) inches.
 - 3. Floor Mounted Water Volume Tanks: four (4) inches.
 - 4. Air Handling Units: four (4) inches.
 - 5. Water Heaters: four (4) inches.
 - 6. Water Softeners: four (4) inches.
 - 7. Air Compressor: four (4) inches.
 - 8. Floor Mounted Expansion Tanks: four (4) inches.
 - 9. Floor Mounted chemical feeder tanks: four (4) inches.
 - 10. Floor Mounted Fans: four (4) inches.
 - 11. Chillers: four (4) inches.
 - 12. Condensing Units: four (4) inches.
 - 13. Heat Pump Units: four (4) inches.

- C. Provide vibration isolation in accordance with Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.

2.10 PORTABLE ROOF PIPE SUPPORTS

A. Manufacturers:

1. Advanced Support Products (ASP)
2. Or ten (10) ten day prior approved equal

B. Steel and PVC Piping: Provide rooftop portable pipe supports in 8'-0" maximum intervals for steel, 4'-0" maximum intervals for PVC piping. Roof supports shall be manufactured by Advanced Support Products (ASP), model SS6000P with height adjustable crossbar and clevis hangers. Product specifications:

1. Support Base: 17" circular base, injected molded polypropylene, with 227 sq. in. of surface on bottom, designed for weight displacement.
2. Base Dimensions: 3"H x 17" in diameter, designed for weight displacement, with molded insert for square tubing and two threaded rod couplings molded in.
3. Height: Adjustable.
4. Frame: 1-5/8" x 1-5/8" 12 gauge channel (ASTM A653), hot- dipped galvanized.
5. Hardware: Corner brackets and leg brackets bolted with 1/2" x 2-1/2" bolt & 1/2" nut; frame bolted to support base with 1/2" x 2-1/2" bolts, 1/2" nuts and washers. Leg brackets and all thread rods, nuts and washers shall be hot- dipped galvanized.
6. Required accessories: 1/2" threaded rod, clevis hangers, strut clamps and protection pads.

C. Condensate disposal piping: Provide rooftop portable pipe supports in 8'-0" maximum intervals for steel condensate piping. Roof supports shall be manufactured by Advanced Support Products (ASP), model REC-SA (Rubber EcoCurb) with channel. Product specifications:

1. Bases: 100% recycled Vulcanized Rubber with UV inhibitors.
2. Frame: 1-5/8" x 1-5/8" 12 gauge channel (ASTM A653), hot- dipped galvanized.
3. Hardware: 1/2" threaded rods (12" high); 1/2" nuts & washers, hot- dipped galvanized.
4. Height: Adjustable.
5. Required accessories: Strut clamps and protection pads.
6. Hot dipped galvanized threaded rods, nuts and washers.

D. Protection pads: Provide protection pad sheets between the roof / grade and support system. Protection pads shall not be adhered to either the roof or the support system.

1. Material: Porous rubber.
2. Weight: 2 lbs.
3. Dimensions: 18" square X ½" thick.

2.11 PORTABLE DUCT SUPPORTS

A. Manufacturers:

1. Advanced Support Products (ASP)
2. Or ten (10) ten day prior approved equal

B. Galvanized steel ductwork: Provide portable duct supports in 5'-0" maximum intervals for steel. Duct supports shall be manufactured by Advanced Support Products (ASP), model SS2000D with height adjustable crossbar and strut clamps. Product specifications:

1. Support Base: 17" circular base, injected molded polypropylene, with 227 sq. in. of surface on bottom, designed for weight displacement.
2. Base Dimensions: 3"H x 17" in diameter, designed for weight displacement, with molded insert for square tubing and two threaded rod couplings molded in.
3. Height: Adjustable.
4. Frame: 1-5/8" x 1-5/8" 12 gauge channel (ASTM A653), hot- dipped galvanized.
5. Hardware: Corner brackets and leg brackets bolted with ½" x 2-1/2" bolts; & ½" nut; frame bolted to support base with ½" x 2-1/2" bolts, ½" nuts and washers. Leg brackets and all thread rods, nuts and washers shall be hot- dipped galvanized.
6. Required accessories: ½" threaded rod, strut clamps and protection pads.

C. Protection pads: Provide protection pad sheets between the roof / grade and support system. Protection pads shall not be adhered to either the roof or the support system.

1. Material: Porous rubber.
2. Weight: 2 lbs.
3. Dimensions: 18" square X ½" thick.

2.12 CROSSOVER BRIDGE WITH STAIRS

A. Manufacturers:

1. Advanced Support Products (ASP)
2. Or ten (10) ten day prior approved equal

B. Materials:

1. Support Base: 17" circular base, injected molded polypropylene, with 227 sq. in. of surface on bottom, designed for weight displacement.

2. Base Dimensions: 3"H x 17" in diameter, designed for weight displacement, with molded insert for square tubing and two threaded rod couplings molded in.
 3. Height: Adjustable.
 4. Frame: 4"x4" angle iron (ASTM 572), grade 50 and 1" x 3/16" bar grating, 19-w-4 carbon steel, ends capped with 1" x 3/16" steel flat bar, welded, hot-dipped galvanized.
 5. Handrails: 1-1/2" schedule 40 pipe, welded; handrails fastened to ramp by flat plate connection; all steel ASTM 572, grade 50, hot-dipped after fabrication.
 6. Hardware: Grating clips with 1-1/2" self-tapping screws, 1/2" x 1-1/2" bolts and 1/2" nuts; hot-dipped galvanized after fabrication.
 7. Accessories: 1/2" threaded rod, clevis hangers, strut clamps and protection pads.
- C. Roof protection pads: Provide roof protection pads sheets between the roof and support system. Roof protection pads shall not be adhered to either the roof or the support system.
1. Material: Porous rubber.
 2. Weight: 2 lbs.
 3. Dimensions: 18" square X 1/2" thick.

2.13 MODULAR FOUR BAR SAFETY RAIL SYSTEM

- A. Manufacturers:
1. Advanced Support Products (ASP).
 2. Or (10) ten day prior approved equal.
- B. Materials:
1. Support Base: 17" circular base, injected molded polypropylene, with 227 sq. in. of surface on bottom, designed for weight displacement.
 2. Base Dimensions: 3"H x 17" in diameter, designed for weight displacement, with molded insert for square tubing and two threaded rod couplings molded in.
 3. Height: Adjustable.
 4. Frame: 2"x2" angle iron ASTM 572, grade 50 and 1" x 3/16" bar grating, 19-w-4 carbon steel, ends capped with 1" x 3/16" steel flat bar, welded, hot-dipped galvanized after fabrication.
 5. Safety rails: 4 bar safety rail, 1-1/2" schedule 40 pipe, welded; safety rails are connected together using post and pin as a hinged design; all steel ASTM 572, grade 50, hot-dipped after fabrication.
 6. Hardware: 1/2" x 1-1/2" bolts and 1/2" nuts; hot-dipped galvanized after fabrication.

- C. Roof protection pads: Provide roof protection pads sheets between the roof and support system. Roof protection pads shall not be adhered to either the roof or the support system.
 - 1. Material: Porous rubber.
 - 2. Weight: 2 lbs.
 - 3. Dimensions: 18" square X ½" thick.
- D. Refer to plans for minimum safety rail linear length requirement.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify openings are ready to receive sleeves.
- B. Verify openings are ready to receive Firestopping/Firesafing.

3.2 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of Firestopping material.
- B. Remove incompatible materials affecting bond.
- C. Install damming materials to arrest liquid material leakage.
- D. Obtain permission from Architect/Engineer before using powder-actuated anchors.
- E. Do not drill or cut structural members.
- F. Obtain permission from Architect/Engineer before drilling or cutting structural members.

3.3 STRUCTURAL STEEL

- A. All structural steel used to fabricate supports shall conform to ASTM A36.

3.4 CUTTING AND PATCHING

- A. In accordance with Division 7 - Thermal and Moisture Protection

3.5 FIRESTOPPING

- A. In accordance with Division 7 - Thermal and Moisture Protection.

3.6 FIRESTOPPING ACCESSORIES

- A. In accordance with Division 7 - Thermal and Moisture Protection.

3.7 INSTALLATION - INSERTS

- A. Install inserts for placement in concrete forms.

- B. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe four (4) inches and larger.
- D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

3.8 INSTALLATION - PIPE HANGERS AND SUPPORTS

- A. Install in accordance with ASME B31.1
- B. Support horizontal piping as scheduled.
- C. Install hangers with minimum 1/2 inch space between finished covering and adjacent work.
- D. Place hangers within 12 inches of each horizontal elbow.
- E. Use hangers with 1-1/2 inch minimum vertical adjustment.
- F. Support vertical piping at every other floor.
- G. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.
- H. Support riser piping independently of connected horizontal piping.
- I. Provide copper plated hangers and supports for copper piping.
- J. Design hangers for pipe movement without disengagement of supported pipe.
- K. Prime coat exposed steel hangers and supports.
- L. Provide clearance in hangers and from structure and other equipment for installation of pipe insulation. Refer to Section 23 07 19 - HVAC Piping Insulation.

3.9 INSTALLATION - EQUIPMENT BASES AND SUPPORTS

- A. Provide housekeeping pads of concrete, minimum four (4) inches thick and extending six (6) inches beyond supported equipment.
- B. Using templates furnished with equipment, install anchor bolts, and accessories for mounting and anchoring equipment.
- C. Construct supports of steel members or formed steel channel. Brace and fasten with flanges bolted to structure.
- D. Provide rigid anchors for pipes after vibration isolation components are installed.

3.10 INSTALLATION - FLASHING

- A. Provide flexible flashing and metal Counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.

- B. Provide curbs for mechanical roof installations 12 inches minimum above roofing surface. Flash and counter-flash with sheet metal; seal watertight. Attach Counterflashing mechanical equipment and lap base flashing on roof curbs. Flatten and solder joints.
- C. Adjust storm collars tight to pipe with bolts; caulk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.
- D. Refer to Division 7 - Thermal and Moisture Protection for additional requirements.

3.11 INSTALLATION - SLEEVES

- A. Provide sleeves at all piping and ductwork penetrations of interior walls and slabs. Exterior watertight entries: Seal with mechanical sleeve seals.
- B. Set sleeves in position in forms. Provide reinforcing around sleeves.
- C. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- D. Extend sleeves through floors two (2) inches above finished floor level. Caulk sleeves.
- E. Extend sleeves through walls two (2) inches each side.
- F. Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with Firestopping insulation and caulk. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
- G. Install stainless steel escutcheons at finished surfaces.

3.12 INSTALLATION - FIRESTOPPING

- A. Install material at all fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, and other items.
- B. Apply primer where recommended by manufacturer for type of Firestopping material and substrate involved, and as required for compliance with required fire ratings.
- C. Apply Firestopping material in sufficient thickness to achieve required fire and smoke rating.
- D. Compress fibered material to maximum 40 percent of its uncompressed size.
- E. Fire Rated Surface:
 - 1. Seal opening at floor, wall, and partition as follows:
 - a. Install sleeve through opening and extending beyond minimum of one (1) inch on both sides of building element.
 - b. Size sleeve allowing minimum of one (1) inch void between sleeve and building element.
 - c. Pack void with backing material.

- d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.
- F. Non-Rated Surfaces:
1. Seal opening through non-fire rated wall and partition floor as follows:
 - a. Install sleeve through opening and extending beyond minimum of one (1) inch on both sides of building element.
 - b. Size sleeve allowing minimum of one (1) inch void between sleeve and building element.
 2. Install escutcheons, floor plates or ceiling plates where conduit, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.
 3. Exterior wall openings below grade: Assemble rubber links of mechanical sealing device to size of piping and tighten in place, in accordance with manufacturer's instructions.
 4. Interior partitions: Seal pipe penetrations. Apply sealant to both sides of penetration to completely fill annular space between sleeve and conduit.

3.13 INSTALLATION - ACCESS DOORS

- A. Access Doors: Provide access doors as required for access to equipment, valves, controls, cleanouts and other apparatus where concealed. Access doors shall have concealed hinges and screw driver cam locks. Minimum size to be 12 inches x 12 inches in walls only for hand access and 24 inches x 24 inches minimum for all ceilings for maintenance access.
- B. All access doors located in wet areas such as restrooms, locker rooms, shower rooms, kitchen and any other wet areas shall be constructed of stainless steel.
- C. Access Doors:
 1. Plastic Surfaces: Milcor Style K.
 2. Ceramic Tile Surface: Milcor Style M.
 3. Drywall Surfaces: Milcor Style DW.
 4. Install panels only in locations approved by the Architect and with trim styles and color coordinated with surface to be installed in.

3.14 INSTALLATION – EQUIPMENT REQUIRING ROOF PORTALBE BASES

- A. Verify that roof surface is smooth and clean to extent needed to receive material.
- B. Clean surfaces to receive 17" circular bases removing any loose gravel and foreign matter before setting 17" circular bases.
- C. Provide protective pad conforming to the new or existing roof manufacturer's system under each 17" circular bases. Do not adhere to the roof system or to circular bases.

3.15 FIELD QUALITY CONTROL

- A. Inspect installed Firestopping for compliance with specifications and submitted schedule.

3.16 CLEANING

- A. Clean adjacent surfaces of firestopping materials.

3.17 PROTECTION OF FINISHED WORK

- A. Protect adjacent surfaces from damage by material installation.

3.18 PIPE HANGERS

- A. Minimum hanger rod size shall be ½”.
- B. Maximum hanger rod spacing shall not exceed 10'-0” on center for pipe sizes 2” and above. Do not exceed 7'-0” hanger spacing for pipes sizes less than 2” diameter.
- C. For trapeze supports provide a minimum of (2) two ½” hanger rods at each end of trapeze for a total of (4) four.
- D. Beam clamps are not acceptable.

END OF SECTION

SECTION 23 05 48

VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Vibration isolation for building mechanical systems.
- B. Related Sections:
 - 1. Section - 23 05 16 - Expansion Fittings and Loops For HVAC Piping
 - 2. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment
- C. Mason Industries model numbers are listed for identification only.
- D. Manufacturers:
 - 1. Mason Industries
 - 2. Kinetics Noise Control
 - 3. Amber / Booth
 - 4. VMC
 - 5. Vibration Eliminator

1.2 PERFORMANCE REQUIREMENTS

- A. It is the intent of this specification to provide vibration isolation supports for all equipment, piping and ductwork as may be required to prevent transmission of vibration to the building structure. It will be the Contractor's responsibility to select and install vibration isolators which will enable the noise criteria standards to be met, to the extent that the noise can be controlled by the vibration isolators.
- B. All vibration isolation devices, including auxiliary steel bases and pouring forms, shall be designed and furnished by a single manufacturer or supplier.
- C. Unless otherwise noted or scheduled, spring type vibration isolators shall be used for all equipment driven by motors of 0.5 HP and larger. Deflections as tabulated are minimums and it shall be the responsibility of the isolation manufacturer to determine the amount of spring deflection required for each isolator to achieve optimum performance in order to prevent the transmission of objectionable vibrations and meet the noise criteria referenced herein.
- D. Unless otherwise noted, equipment driven by motors 0.25 HP and smaller shall be isolated by means of Type ND elastomeric mounts or Type HD elastomeric hangers properly sized for 0.35 inch deflection.
- E. All elastomeric isolators shall be of high quality synthetic rubber with anti-ozone and anti-oxidant additives.

- F. Design and treat vibration isolators for resistance to corrosion. Furnish phosphatized steel components with epoxy powder paint coating. Components exposed to the weather shall be epoxy powder paint coated or hot-dipped galvanized. Furnish zinc electroplated nuts, bolts and washers. Structural steel bases shall be thoroughly cleaned of welding slag and primed with zinc-chromate or metal etching primer.
- G. Isolators for equipment installed outdoors shall be designed to provide adequate restraint due to normal wind conditions and to withstand wind loads of 30 lbs/sq.ft. Wind loading shall be applied to all exposed surface of the isolated equipment in order to identify worst case load.
- H. Air handling equipment subjected to excessive horizontal air thrust operating at three (3) inches S.P. shall be furnished with Type WBI/WBD isolated thrust resisters to limit displacement to 1/4 inch.
- I. Height savings brackets used with isolators having 2.5 inch deflection or greater shall be of the precompression type to limit exposed bolt length.
- J. All spring isolators shall be completely stable in operation and shall be designed for not less than 50 percent reserve deflection beyond actual operating conditions. All spring isolators must be completely stable in operation and have a Kx/Ky ratio of at least 1:1.
- K. All isolation materials and flexible connectors shall be of the same manufacturer and shall be selected and certified using published or factory certified data. Any variance or non-compliance with these specification requirements shall be corrected by the contractor at no additional cost to the Owner. Manufacturer may purchase other manufactured products in order to meet this specification and shall guarantee outsourced product as a single point of responsibility. Outsourced products must be identified as such in the submittal for approval.
- L. The contractor and manufacturer of the isolation and equipment shall refer to the isolator schedule which lists isolator types and isolator deflections.
- M. Deflection table is based on maintaining rooms at the following maximum sound levels, in Noise Criteria (NC) as defined by ASHRAE and ANSI S1.8.
1. Offices
Executive: 30
Conference rooms: 30
Private: 35
Open-plan areas: 35
Computer/business machine areas: 40
Public circulation: 40
 2. Schools
Lecture and classrooms: 30
Open-plan classrooms: 35
 3. Libraries: 25
 4. Theaters
Theater: 25
Stage house: 25
Trap room: 25
Orchestra pit: 25

Rehearsal rooms: 25
Teaching studios: 30
Practice rooms: 30
Ensemble rooms: 30
Shop: 45

1.3 SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Shop Drawings: Indicate inertia bases and locate vibration isolators, with static and dynamic load on each. Indicate assembly, materials, thickness, dimensional data, and layout as well as connection details.
- C. Product Data: Submit schedule of vibration isolator type with location and load on each. Submit catalog information indicating materials and dimensional data. All steel bases and concrete inertia bases shall be completely detailed. Include clearly outlined procedures for installing and adjusting the isolators.
- D. Design Data: Submit calculations indicating maximum room sound levels are not exceeded.
- E. Manufacturer's Installation Instructions: Submit special procedures and setting dimensions. Indicate installation requirements maintaining integrity of sound isolation.
- F. Manufacturer's Certificate: Certify isolators meet or exceed specified requirements.
- G. Manufacturer's Field Reports: Indicate vibration isolation installation is complete and in accordance with instructions. Provide a copy of field report to Architect/Engineer.

1.4 QUALITY ASSURANCE

- A. The vibration isolation manufacturer, or qualified representative, shall be responsible for providing such supervision as may be necessary to assure correct installation and adjustment of the isolators. Vibration isolation manufacturer shall also inspect vibration isolation in units with factory provided isolation in order to confirm scheduled deflection and isolator type is in accordance with this specification. Upon completion of the installation and after the system is put into operation, the manufacturer, or representative, shall make a final inspection and submit his report to the Architect and Engineer in writing certifying the correctness of installation and compliance is in accordance approved submittal data.

1.5 QUALIFICATIONS

- A. Installer: Company specializing in performing Work of this section with minimum three (3) years experience.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATOR TYPES

All vibration isolators described in this section shall be the product of a single manufacturer. .
Submittals and certification sheets shall be in accordance with Specification 1.3 of this section.

- A. Type WSW: Two layers of 3/8-inch thick neoprene pad consisting of square waffle modules separated horizontally by a 16-gauge galvanized shim. Where the load bearing area of the equipment is not the same size/shape as the load bearing area/shape of the pad, load distribution plates, minimum ¼" thick galvanized steel, shall be utilized to ensure the load bearing capacity of the pad is maximized. Pads shall be sized for approximate deflection of 0.12 inch to 0.16 inch.
- B. Type ND: Neoprene mountings shall have minimum static deflection of 0.35 inch. All metal surfaces shall be neoprene covered and have friction pads both top and bottom. Bolt holes on the bottom and a tapped hole with a mounting bolt and washer shall be provided. Steel rails shall be used above the mountings under equipment such as small vent sets to compensate for the overhang. Where the load bearing area of the equipment or support structure is not the same size/shape as the load bearing area/shape of the pad, load distribution plates, minimum ¼" thick galvanized steel, shall be utilized to ensure the load bearing capacity of the pad is maximized.
- C. Type SLF: Spring isolators shall be free-standing and laterally stable without any housing and complete with a steel-washer-reinforced molded neoprene cup of 1/4-inch neoprene acoustical friction pad between the baseplate and the support. All mountings shall have leveling bolts that must be rigidly bolted to the equipment. Installed and operating heights shall be equal. The ratio of the spring diameter divided by the compressed spring height shall be no less than 0.8. Springs shall have minimum additional travel to solid equal to 50 percent of the rated deflection. Submittals shall include spring diameters, deflection, compressed spring height and solid spring height.
- D. Type SLR: Restrained spring mountings shall have an SLF mounting as described in Specification 2.1 C, within a rigid housing that includes vertical limit stops to prevent spring extension when weight is removed. The housing shall serve as blocking during erection. A steel spacer shall be removed after adjustment. Installed and operating heights are equal. A minimum clearance of 1/2 inch shall be maintained around restraining bolts and between the housing and the spring so as not to interfere with the spring action. Limit stops shall be out of contact during normal operation. Since housings will be bolted or welded in position under outdoor equipment, there must be an internal isolation pad in addition to the friction pad on bottom.
- E. Type HD: Hangers shall consist of rigid steel frames containing minimum 1-1/4-inch thick neoprene element. The neoprene element shall have neoprene bushings projecting through the steel box. In order to maintain stability, the boxes shall not be articulated as clevis hangers.
- F. Type 30N: Hangers shall consist of rigid steel frames containing minimum 1-1/4-inch thick neoprene elements at the top and a steel spring as described in 2.1 C, seated in a steel-washer-reinforced neoprene cup on the bottom. The neoprene element and the cup shall have neoprene bushings projecting through the steel box. In order to maintain stability, the boxes shall not be articulated as clevis hangers nor the neoprene element stacked on top of the spring. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30-degree arc from side to side before contacting the cup bushing and short circuiting the spring. Submittals shall include a hanger drawing showing the 30-degree capability.
- G. Type PC30N: Hangers shall be as described in Specification 2.1 F, but they shall be precompressed and locked at the rated deflection by means of a resilient seismic up stop to keep the piping or equipment at a fixed elevation during installation. The hangers shall be designed with a release mechanism to free the spring after installation is complete and the hanger is subjected to its full load. Deflection shall be clearly indicated by means

of a scale. Submittals shall include a drawing of the hanger showing the 30-degree capability.

- H. Type WBI/WBD: Horizontal thrust restraints shall consist of a spring element in series with a neoprene molded cup, as described in paragraph 2.1 C, with the same deflection as specified for the mountings or hangers supporting the unit. The spring element shall be designed so it can be preset for thrust at the factory and adjusted in the field to allow for a maximum of 1/4-inch movement at start and stop. The assembly shall be furnished with a rod and angle brackets for attachment to both the equipment and the ductwork or the equipment and the structure. Horizontal restraints shall be attached at the centerline of thrust and symmetrical on either side of the unit.
- I. Type SLR-MT: Restrained air spring mountings shall be manufactured with upper and lower steel sections connected by a replaceable flexible DuPont Kevlar reinforced neoprene element. Air spring configuration shall be multiple bellows to achieve a maximum natural frequency of 3 Hz. Air springs shall be designed for a burst pressure that is a minimum of three times the published maximum operating pressure. Restrained air springs shall be within a rigid housing that includes vertical limit stops to prevent air spring extension when weight is removed. The housing shall serve as blocking during erection. A steel spacer shall be removed after adjustment. Installed and operating

heights are equal. A minimum clearance of 1/2 inch {12mm} shall be maintained around restraining bolts and between the housing and the air springs so as not to interfere with the air spring action. Limit stops shall be out of contact during normal operation. Air spring systems shall be connected to a supplementary air supply compressor (supplied with the air spring system) through a Mason Industries air spring control panel and equipped with three leveling valves to maintain level within plus or minus 0.125". Air spring mounts are to be located between the supporting steel and the roof or the grillage and dunnage as shown on the drawings when there is no provision for direct mounting. Submittals shall include natural frequency, load and damping tests performed by an independent lab or acoustician.

2.2 BASES

- A. Type WF: A welded integral structural steel fan and motor base with NEMA standard motor slide rails and holes drilled to receive the fan and motor slide rails. Vibration isolation manufacturer shall furnish integral structural steel bases. Rectangular bases are preferred for all equipment. Centrifugal refrigeration machines and pump bases may be T or L shaped where space is a problem. Pump bases for split-case pumps shall be large enough to support suction and discharge elbows. All perimeter members shall be steel beams with a minimum depth equal to 1/10 of the longest dimension of the base. Base depth need not exceed 14 inches provided that the deflection and misalignment is kept within acceptable limits as determined by the manufacturer. Height-saving brackets shall be employed in all mounting locations to maintain a 1-inch operating clearance under base. .
- B. Type ICS: Vibration isolation manufacturer shall provide steel members welded to height-saving brackets to cradle equipment having legs or bases that do not require a complete supplementary base. Members shall have sufficient rigidity to prevent misalignment of equipment.
- C. Type RBMK. Vibration isolation manufacturer shall furnish structural steel concrete pouring forms for floating concrete bases. Wood formed bases, formed steel bases and sheet metal formed bases are not acceptable. Bases for split-case pumps shall be large enough to provide for suction and discharge elbows. Bases may be T or L shaped where space is a problem. Bases shall be a minimum of 1/12 of the longest dimension of the

base but not less than 6 inches. The base depth need not exceed 12 inches unless specifically recommended by the base manufacturer for mass or rigidity. Forms shall include minimum concrete reinforcing consisting of 1/2-inch bars welded in place on 6-inch centers running both ways in a layer 1-1/2 inches above the bottom. Forms shall be furnished with steel templates to hold the anchor bolt sleeves and anchor bolts while concrete is being poured. Recessed height-saving brackets shall be employed in all mounting locations to maintain a 1-inch operating clearance under base.

2.3 FLEXIBLE PIPE CONNECTIONS

- A. Type SFDEJ, SFEJ, SFDCR or SFU and Control Rods CR: Flanged and threaded rubber flexible joints shall be peroxide cured EPDM throughout with Kevlar tire cord reinforcement. Substitutions must have certifiable equal or superior characteristics. The raised face rubber flanges must encase solid steel rings to prevent pull out. Flexible cable wire is not acceptable. Sizes 1-1/2" through 14" shall have a ductile iron external ring between the two spheres. Sizes 16" through 24" may be single sphere. Sizes 3/4" through 2" may have one sphere, bolted threaded flange assemblies and cable retention. Minimum ratings through 14" shall be 250psi at 170°F and 215psi at 250°F, 16" through 24" 180psi at 170°F and 150psi at 250°F. Higher published rated connectors may be used where required. Safety factors shall be a minimum of 3/1. All flexible joints must be factory tested to 150% of maximum pressure for 12 minutes before shipment. The piping gap shall be equal to the length of the flexible joint under pressure. Control rods passing through 1/2" thick Neoprene washer bushings large enough to take the thrust at 1000psi of surface area may be used on unanchored piping where the manufacturer determines the condition exceeds the flexible joint rating without them. Submittals shall include two test reports by independent consultants showing minimum reductions of 20 DB in vibration accelerations and 10 DB in sound pressure levels at typical blade passage frequencies on this or a similar product by the same manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Isolators shall be installed as recommended by the manufacturer. Isolate all mechanical equipment 0.5 hp and over per the isolation schedule and these specifications.

3.2 PIPING ISOLATION

- A. Horizontal Pipe Isolation: All pumped water, pumped condensate and refrigerant piping size 1-1/4 inch and larger within mechanical rooms and on pipe size 2 inch and larger outside mechanical rooms shall be isolated. Outside equipment rooms this piping shall be isolated for the greater of 50 feet or 100 pipe diameters from externally isolated equipment. For the first 3 support locations from externally isolated equipment provide Type 30N hangers or Type SLF floor mounts with the same deflection as equipment isolators. All other piping within the equipment rooms shall be isolated with the same specification isolators with a 1" inch minimum deflection. Install piping hangers at regular intervals according the pipe hanger schedule. Where floor supports are required, provide sufficient spring capacity to absorb expansion and contraction of piping, and yet to permit piping to function as a floating system. Size hangers for 200 percent rated load. Coordinate selection of piping supports with equipment supports to accommodate expansion and contraction without creating excessive stresses at equipment connections.
- B. Pipe Riser Isolation: All vertical pipe risers 1-1/4 inch and larger, where specifically shown and detailed on riser drawings shall be fully supported by Type SW SLF isolators with brackets. Refer to details on Drawings. Steel spring deflection shall be 3/4 inch minimum. In locations where added deflection is required due to pipe

expansion/contraction, the spring deflection shall be a minimum of 4 times the anticipated deflection change. Springs shall be selected to keep the riser in tension. Wall sleeves for take-offs from riser shall be sized for insulation O.D. plus two times the anticipated movement to prevent binding. Provide Type SWS wall sleeves. In addition to submittal data requirements previously outlined, riser diagrams and calculations shall be submitted for approval. Calculations must show anticipated expansion and contraction at each support point, initial and final loads on the building structure, and spring deflection changes. Submittal data shall include certification that the piping system has been examined for excessive stresses and that none will exist in the design proposed.

3.3 INSTALLATION

- A. Comply with manufacturer’s instructions for the installation and load application of vibration isolation materials and products. Adjust to ensure that units do not exceed rated operating deflections or bottom out under loading, and are not short-circuited by other contacts or bearing points. Remove space blocks and similar devices (if any) intended for temporary protection against overloading during installation or shipment.
- B. Locate isolation hangers as near the overhead support structure as possible.
- C. Adjust leveling devices as required to distribute loading uniformly on isolators. Shim units as required where leveling devices cannot be used to distribute loading properly.
- D. Install isolated inertia base frames and steel bases on isolator units as indicated so that a minimum of one (1) inch clearance below base will result when supported equipment has been installed and loaded for operation.
- E. Install Work in accordance with ASME B31.9.
- F. Install flexible pipe connectors to equipment supported by vibration isolation. Provide line size flexible connectors.
- G. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end.
- H. Refer to Section 23 05 16 - Expansion Fittings and Loops for HVAC Piping.
- I. Contractor shall install load distribution plates provided by vibration isolation manufacturer on WSW type isolators. Plates shall be aligned with isolation pad.

EQUIPMENT ISOLATION SCHEDULE						
EQUIPMENT	LOCATION					
	ELEVATED STRUCTURE			SLAB ON GRADE		
	ISOLAT OR TYPE	MINIMUM DEFLECT ION (Inches)	BASE (1) TYPE	ISOLAT OR TYPE	MINIMUM DEFLECT ION (Inches)	BASE (1) TYPE

AIR HANDLING UNITS (NOTE 2)						
FLOOR MOUNTED	SLF	0.75	-	SLF	0.75	-
TO 15 HP	SLF	1.5	-	SLF	0.75	-
20 HP & OVER						
SUSPENDED	30N	1	-	30N	1	-
UP TO 15 HP	PC30N	1.75	-	PC30N	1	-
20 HP & OVER						
HIGH PRESSURE FAN SECTION (NOTE 1)	SLF/W	1.5	RBMK	SLF/W	0.75	RBMK
UP TO 30 HP	BI	2.5	RBMK	BI	1.5	RBMK
40 HP & OVER	SLF/W			SLF/W		
	BI			BI		
CENTRIFUGAL FANS						
CL. I & II UP TO 54-1/2" W.D.						
Up to 15 HP	SLF	0.75	WF	SLF	0.75	WF
20-50 HP	SLF	1.5	RBMK	SLF	0.75	WF
60 HP & OVER	SLF	2.5	RBMK	SLF	1.5	WF
CL. I & II 60" W.D. & OVER/ALL						
CL. III FANS UP TO 15 HP	SLF/W	1.5	RBMK	SLF/W	0.75	RBMK
20-50 HP	BI	2.5	RBMK	BI	1.5	RBMK
60 HP & OVER	SLF/W	2.5	RBMK	SLF/W	1.5	RBMK
	BI			BI		
	SLF/W			SLF/W		
	BI			BI		
AXIAL-FLOW FANS (NOTE 1)						
FLOOR MTD.						
UP TO 15 HP	SLF	0.75	-	SLF	0.75	-
20 HP & OVER	SLF	1.5	-	SLF	0.75	-
SUSPENDED (NOTE 1)						
UP TO 15 HO	30N	1	-	30N	1	-
20 HP & OVER	PC30N	1.75	WF	PC30N	1.5	-
VENT (UTILITY SETS)						
FLOOR MTD.	SLF	0.75	-	SLF	0.75	-
SUSPENDED	30N	1	-	30N	0.75	-
CABINET FANS, FAN SECTIONS (NOTE 1)						
CL. I & II UP TO 54-1/2" W.D.						
Up to 15 HP	SLF	0.75	-	SLF	0.75	-
20-50 HP	SLF	1.5	-	SLF	0.75	-
SUSPENDED						
UP TO 15 HP	30N	1	-	30N	0.75	-
20 HP & OVER	PC30N	1.75	-	30N	1.75	-
PUMPS						
FLOOR MTD. UP TO 60 HP	SLF	1.50	RBMK	SLF	0.75	RBMK
FLOOR MTD. 75 HP AND LARGER	SLF	2.50	RBMK	SLF	0.75	RBMK
SUSPENDED INLINE	PC30N	1.75	-	PC30N	1.75	-
REFRIGERATION UNITS						
RECIPROCATING	SLF	1.5	RBMK	SLF	0.75	RBMK
COMPRSSORS	SLR/IC	1.5	-	SLF	0.75	-
RECIPROCATING COND.	S	1.5	-	WSW	0.15	-
UNITS & CHILLERS	SLR	1.5	RBMK	WSW	0.15	-

HERMETIC CENTRIFUGALS OPEN CENTRIFUGALS ABSORPTION MACHINES	SLF SLR/IC S	0.75	-	WSW	0.15	-
AIR COMPRESSORS TANK TYPE (HORIZONTAL TANK)	SLF	1.5	-	SLF	0.75	-
TANK TYPE (VERTICAL TANK)	SLF	1.5	-	SLF	0.75	-
COOLING TOWERS & CLOSED CIRCUIT COOLERS UP TO 500 TONS	SLR	0.75	(1)	WSW	0.15	-
OVER 500 TONS	SLR	2.5	(1)	WSW	0.15	-
AIR COOLED CONDENSERS UP TO 50 TONS	SLR	0.75	(1)	WSW	0.15	-
OVER 50 TONS	SLR	1.5	(1)	WSW	0.15	-
ROOFTOP AIR CONDITIONING UNITS REQUIRING WEATHER SEAL	SLF	0.75	RSC/C	-	-	-
UP TO 5000 CFM (12 TON)	SLR	1.5	MAB	-	-	-
OVER 5000 CFM (12 TON)	SLR	1.5	RSC/C	-	-	-
OTHER TYPES UP TO 25 TONS	SLR	1.5	MAB	-	-	-
OVER 25 TONS			(1)	-	-	-
			(1)			
BOILER (PACKAGE TYPE) ALL SIZES	SLR	0.75		WSW	0.15	-
ENGINE DRIVEN GENERATORS UP TO 60 HP	SLR	1.5	RBMK	SLR	0.75	-
75 HP & OVER	SLR	2.5	RBMK	SLR	0.75	-

Notes:

1. Provide steel base type WF if equipment requires base frame or does not include integral base rail for vibration isolation.
2. Provide WSW isolator type with load distribution plate for floor mounted AHU's that are internally isolated. Isolation deflection and type specified refers to factory isolation requirements.

END OF SECTION

SECTION 23 05 53

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Nameplates.
 - 2. Tags.
 - 3. Stencils.
 - 4. Pipe markers.
 - 5. Ceiling tacks.
 - 6. Labels.
 - 7. Lockout devices.
 - 8. Pipe painting (if required)
- B. Related Sections:
 - 1. Section 09 91 00 - Painting and Staining.
- C. Color scheme for identification must be coordinated with district standards. Color scheme specified is bases of design if required for project. Contractor shall confirm painting requirements with Architect/District.

1.2 REFERENCES

- A. American Society of Mechanical Engineers:
 - 1. ASME A13.1 - Scheme for the Identification of Piping Systems.
 - 2. District Standards for identification and color scheme.

1.3 SUBMITTALS

- A. Product Data: Submit manufacturers catalog literature for each product required.
- B. Shop Drawings: Submit list of wording, symbols, letter size, and color coding for mechanical identification and valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- C. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- E. Identify painting requirements as directed by Architect/District. Contractor to confirm if painting of piping is required for project. Contractor shall provide primer coat on un-insulated outdoor condenser water piping as a minimum.

1.4 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of tagged valves; include valve tag numbers.

1.5 QUALITY ASSURANCE

- A. Conform to ASME A13.1 for color scheme for identification of piping systems and accessories.
- B. Conform to ANSI / OSHA Pipe Marking Specifications.
- C. Specification is not limited to manufacturers listed. Substitutions are allowed in accordance with Division 1 - General Requirements and Division 23, Section 23 05 00 - Common Work Results for HVAC.

1.6 QUALIFICATIONS

- A. Installer: Company specializing in performing Work of this section with minimum three (3) years experience.

PART 2 - PRODUCTS

2.1 NAMEPLATES

- A. Manufacturers:
 - 1. Craftmark Identification Systems.
 - 2. Safety Sign Co.
 - 3. Seton Identification Products.
 - 4. Almetek Industries.
- B. Product Description: Laminated three-layer plastic with engraved black letters on light contrasting background color.

2.2 TAGS

- A. Plastic Tags:
 - 1. Manufacturers:
 - a. Craftmark Identification Systems.
 - b. Safety Sign Co.
 - c. Seton Identification Products.
 - d. Almetek Industries.
 - 2. Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inches.
- B. Metal Tags:
 - 1. Manufacturers:
 - a. Craftmark Identification Systems.
 - b. Safety Sign Co.

- c. Seton Identification Products.
 - d. Almetek Industries.
 - 2. Brass with stamped letters; tag size minimum 1-1/2 inches diameter with finished edges.
- C. Information Tags:
 - 1. Manufacturers:
 - a. Craftmark Identification Systems.
 - b. Safety Sign Co.
 - c. Seton Identification Products.
 - d. Almetek Industries.
 - 2. Clear plastic with printed "Danger," "Caution," or "Warning" and message; size 3-1/4 x 5-5/8 inches with grommet and self-locking nylon ties.
- D. Tag Chart: Typewritten letter size list of applied tags and location in plastic laminated chart to indicate valve make, size, model and service.

2.3 STENCILS

- A. Manufacturers:
 - 1. Manufacturers:
 - a. Craftmark Identification Systems.
 - b. Safety Sign Co.
 - c. Seton Identification Products.
 - d. Almetek Industries.
- B. Stencils: With clean cut symbols and letters of following size:
 - 1. Up to two (2) inches Outside Diameter of Insulation or Pipe: 1/2 inch high letters.
 - 2. 2-1/2 to six (6) inches Outside Diameter of Insulation or Pipe: one (1) inch high letters.
 - 3. Over six (6) inches Outside Diameter of Insulation or Pipe: 1-3/4 inches high letters.
 - 4. Ductwork and Equipment: 1-3/4 inches high letters.
- C. Stencil Paint: As specified in Section 09 91 00 Paintings and Staining, semi-gloss enamel, colors and lettering size in conformance with ASME A13.1.

2.4 PIPE MARKERS

- A. Plastic Pipe Markers:
 - 1. Manufacturers:
 - a. Craftmark Identification Systems.
 - b. Safety Sign Co.

- c. Seton Identification Products.
 - d. Almetek Industries.
 - 2. Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering. Larger sizes may have maximum sheet size with spring fastener.
- B. Plastic Tape Pipe Markers:
 - 1. Manufacturers:
 - a. Craftmark Identification Systems.
 - b. Safety Sign Co.
 - c. Seton Identification Products.
 - d. Almetek Industries.
 - 2. Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.
- C. Plastic Underground Pipe Markers:
 - 1. Manufacturers:
 - a. Craftmark Identification Systems.
 - b. Safety Sign Co.
 - c. Seton Identification Products.
 - d. Almetek Industries.
 - 2. Bright colored continuously printed plastic ribbon tape, minimum six (6) inches wide by 4 mil thick, manufactured for direct burial service.

2.5 CEILING TACKS

- A. Manufacturers:
 - 1. Craftmark Identification Systems.
 - 2. Safety Sign Co.
 - 3. Seton Identification Products.
 - 4. Almetek Industries.
- B. Description: Steel with 3/4 inch diameter color-coded head.

2.6 LABELS

- A. Manufacturers:
 - 1. Craftmark Identification Systems.
 - 2. Safety Sign Co.
 - 3. Seton Identification Products.
 - 4. Almetek Industries.
- B. Description: Laminated Mylar, size 1.9 x 0.75 inches, adhesive backed with printed identification and bar code.

2.7 LOCKOUT DEVICES

- A. Lockout Hasps:
 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

1. Manufacturers:
 - a. Craftmark Identification Systems.
 - b. Safety Sign Co.
 - c. Seton Identification Products.
 - d. Almetek Industries.
 2. Reinforced nylon hasp with erasable label surface; size minimum 7-1/4 x 3 inches.
- B. Valve Lockout Devices:
1. Manufacturers:
 - a. Craftmark Identification Systems.
 - b. Safety Sign Co.
 - c. Seton Identification Products.
 - d. Almetek Industries.
 2. Nylon device preventing access to valve operator, accepting lock shackle.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Prepare surfaces in accordance with Section 09 91 00 Paintings and Staining for stencil painting.

3.2 INSTALLATION

- A. Apply stencil painting in accordance with Section 09 91 00 Paintings and Staining.
- B. Install identifying devices after completion of coverings and painting.
- C. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive.
- D. Install labels with sufficient adhesive for permanent adhesion and seal with clear lacquer. For unfinished canvas covering, apply paint primer before applying labels.
- E. Install tags using corrosion resistant chain or 4 ply 0.018 smooth copper wire. Tags shall be numerically sequenced with all valves of each system type grouped together.
- F. Install underground plastic pipe markers six (6) to eight (8) inches below finished grade, directly above buried pipe.
- G. All exterior visible piping shall be identified with UV and acid resistant outdoor pipe markers.
- H. Identify air handling units, pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates. Identify in-line pumps and other small devices with tags.
- I. Identify control panels and major control components outside panels with plastic nameplates.

- J. Identify air terminal units and radiator valves with numbered tags.
- K. Tag automatic controls, instruments, and relays. Key to control schematic.
- L. Identify insulated piping, concealed or exposed indoor with plastic tape pipe markers. Use tags on piping 3/4 inch diameter and smaller. Use plastic pipe UV protected markers on exterior piping. Identify service and flow direction. Install in clear view and align with axis of piping. Locate identification at every 20 feet on center for straight runs including risers and drops. Locate identification adjacent to each valve and tee, at each side of penetration of wall or enclosure, and at each obstruction.
- M. Provide ceiling tacks to locate valves or dampers above T-bar type panel ceilings. Locate in corner of panel closest to equipment. Coordinate with Architect.
- N. Identify un-insulated piping with plastic pipe markers. Locate identification at every 20 feet on center for straight runs including risers and drops. Locate identification adjacent to each valve and tee, at each side of penetration of wall or enclosure, and at each obstruction.

3.3 IDENTIFICATION SCHEDULE

- A. Markers shall be colored as indicated below per ANSI/OSHA Standards OR as specified in District Standards:

SYSTEM	COLOR	LEGEND
Chilled Water	Green	Chilled Water Supply Chilled Water Return
Domestic Water	Green	Domestic Water
Domestic Hot Water Supply	Yellow	Domestic Hot Water Supply
Domestic Hot Water Return	Yellow	Domestic Hot Water Return
Fire Protection	Red	Fire Protection
Automatic Sprinkler	Red	Fire Sprinkler
Gas	Yellow	Natural Gas
Condenser Water	Green	Condenser Water Supply Condenser Water Return

B. PIPE PAINTING:

- 1. All piping exposed to view in conditioned spaces shall be painted as indicated or as directed by the Architect in the field. Confirm all color selections and painting requirements with Architect/District prior to installation.
- 2. The entire fire protection piping system shall be painted red.

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

3. All outdoor un-insulated piping shall be painted with primer as a minimum.
4. All piping located in mechanical rooms and outdoor piping shall be painted as indicated in Painting Schedule. Painting requirement must be confirmed by contractor.

C. PAINTING SCHEDULE

SYSTEM	COLOR
Storm Sewer	White
Sanitary Sewer Waste and Vent	Light Gray
Domestic Cold Water	Dark Blue
Domestic Hot Water Supply and Return	Orange
Condenser Water Supply and Return	Light Green
Gas	Yellow
Chilled Water Supply and Return	Light Blue
Heating Hot Water supply and Return	Reddish Orange

END OF SECTION

SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING FOR HVAC

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Testing, adjusting, and balancing of air systems.
 - 2. Testing, adjusting, and balancing of Hydronic piping systems
 - 3. Testing, adjusting, and balancing of refrigerating systems.
 - 4. Measurement of final operating condition of HVAC systems.
 - 5. Sound measurement of equipment operating conditions.
 - 6. Vibration measurement of equipment operating conditions.
- B. Related Sections:
 - 1. Sequences of operation for HVAC equipment as scheduled on Drawings.
- C. Testing, Adjusting and Balancing (TAB) contractor shall bid work specified under this section direct to Owner. TAB contractor shall not be hired by general contractor or any sub-contractor.
- D. Mechanical contractor is responsible for coordinating work with the TAB Contractor. Mechanical contractor requirements are specified herein.
- E. TAB Contractors:
 - 1. Engineered Air Balance
 - 2. Precision Air

1.2 REFERENCES

- A. Associated Air Balance Council:
 - 1. AABC MN-1 - National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems.
- B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
 - 1. ASHRAE 111 - Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning and Refrigeration Systems.
- C. Natural Environmental Balancing Bureau:
 - 1. NEBB - Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.

1.3 SUBMITTALS

- A. Agency Data: Submit proof that the proposed testing, adjusting, and balancing agency meets the qualifications specified below.
- B. Engineer and Technicians Data: Submit proof that the Test and Balance Engineer assigned to supervise the procedures, and the technicians proposed to perform the procedures meet the qualifications specified below.
- C. Procedures and Agenda: Submit a synopsis of the testing, adjusting and balancing procedures and agenda proposed to be used for this project.
- D. Sample Forms: Submit sample forms, if other than those standard forms, if other than those standard forms prepared by the Associated Air Balance Council (AABC) or National Environmental Balancing Bureau (NEBB) are proposed.
- E. Certified Reports: Submit testing, adjusting, and balancing reports bearing the seal and signature of the Test and Balance Engineer. The reports shall be certified proof that the systems have been tested, adjusted, and balanced in accordance with the referenced standards; are an accurate representation of how the systems have been installed; are a true representation of how the systems are operating at the completion of the testing, adjusting, and balancing procedures; and are an accurate record of all final quantities measured, to establish normal operating values of the systems. Follow the procedures and format specified below:
 - 1. Draft Reports: Upon completion of testing, adjusting and balancing procedures, prepare draft reports on the approved forms. Draft reports may be hand written, but must be complete, factual, accurate, and legible. Organize and format draft reports in the same manner specified for the final reports. Submit two (2) complete sets of draft reports. Only one (1) complete set of draft reports will be returned.
 - 2. Final Report: Upon verification and approval of draft reports, prepare final reports, type written, and organized and formatted as specified below. Submit two (2) complete sets of final reports.
 - 3. Report Format: Report forms shall be those standard forms prepared by the referenced standard for each respective item and system to be tested, adjusted, and balanced. Bind report forms complete with schematic systems diagrams and other data in reinforced, vinyl, three-ring binder. Provide binding edge labels with the project identification and a title descriptive of the contents. Divide the contents of the binder into the below listed divisions, separated by divider tabs.
 - a. General Information and Summary
 - b. Air Systems
 - c. Refrigerant Systems
 - d. Temperature Control Systems
 - e. Special Systems.
 - 4. Report Contents: Provide the following minimum information, forms and data:
 - a. General Information and Summary: Inside cover sheet to identify testing, adjusting, and balancing agency, the Company, Engineer, and Project. Include addresses, and contact names and telephone numbers. Also

include a certification sheet containing the seal name address, telephone number, and signature of the Certified Test and Balance Engineer. Include in this division a listing of the instrumentations used for the procedures along with the proof of calibration.

- b. The remainder of the report shall contain the appropriate forms containing as a minimum, the information indicated on the standard report forms prepared by the AABC or NEBB, for each respective item and system. Prepare a schematic diagram for each item of equipment and system to accompany each respective report form.
- c. Calibration Reports: Submit proof that all required instrumentation has been calibrated to tolerances specified in the referenced standards, within a period of six (6) months prior to starting the project.

1.4 QUALITY ASSURANCE

- A. Test and Balance Engineer's Qualifications: A Professional Engineers registered in the State in which the services are to be performed, and having at least three (3) years of successful testing, adjusting, and balancing experience on projects with testing and balancing requirements similar to those required for this project.
- B. Agency Qualifications:
 1. Employ the services of an independent testing, adjusting, and balancing agency meeting the qualifications specified below, to be the single source of responsibility to the test, adjust, and balance the building mechanical systems identified above, to produce the design objectives. Services shall include checking installations for conformity to design, measurement and establishment of the fluid quantities of the mechanical systems as required to meet design specifications, and recording and reporting the results.
 2. The independent testing, adjusting, and balancing agency certified by National Environmental Balancing Bureau (NEBB) or by the Associated Air Balance Council (AABC) in those testing and balancing disciplines required for this project, and having at least one Professional Engineer registered in the State in which the services are to be performed, certified by NEBB or AABC as a Test and Balance Engineer.
- C. Codes and Standards
 1. NEBB: "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."
 2. AABC: "National Standards for Total System Balance."
 3. American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE) ASHRAE Handbook, 1999 HVAC Applications Volume, Chapter 36, Testing, Adjusting, and Balancing.
- D. Pre-Balancing Conference: Prior to beginning of testing, adjusting, and balancing procedures, schedule and conduct a conference with the Engineer and representatives of installers of the mechanical systems. The objective of the conference is final

coordination and verification of the system operation and readiness for testing, adjusting, and balancing.

1.5 PROJECT CONDITIONS

- A. Systems Operation: Systems shall be fully operational prior to beginning procedures.

1.6 SEQUENCING AND SCHEDULING

- A. Test, adjust, and balance the air systems before hydronic, steam, and refrigerant systems.
- B. Test, adjust and balance air conditioning systems during summer season and heating systems during winter season, including at least a period of operation at outside conditions within five (5) degrees Fahrenheit wet bulb temperature of maximum summer design condition, and within ten (10) degrees Fahrenheit dry bulb temperature of minimum winter design condition. Take final temperature reading during seasonal operation.
- C. Notice: Provide minimum 7 days advanced notice for each test. Include scheduled test dates and times.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.1 SERVICES OF THE MECHANICAL CONTRACTOR

- A. Examine the contract documents to become familiar with Project requirements and to discover conditions in systems design that may preclude proper TAB of systems and equipment.
- B. Examine the approved submittals for HVAC systems and equipment.
- C. Verify systems are complete and operable before commencing work. Verify the following:
 - 1. Systems are started and operating in safe and normal condition.
 - 2. Temperature control systems are installed complete and operable.
 - 3. Proper thermal overload protection is in place for electrical equipment.
 - 4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
 - 5. Duct systems are clean of debris.
 - 6. Fans are rotating correctly.
 - 7. Fire and volume dampers are in place and open.
 - 8. Air coil fins are cleaned and combed.
 - 9. Access doors are closed and duct end caps are in place.
 - 10. Air outlets are installed and connected.
 - 11. Duct system leakage is minimized.
 - 12. Hydronic systems are flushed, filled, and vented.

13. Pumps are rotating correctly.
 14. Proper strainer baskets are clean and in place or in normal position.
 15. Service and balancing valves are open.
 16. Re-sheave
- D. Contractor shall provide all volume dampers, balancing dampers, balancing valves, test ports and Pete's plugs as required by the Testing and Balancing Firm. Contractor shall furnish a set of sheet metal shop drawings and HVAC piping drawings to the Testing and Balancing Firm during the submittal phase and incorporate the Testing and Balancing Firm's mark-ups and requests into the project. Contractor shall provide all required equipment to facilitate Testing and Balancing Firm's work. This coordination shall be included in the Contractor's base bid price.
- E. Provide, correct, repair or replace deficient items or conditions found during the testing and balancing.
- F. Provide replacement sheaves as directed by TAB Contractor to achieve scheduled air volumes.
- G. For motors with a variable frequency drive, contractor shall provide belt and sheave adjustment such that units deliver their design cfm when speed drive is at 60 hertz.

3.2 SERVICES OF THE TESTING AND BALANCING CONTRACTOR

- A. Furnish instruments required for testing, adjusting, and balancing operations.
- B. Make instruments available to Architect/Engineer to facilitate spot checks during testing.
- C. Complete system-readiness checks and prepare reports. Verify the following:
1. Permanent electrical-power wiring is complete.
 2. Hydronic systems are filled, clean, and free of air.
 3. Automatic temperature-control systems are operational.
 4. Equipment and duct access doors are securely closed.
 5. Balance, smoke, and fire dampers are open.
 6. Isolating and balancing valves are open and control valves are operational.
 7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
 8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 INSTALLATION TOLERANCES

- A. Set HVAC system's air flow rates and water flow rates within the following tolerances:
1. Supply, Return, and Exhaust fans and Equipment with Fans: +/- 5%
 2. Air Outlets and Inlets: +/- 5%
 3. Heating-Water Flow Rate: +/- 5%
 4. Cooling-Water Flow Rate: +/- 5%

3.4 ADJUSTING

- A. Verify recorded data represents actual measured or observed conditions.
- B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- C. After adjustment, take measurements to verify balance has not been disrupted. If disrupted, verify correcting adjustments have been made.
- D. Report defects and deficiencies noted during performance of services, preventing system balance.
- E. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

3.5 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Adjust air handling and distribution systems to obtain required or design supply, return, and exhaust air quantities.
- B. Make air quantity measurements in main ducts by Pitot tube traverse of entire cross sectional area of duct.
- C. Measure air quantities at air inlets and outlets.
- D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts.
- E. Use volume control devices to regulate air quantities only to extent adjustments do not create objectionable air motion or sound levels. Effect volume control by using volume dampers located in ducts.
- F. Vary total system air quantities by adjustment of fan speeds. Provide sheave drive changes to vary fan speed. Vary branch air quantities by damper regulation.
- G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.
- H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across fan. Make allowances for 50 percent loading of filters.
- I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
- J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
- K. Measure building static pressure and adjust supply, return, and exhaust air systems to obtain required relationship between each to maintain approximately 0.05 inches positive static pressure near building entries in clean rooms.

3.6 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
 - 1. Measure total airflow.
 - a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.
 - 2. Measure fan static pressures as follows to determine actual static pressure:
 - a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
 - b. Measure static pressure directly at the fan outlet or through the flexible connection.
 - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
 - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
 - 3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
 - a. Report the cleanliness status of filters and the time static pressures are measured.
 - 4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
 - 5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
 - 6. Obtain approval from construction manager for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
 - 7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.

1. Measure airflow of submain and branch ducts.
 - a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
 2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
 3. Re-measure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
- C. Measure air outlets and inlets without making adjustments.
1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
- D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.
1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
 2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.7 PROCEDURES FOR DUAL-DUCT SYSTEMS

- A. Verify that the cooling coil is capable of full-system airflow, and set mixing boxes at full-cold airflow position for fan volume.
- B. Measure static pressure in both hot and cold ducts at the end of the longest duct run to determine that sufficient static pressure exists to operate controls of mixing boxes and to overcome resistance in the ducts and outlets downstream from mixing boxes.
1. If insufficient static pressure exists, increase airflow at the fan.
- C. Test and adjust the constant-volume mixing boxes as follows:
1. Verify both hot and cold operations by adjusting the thermostat and observing changes in air temperature and volume.
 2. Verify sufficient inlet static pressure before making volume adjustments.
 3. Adjust mixing boxes to indicated airflows within specified tolerances. Measure airflow by Pitot-tube traverse readings or by measuring static pressure at mixing-box taps if provided by mixing-box manufacturer.
- D. Do not over pressurize ducts.

- E. Re-measure static pressure in both hot and cold ducts at the end of the longest duct run to determine that sufficient static pressure exists to operate controls of mixing boxes and to overcome resistance in the ducts and outlets downstream from mixing boxes.
- F. Adjust variable-air-volume, dual-duct systems in the same way as constant-volume, dual-duct systems; adjust maximum- and minimum-airflow setting of each mixing box.

3.8 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 minimum set-point airflow with the remainder at maximum-airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.
- B. **Pressure-Independent, Variable-Air-Volume Systems:** After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
 - 1. Set outdoor-air dampers at minimum, and set return- and exhaust-air dampers at a position that simulates full-cooling load.
 - 2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
 - 3. Measure total system airflow. Adjust to within indicated airflow.
 - 4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
 - 5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.
 - a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.
 - 6. Re-measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
 - b. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.
 - 7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
 - 8. Record final fan-performance data.

- C. Pressure-Dependent, Variable-Air-Volume Systems without Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Balance variable-air-volume systems the same as described for constant-volume air systems.
 2. Set terminal units and supply fan at full-airflow condition.
 3. Adjust inlet dampers of each terminal unit to indicated airflow and verify operation of the static-pressure controller. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
 4. Readjust fan airflow for final maximum readings.
 5. Measure operating static pressure at the sensor that controls the supply fan if one is installed, and verify operation of the static-pressure controller.
 6. Set supply fan at minimum airflow if minimum airflow is indicated. Measure static pressure to verify that it is being maintained by the controller.
 7. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.
 - a. If air outlets are out of balance at minimum airflow, report the condition but leave the outlets balanced for maximum airflow.
 8. Measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
 - a. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.
- D. Pressure-Dependent, Variable-Air-Volume Systems with Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Set system at maximum indicated airflow by setting the required number of terminal units at minimum airflow. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.
 2. Adjust supply fan to maximum indicated airflow with the variable-airflow controller set at maximum airflow.
 3. Set terminal units at full-airflow condition.
 4. Adjust terminal units starting at the supply-fan end of the system and continuing progressively to the end of the system. Adjust inlet dampers of each terminal unit to indicated airflow. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
 5. Adjust terminal units for minimum airflow.

6. Measure static pressure at the sensor.
7. Measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.

3.9 PROCEDURES FOR MULTIZONE SYSTEMS

- A. Set unit at maximum airflow through the cooling coil.
- B. Adjust each zone's balancing damper to achieve indicated airflow within the zone.

3.10 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 the 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 liquid level in expansion tank.
 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.

3.11 PROCEDURES FOR CONSTANT-FLOW 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.

- a. If impeller sizes must be adjusted to achieve pump performance, obtain approval from Owner/Engineer and comply with requirements in "Hydronic Pump Specification."
2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.
 - b. Monitor motor performance during procedures and do not operate motors in overload conditions.
3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on 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 10 percent of design.
- B. Measure flow at all automatic flow control valves to verify that valves are functioning as designed.
- C. Measure flow at all pressure-independent characterized control valves, with valves in fully open position, to verify that valves are functioning as designed.
- D. Set calibrated balancing valves, if installed, at calculated pre-settings.
- E. 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.
- F. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.
- G. Adjust balancing stations to within specified tolerances of indicated 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.
- H. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.
- I. Measure the differential-pressure-control-valve settings existing at the conclusion of balancing.

- J. Check settings and operation of each safety valve. Record settings.

3.12 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.

3.13 PROCEDURES FOR PRIMARY-SECONDARY HYDRONIC SYSTEMS

- A. Balance the primary circuit flow first and then balance the secondary circuits.

3.14 PROCEDURES FOR DOMESTIC HOT WATER SYSTEMS

- A. The test and balance contractor shall provide testing, adjusting and balancing of the hot water system, once the system is fully installed and operational. Preliminary and final reports shall be prepared and issued to the General Contractor, Architect and Engineer.
- B. Preparation of the hot water system for balancing:
 - 1. Confirm outlet temperature of the system at water heaters and/or storage tanks.
 - 2. Verify recirculation pump operation and rotation.
 - 3. Confirm/adjust setpoint of each individual riser balancing valve to flow a minimum of 0.5 gpm or as otherwise noted on the documents.
- C. The test and balance report shall indicate the following:
 - 1. Pressure, temperature and flow in gpm at the discharge side of each balancing valve referencing the valve tag number.
 - 2. Pressure, temperature and flow in gpm at the suction side of each circulating pump.

3.15 PROCEDURES FOR HEAT EXCHANGERS

- A. Measure water flow through all circuits.
- B. Adjust water flow to within specified tolerances.
- C. Measure inlet and outlet water temperatures.
- D. Measure inlet steam pressure.
- E. Check settings and operation of safety and relief valves. Record settings.

3.16 PROCEDURES FOR MOTORS

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
 - 1. Manufacturer's name, model number, and serial number.
 - 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 of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.17 PROCEDURES FOR CHILLERS

- A. Balance water flow through each evaporator and condenser to within specified tolerances of indicated flow with all pumps operating. With only one chiller operating in a multiple chiller installation, do not exceed the flow for the maximum tube velocity recommended by the chiller manufacturer. Measure and record the following data with each chiller operating at design conditions:
1. Evaporator-water entering and leaving temperatures, pressure drop, and water flow.
 2. For water-cooled chillers, condenser-water entering and leaving temperatures, pressure drop, and water flow.
 3. Evaporator and condenser refrigerant temperatures and pressures, using instruments furnished by chiller manufacturer.
 4. Power factor if factory-installed instrumentation is furnished for measuring kilowatts.
 5. Kilowatt input if factory-installed instrumentation is furnished for measuring kilowatts.
 6. Capacity: Calculate in tons of cooling.
 7. For air-cooled chillers, verify condenser-fan rotation and record fan and motor data including number of fans and entering- and leaving-air temperatures.

3.18 PROCEDURES FOR COOLING TOWERS

- A. A complete Factory CTI certified test of the cooling tower will be performed at the expense of the cooling tower manufacturer. A copy of this test (provided by others) shall be included in the final TAB report. Balance the flow over and through bypass connections of the tower.

3.19 PROCEDURES FOR CONDENSING UNITS

- A. Verify proper rotation of fans.
- B. Measure entering- and leaving-air temperatures.
- C. Record compressor data.

3.20 PROCEDURES FOR BOILERS

- A. Hydronic Boilers: Measure and record entering- and leaving-water temperatures and water flow.

3.21 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. Verify the following:
 - 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 and the face velocity of filters and coils.
 - 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 air flow rates and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated

rates. If increase or decrease is 5 percent or less, equipment adjustments are not required.

4. Balance each air outlet.

3.22 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
 1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
 2. Include a list of instruments used for procedures, along with proof of calibration.
- B. Final Report Contents: In addition to certified field-report data, include the following:
 1. Pump curves.
 2. Fan curves.
 3. Manufacturers' test data.
 4. Field test reports prepared by system and equipment installers.
 5. Other information relative to equipment performance; do not include Shop Drawings and product data.
- C. General Report Data: In addition to form titles and entries, include the following data:
 1. Title page.
 2. Name and address of the TAB contractor.
 3. Project name.
 4. Project location.
 5. Architect's name and address.
 6. Engineer's name and address.
 7. Contractor's name and address.
 8. Report date.
 9. Signature of TAB supervisor who certifies the report.
 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 11. Summary of contents including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
 12. Nomenclature sheets for each item of equipment.
 13. Data for terminal units, including manufacturer's name, type, size, and fittings.
 14. Notes to explain why certain final data in the body of reports vary from indicated values.
 15. Test conditions for fans and pump performance forms including the following:
 - a. Settings for outdoor-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.

- d. Face and bypass damper settings at coils.
 - e. Fan drive settings including settings and percentage of maximum pitch diameter.
 - f. Inlet vane settings for variable-air-volume systems.
 - g. Settings for supply-air, static-pressure controller.
 - h. Other system operating conditions that affect performance.
- D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
 1. Quantities of outdoor, supply, return, and exhaust airflows.
 2. Water and steam flow rates.
 3. Duct, outlet, and inlet sizes.
 4. Pipe and valve sizes and locations.
 5. Terminal units.
 6. Balancing stations.
 7. Position of balancing devices.
- E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:
 1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Unit arrangement and class.
 - g. Discharge arrangement.
 - h. Sheave make, size in inches, and bore.
 - i. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 - j. Number, make, and size of belts.
 - k. Number, type, and size of filters.
 2. Motor Data:
 - a. Motor make, and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches, and bore.
 - f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 3. Test Data (Indicated and Actual Values):
 - a. Total air flow rate in cfm (L/s).
 - b. Total system static pressure in inches wg (Pa).
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg (Pa).
 - e. Filter static-pressure differential in inches wg (Pa).
 - f. Preheat-coil static-pressure differential in inches wg (Pa).
 - g. Cooling-coil static-pressure differential in inches wg (Pa).

- h. Heating-coil static-pressure differential in inches wg (Pa).
- i. Outdoor airflow in cfm (L/s).
- j. Return airflow in cfm (L/s).
- k. Outdoor-air damper position.
- l. Return-air damper position.
- m. Vortex damper position.

F. Apparatus-Coil Test Reports:

1. Coil Data:

- a. System identification.
- b. Location.
- c. Coil type.
- d. Number of rows.
- e. Fin spacing in fins per inch o.c.
- f. Make and model number.
- g. Face area in sq. ft
- h. Tube size in NPS (DN).
- i. Tube and fin materials.
- j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):

- a. Air flow rate in cfm (L/s).
- b. Average face velocity in fpm (m/s).
- c. Air pressure drop in inches wg (Pa).
- d. Outdoor-air, wet- and dry-bulb temperatures in deg F (deg C).
- e. Return-air, wet- and dry-bulb temperatures in deg F (deg C).
- f. Entering-air, wet- and dry-bulb temperatures in deg F (deg C).
- g. Leaving-air, wet- and dry-bulb temperatures in deg F (deg C).
- h. Water flow rate in gpm (L/s).
- i. Water pressure differential in feet of head or psig (kPa).
- j. Entering-water temperature in deg F (deg C).
- k. Leaving-water temperature in deg F (deg C).
- l. Refrigerant expansion valve and refrigerant types.
- m. Refrigerant suction pressure in psig (kPa).
- n. Refrigerant suction temperature in deg F (deg C).
- o. Inlet steam pressure in psig (kPa).

G. Gas Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:

1. Unit Data:

- a. System identification.
- b. Location.
- c. Make and type.
- d. Model number and unit size.
- e. Manufacturer's serial number.
- f. Fuel type in input data.
- g. Output capacity in Btu/h (kW).
- h. Ignition type.
- i. Burner-control types.

- j. Motor horsepower and rpm.
 - k. Motor volts, phase, and hertz.
 - l. Motor full-load amperage and service factor.
 - m. Sheave make, size in inches, and bore.
 - n. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 - 2. Test Data (Indicated and Actual Values):
 - a. Total air flow rate in cfm (L/s).
 - b. Entering-air temperature in deg F.
 - c. Leaving-air temperature in deg F.
 - d. Air temperature differential in deg F.
 - e. Entering-air static pressure in inches wg (Pa).
 - f. Leaving-air static pressure in inches wg (Pa).
 - g. Air static-pressure differential in inches wg (Pa).
 - h. Low-fire fuel input in Btu/h (kW).
 - i. High-fire fuel input in Btu/h (kW).
 - j. Manifold pressure in psig (kPa).
 - k. High-temperature-limit setting in deg F.
 - l. Operating set point in Btu/h (kW).
 - m. Motor voltage at each connection.
 - n. Motor amperage for each phase.
 - o. Heating value of fuel in Btu/h (kW).
- H. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:
- 1. Unit Data:
 - a. System identification.
 - b. Location.
 - c. Coil identification.
 - d. Capacity in Btu/h (kW).
 - e. Number of stages.
 - f. Connected volts, phase, and hertz.
 - g. Rated amperage.
 - h. Air flow rate in cfm.
 - i. Face area in sq. ft.
 - j. Minimum face velocity in fpm.
 - 2. Test Data (Indicated and Actual Values):
 - a. Heat output in Btu/h (kW).
 - b. Air flow rate in cfm.
 - c. Air velocity in fpm.
 - d. Entering-air temperature in deg F.
 - e. Leaving-air temperature in deg F.
 - f. Voltage at each connection.
 - g. Amperage for each phase.
- I. Fan Test Reports: For supply, return, and exhaust fans, include the following:
- 1. Fan Data:

- a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and size.
 - e. Manufacturer's serial number.
 - f. Arrangement and class.
 - g. Sheave make, size in inches, and bore.
 - h. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 2. Motor Data:
 - a. Motor make, and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches, and bore.
 - f. Center-to-center dimensions of sheave, and amount of adjustments in inches .
 - g. Number, make, and size of belts.
 3. Test Data (Indicated and Actual Values):
 - a. Total airflow rate in cfm.
 - b. Total system static pressure in inches wg (Pa).
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg (Pa).
 - e. Suction static pressure in inches wg (Pa).
- J. 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 (Pa).
 - e. Duct size in inches.
 - f. Duct area in sq. ft..
 - g. Indicated air flow rate in cfm.
 - h. Indicated velocity in fpm.
 - i. Actual air flow rate in cfm.
 - j. Actual average velocity in fpm.
 - k. Barometric pressure in psig (Pa).
- K. Air-Terminal-Device Reports:
 1. Unit Data:
 - a. System and air-handling unit identification.
 - b. Location and zone.
 - c. Apparatus used for test.

- d. Area served.
 - e. Make.
 - f. Number from system diagram.
 - g. Type and model number.
 - h. Size.
 - i. Effective area in sq. ft.
 2. Test Data (Indicated and Actual Values):
 - a. Air flow rate in cfm.
 - b. Air velocity in fpm.
 - c. Preliminary air flow rate as needed in cfm.
 - d. Preliminary velocity as needed in fpm.
 - e. Final air flow rate in cfm.
 - f. Final velocity in fpm.
 - g. Space temperature in deg F.
- L. 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. Air flow rate in cfm (L/s).
 - b. Entering-water temperature in deg F.
 - c. Leaving-water temperature in deg F.
 - d. Water pressure drop in feet of head or psig (kPa).
 - e. Entering-air temperature in deg F.
 - f. Leaving-air temperature in deg F.
- M. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:
 1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Service.
 - d. Make and size.
 - e. Model number and serial number.
 - f. Water flow rate in gpm.
 - g. Water pressure differential in feet of head or psig (kPa).
 - h. Required net positive suction head in feet of head or psig (kPa).
 - i. Pump rpm.
 - j. Impeller diameter in inches.
 - k. Motor make and frame size.
 - l. Motor horsepower and rpm.

- m. Voltage at each connection.
- n. Amperage for each phase.
- o. Full-load amperage and service factor.
- p. Seal type.

2. Test Data (Indicated and Actual Values):

- a. Static head in feet of head or psig (kPa).
- b. Pump shutoff pressure in feet of head or psig (kPa).
- c. Actual impeller size in inches.
- d. Full-open flow rate in gpm.
- e. Full-open pressure in feet of head or psig (kPa).
- f. Final discharge pressure in feet of head or psig (kPa).
- g. Final suction pressure in feet of head or psig (kPa).
- h. Final total pressure in feet of head or psig (kPa).
- i. Final water flow rate in gpm.
- j. Voltage at each connection.
- k. Amperage for each phase.

N. Vibration Test:

1. Location of points:

- a. Fan bearing, drive end
- b. Fan bearing, opposite end
- c. Motor bearing, center (when applicable)
- d. Motor bearing, drive end
- e. Motor bearing, opposite end
- f. Casing (bottom or top)
- g. Casing (side)
- h. Duct after flexible connection (discharge)
- i. Duct after flexible connection (suction)

2. Test readings:

- a. Horizontal, velocity and displacement
- b. Vertical, velocity and displacement
- c. Axial, velocity and displacement
- d. Normally acceptable readings, velocity and acceleration
- e. Unusual conditions at time of test
- f. Vibration source (when non-complying)

O. Instrument Calibration Reports:

1. Report Data:

- a. Instrument type and make.
- b. Serial number.
- c. Application.
- d. Dates of use.
- e. Dates of calibration.

END OF SECTION

SECTION 23 07 13

DUCT INSULATION

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Insulation systems for sheet metal duct conveying cold, hot and grease latent air.

1.2 SYSTEM DESCRIPTION

- A. Design Requirements: Provide duct insulation systems which have been manufactured, fabricated and installed to meet all thermal requirements of mechanical systems. Insulating systems shall be installed in strict accordance with manufacturer's field requirements and the current International Energy Conservation Code including all local amendments and criteria specified herein.
- B. Performance Requirements: Provide duct insulation systems which have been manufactured and installed to meet the following standards:
- C.
 - 1. NFPA 90A.
 - 2. NFPA 90B.
 - 3. UL 723, ASTM E84: Flamespread 25, smoke developed 50.
 - 4. ASTM C1136: 150 degrees F.
 - 5. ASTM C1290.
 - 6. UL 181 for Class I Air Duct.
 - 7. NAIMA AHS-152T.

1.3 SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. When manufacturer's cut sheets apply to a product series rather than a specific product, clearly indicate applicable data by **highlighting** or by other means. Clearly reference covered specification and drawing on each submittal. General catalogs shall not be accepted as cut sheets to fulfill submittal requirements. Select and show specific pertinent performance data and quantities appropriate to scope of work
- C. Submit manufacturer's product data and installation instructions.
- D. Provide drawings indicating typical duct insulation details, thickness and location. Identify areas and required insulation.
- E. Manufacturer's certificate that products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Utilize an installer having demonstrated five (5) years experience on projects of similar size and complexity.

- B. Condensation on any insulated system is not acceptable. Contractor shall replace insulation deemed unacceptable due to exposure to condensation at no additional cost to project.
- C. Insulation to provide minimum R-value in accordance with current International Energy Conservation Code including all local amendments and criteria specified herein.

1.5 DELIVERY, STORAGE & HANDLING

- A. Deliver insulation materials in manufacturer's original, unopened containers with identification labels intact.
- B. Contractor shall adequately protect insulation from damage after delivery to the project. Materials shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.
- C. Do not deliver materials to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Fiber Glass Insulation:
 - 1. Owens Corning
 - 2. Johns Manville
 - 3. Knauf Fiber Glass
 - 4. Certainteed Insulations
- B. Mastics, Adhesives and Mesh:
 - 1. Childers
 - 2. Foster
 - 3. Vimasco
- C. Fire Wrap Insulation:
 - 1. 3M Fire Barrier Duct Wrap
 - 2. Vesuvius Pyroscat Duct Wrap
 - 3. Unifrax Corporation

2.2 DUCT WRAP

- A. Material: Resilient blanket of fiberglass insulation factory laminated to foil/kraft vapor retarder facing.
- B. Density: 0.75 pounds per cubic foot.
- C. Installed minimum R value: 8.3.
- D. Nominal Thickness: 3.0 inches.
- E. Installed Thickness: 2-1/4 inches.
- F. Operating Temperature (ASTM C411): up to 250° Fahrenheit.
- G. Insulation Jacket Temperature Limit (ASTM C1136): up to 150° Fahrenheit.
- H. Water Vapor Sorption (ASTM C1104): < 3 percent by weight at 120° Fahrenheit, 95% RH.
- I. Fungi Resistance (ASTM 665): Comply with requirements.
- J. Bacteria Resistance (ASTM G22): Comply with requirements.
- K. Thermal Conductivity: $k = 0.27$
- L. Surface Burning Characteristics (ASTM E84): Flamespread 25, smoke developed 50.

2.3 ACOUSTICAL FLEXIBLE DUCT LINER:

- A. Material: Flexible blanket of glass fibers with a tough, fire-resistant anti-microbial, acrylic coating on the airstream side to resist damage during installation and in service.
- B. Density: 1.0 pounds per cubic foot.
- C. Nominal Thickness: 1-1/4 inches.
- D. Material Standards: Comply with NFPA 90A, NFPA 90B, and ASTM C1071.
- E. Operating Temperature (ASTM C411): 250 degrees Fahrenheit.
- F. Maximum Air Velocity (UL 181): 6000 ft/m.
- G. Water Vapor Sorption (ASTM C1104): < 3 percent by weight at 120 degrees Fahrenheit, 95 percent RH.
- H. Fungi Resistance (ASTM G21): Comply with requirements.
- I. Bacteria Resistance (ASTM G22): Comply with requirements.
- J. Corrosiveness (ASTM C665): Will not cause corrosion greater than that caused by sterile cotton on aluminum or steel.
- K. Thermal Conductivity k , (ASTM C518): 0.27
- L. Surface Burning Characteristics (UL 723/ULC-S102-M): Flamespread 25, Smoke developed 50.

2.4 ACOUSTICAL RIGID DUCT LINER

- A. Material: Acoustical insulation applied to interior of sheet metal ducts. Semi-rigid board of glass fibers with a tough, fire-resistant, anti-microbial, acrylic coating on the airstream side. Factory applied edge coating. Duct liner for rectangular and round duct as required.
- B. Density: 3 pounds per cubic foot.
- C. Nominal Thickness: 1-1/2 inch.
- D. Material Standards: Comply with NFPA 90A, NFPA 90B, and ASTM C1071.
- E. Water Vapor Sorption (ASTM C1104): < 3 percent by weight at 120 degrees Fahrenheit, 95 percent RH.
- F. Fungi Resistance (ASTM C1338): Comply with requirements.
- G. Bacteria Resistance (ASTM G22): Comply with requirements.
- H. Corrosiveness (ASTM C665): Will not cause corrosion greater than that caused by sterile cotton on aluminum or steel.
- I. Thermal Conductivity, k: 0.16.
- J. Surface Burning Characteristics (UL 723/ULC-S102-M): Flamespread 25, smoke developed 50.

2.5 GREASE EXHAUST DUCT

- A. 1-1/2 inch thick refractory ceramic blanket or calcia, magnesia and silica with aluminum foil, fiberglass-reinforced scrim encapsulation.
- B. Product to be UL Listed as a two (2) hour duct enclosure.
- C. Product shall be tested in accordance with the following:
 - 1. ASTM G 411
 - 2. ASTM C 51
 - 3. ASTM E 84
 - 4. ASTM E 119
 - 5. ASTM E 136
 - 6. ASTM E 814
 - 7. UL 1978 Sections 12 and B

2.6 ACCESSORIES

- A. Pressure-Sensitivity Aluminum Foil Tapes:
 - 1. Material Standard: Listed and labeled under UL 181A, Part I, identified by name, date of manufacture, product name/number and UL 181A.
 - 2. Size: At least 2-1/2 inches wide.
- B. Heat-Activated Tapes:

1. Material Standard: Listed and labeled under UL 181A, Part II, identified by name, date of manufacture, product name/number and UL 181A, may be used in all applications except for bonding to sheet metal.
 2. Size: At least three (3) inches wide.
- C. Mastic and Glass Fabric System:
- a. Material Standard: Listed and labeled under UL 181A, Part III.
 - b. Size: At least three (3) inches wide.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- A. Comply with the instructions and recommendations of the duct insulation manufacturer.

3.2 INSTALLATION

A. ACOUSTICAL LINING OF SHEET METAL DUCT AND FITTINGS:

1. Completely cover all portions of duct designated to receive duct liner with duct liner material. Neatly butt all transverse joints with no interruptions or gaps. The black pigmented or mat faced surface of the duct liner shall face the airstream.
2. Affix duct liner to the sheet metal with 90 percent coverage of adhesive complying with the requirements of ASTM C916. All exposed leading edges and transverse joints shall be factory coated or coated with adhesive during fabrication.
3. Secure duct liner with mechanical fasteners, either weld-secured or impact-driven. Compress the duct liner sufficiently to hold it firmly in place. Adhesive bonded pins are not permitted. Space mechanical fasteners with respect to duct liner interior width as follows:
 - a. Maximum spacing for mechanical fasteners where air velocity is 0 – 2,500 FPM is as follows:
 1. From transverse end of liner: three (3) inches.
 2. Across width of duct: 12 inches on center.
 3. From corners of duct: four (4) inches.
 4. Along length of duct: 18 inches on center.
 - b. Maximum spacing for mechanical fasteners where air velocity is 2,501 – 5,000 FPM is as follows:
 1. From transverse end of liner: three (3) inches.
 2. Across width of duct: six (6) inches on center.
 3. From corners of duct: four (4) inches.
 4. Along length of duct: 16 inches on center.
4. Provide galvanized metal clips on all leading edges of duct liner. Exposed insulation is not acceptable.
5. Cut duct liner to ensure overlapped and compressed longitudinal corner joints.

6. Cut duct liner board to ensure tight, overlapped corner joints. Support the top pieces of liner board at the edges by the side pieces.
7. If the specification requires use of multiple insulation layers, take the following additional steps:
 - a. Affix bottom layer of duct liner in normal manner.
 - b. Affix top layer of duct liner to bottom layer using a minimum of 90% adhesive coverage.
 - c. Treat the leading edges of the duct liner with galvanized angle clips to prevent separation of the 2 layers.
 - d. Use mechanical fasteners of the proper length for the double layer.
8. Application: Provide duct liner as follows:
 - a. Provide duct liner in first 10 feet of duct from roof mounted exhaust fans.
 - b. Provide duct liner in all return air boots and transfer ducts.

B. THERMAL INSULATION WRAP ON DUCT AND FITTINGS:

1. Before applying duct wrap, air ducts must be clean, dry and tightly sealed at all joints and seams.
2. All portions of duct designated to receive duct wrap shall be completely covered with duct wrap.
3. To ensure installed thermal performance, duct wrap insulation shall be cut to "stretch-out" dimensions as shown in tables in manufacturer's literature.
4. Remove a two (2) inch piece of insulation from the facing at the end of the piece of duct wrap to form an overlapping stapling and taping flap.
5. Install duct wrap insulation with facing outside so that the tape flap overlaps the insulation and facing at the other end of the piece of duct wrap. Adjacent sections of duct wrap insulation shall be tightly butted with the two (2) inch stapling and taping flap overlapping. On rectangular duct, install so insulation is not excessively compressed at corners. Staple seams approximately six (6) inches on center with 1/2 inch minimum steel outward clinching staples.
6. Seal seams and joints with glass fabric and mastic. Do not use cloth duct tape of any color or finish using reclaimed rubber adhesives on duct wrap insulation. Tightly butt adjacent sections of duct wrap with the two (2) inch tape flap overlapping.
7. Where rectangular ducts are 24 inches in width or greater, additionally secure duct wrap insulation to the bottom of the duct with mechanical fasteners such as pins and speed clip washers or cuphead weld pins, spaced on 18 inch centers (maximum) to prevent sagging of insulation. Do not overly compress insulation.
8. Seal all tears, punctures and other penetrations of the duct wrap facing using glass fabric and mastic.

9. Application: Provide duct wrap as follows:
 - a. All supply duct
 - b. All outside air supply and intake duct
 - c. All return air duct
 - d. All return air plenums on air units
 - e. All intake plenums on outside air handling units
 - f. All ductwork routed in un-conditioned spaces including but not limited to: un-conditioned plenums (non-return air plenums), attics, exterior soffits, ventilated mechanical/boiler rooms and crawl spaces.

C. GREASE EXHAUST DUCT AND FITTINGS:

1. Provide one (1) or two (2) layers of Ductwrap to create a 2 hour rated duct enclosure. Each layer shall be lapped a minimum of three (3) inches. Inner layer shall be held in place with one (1) inch wide filament tape, spaced 1-1/2 inch from edges and midway at 10-1-2 centers. The outer layer shall be offset by 10-1/2 inches of inner layer, and one (1) inch wide filament tape shall be used in same manner as inner layer. 1/2 inch x 0.015 inch carbon steel banding strips on shall be installed same dimensions as tape to secure both layers on duct. All horizontal and vertical support hangers shall be wrapped with 1-layer of fire rated duct wrap and be secured with stainless steel ties or 1/2 inch hose clamps.
2. Access Door Installation: Four galvanized steel threaded rods, 1/4 inch diameter by 5 inches long are to be welded to the duct at the corners of the door opening. Four steel tubes, each 3 inches long, are placed over the rods to act as protection for the duct wrap when fastening the door. Four insulation pins are to be welded to the door panel for installation of the blanket. One layer of duct wrap is cut approximately the same size as the access panel and impaled over the insulation pins on the panel. It is essential that this layer fit tightly against the wrap surrounding the access door opening with no through openings. A second layer of duct wrap is cut to overlap the first layer by a minimum of one (1) inch. The second layer is impaled over the pins and both layers are locked in place with galvanized speed clips. Pins that extend beyond the outer layer of duct wrap shall be turned down to avoid sharp points. The insulated door panel is placed over the threaded rods and held in place with washers and wing nuts. Provide an access door at each change in duct direction and a minimum of every 10 feet on straight duct.
3. Filament tape can be used to temporarily hold the blanket in place until the banding is applied. The steel banding is applied around the duct 1-1/2 inch from edge of the blanket, and maximum 10-1/2 inch centers. The banding is placed around the material and tightened so as to sufficiently hold the duct wrap in place against the duct, compressing the foil but not cutting the foil.
4. Additional Pinning to Prevent Sagging of Wrap: For ducts 24 inches and larger in width, additional pins are needed to support the blanket on the bottom horizontal surface and on the outside face of a vertical duct run. Space pins a maximum of

10-1/2 inches apart in the direction of the blanket width, and a maximum of 12 inches apart in the direction of the blanket length.

5. Provide 12 ga copper-coated steel insulation pins with 1.5 inch square or round cup-head pins. Insulation pins are to be welded to ducts.
6. Duct Support Systems: Provide one layer of insulation to cover support components. Maintain 3 inch overlap.
7. Application:
 - a. Provide 2 hour enclosure on grease exhaust duct. Enclosure shall extend from kitchen hood to underside of roof deck.

D. EXTERIOR OR INTERIOR EXPOSED DUCT

1. Duct shall be galvanized double wall insulated round or rectangular with perforated liner. Insulation shall be acrylic coated to prevent biological growth and airside erosion. Provide 2", 1.5 pcf insulation on exterior duct and 1", 1.5 pcf on interior exposed duct. Duct and fittings shall use a bolted flange with neoprene gasket at each connection. Provide factory seal at flange and duct. Visual sealant on exposed interior duct to be painted is unacceptable.
2. Round duct to be galvanized spiral lockseam type.
3. Exposed round duct shall utilize single rod hangers with angle support rings. Double rod hangers are only acceptable on concealed duct.
4. Application: Provide double wall duct as follows:
 - a. Gymnasiums
 - b. Natatoriums
 - c. Return air plenums with ducted connection to return grilles
 - d. Ducted connections to return air grilles
 - e. Any area where ductwork is exposed

3.3 FIELD QUALITY CONTROL

- A. Inspection: Upon completion of installation of the duct system and before operation is to commence, visually inspect the system and verify that it has been correctly installed.
- B. Contractor shall inspect systems during test and balance to ensure that the formation of condensation is not present. Contractor shall be responsible for damage caused by condensation.

3.4 PROTECTION

- A. Protect installed work from damage due to subsequent construction activity on the site.

3.5 INSULATION SCHEDULE

- A. Supply and return ducts routed indoors (Ambient temperature \leq 85 degrees Fahrenheit, RH \leq 70 percent): R-8.3 (minimum).
- B. Supply, return, and exhaust ducts routed in unconditioned spaces including but not

limited to: un-conditioned plenums (non-return air plenums), attics, exterior soffits, mechanical/boiler rooms and crawl spaces. (Ambient temperature \leq 95 degrees Fahrenheit, RH \leq 70 percent): R-8.3 (minimum).

- C. Supply, return and exhaust ducts routed outdoors or in spaces where temperature and relative humidity exceed that specified for unconditioned spaces: R-8.3 (minimum).
- D. R-values represent installed values.
- E. Provide multiple layers of insulation or thicker insulation to achieve R-values listed. If multiple layers are utilized, inner insulation layer shall not include vapor retarder.

END OF SECTION

SECTION 23 09 23

DIRECT DIGITAL CONTROLS

PART 1 – GENERAL

1.1 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

- A. Heating and cooling piping:
 - 1. Control valves
 - 2. Flow meters
 - 3. Flow switches
 - 4. Press and temp sensor wells & sockets
 - 5. Temp sensor wells and sockets
- B. Duct accessories:
 - 1. Airflow stations
 - 2. BAS control dampers
 - 3. Terminal unit controls

1.2 PRODUCTS NOT FURNISHED OR INSTALLED BUT INTEGRATED WITH THE WORK OF THIS SECTION

- A. Communications with Third Party Equipment:
 - 1. Any additional integral control systems included with the products integrated with the work of this section shall be furnished with a BACnet interface for integration into the Direct Digital Control System described in this section (reference sequence of operations and points list for specifics). Those systems include:
 - a. Variable Speed Drives
 - b. Rooftop Units

1.3 RELATED SECTIONS

- A. The General Conditions of the Contract, Supplementary Conditions, and General Requirements are part of this specification and shall be used in conjunction with this section as part of the contract documents.
- B. The following sections constitute related work:

1. Division 01- General
2. Division 23 – Mechanical
3. Division 26 – Electrical

1.4 DESCRIPTION

- A. General: All new controls shall be tied into the existing Johnson Controls system.

1.5 QUALITY ASSURANCE

- A. Installer and Manufacturer Qualifications
1. Installer shall have an established working relationship with Control System Manufacturer for a period of 10 years or greater. If the distributorship has not had duration of more than 10 years, the contractor will not be approved without the written approval prior to bid date (no exceptions).
 2. Installer shall have successfully completed Control System Manufacturer's control system training. Upon request, Installer shall present record of completed training including course outlines.
 3. BAS Graphics shall be Three Dimensional Thermographic.
 4. BAS provider shall warranty controllers for 10 years.
 5. BAS Provider shall provide lifetime training for the lifecycle of the facility to the owner at no additional cost.

1.6 CODES AND STANDARDS

- A. Work, materials, and equipment shall comply with the most restrictive of local, state, and federal authority’s codes and ordinances for these plans and specifications. At a minimum, the installation shall comply with current editions in effect 30 days prior to receipt of bids of the following codes:
1. National Electric Code (NEC)
 2. International Energy Conservation Code (IECC)
 3. International Building Code (IBC)
 4. Uniform Mechanical Code (UMC)
 5. ASHRAE Standard 135-2016: BACnet - A Data Communication Protocol for Building Automation and Control Networks

1.7 SYSTEM PERFORMANCE

- A. Performance Standards. System shall conform to the following minimum standards over network connections. Systems shall be tested using manufacturer's recommended hardware and software for operator workstation (server and browser for web-based systems).

1. **Graphic Display.** A graphic with 20 dynamic points shall display with current data within 10 seconds.
2. **Graphic Refresh.** A graphic with 20 dynamic points shall update with current data within 8 seconds and shall automatically refresh every 15 seconds.
3. **Configuration and Tuning Screens.** Screens used for configuring, calibrating, or tuning points, PID loops, and similar control logic shall automatically refresh within 6 seconds.
4. **Object Command.** Devices shall react to command of a binary object within 2 seconds. Devices shall begin reacting to command of an analog object within 2 seconds.
5. **Alarm Response Time.** An object that goes into alarm shall be annunciated at the workstation within 15 seconds.
6. **Program Execution Frequency.** Custom and standard applications shall be capable of running as often as once every 5 seconds. Select execution times consistent with the mechanical process under control.
7. **Performance.** Programmable controllers shall be able to completely execute DDC PID control loops at a frequency adjustable down to once per second. Select execution times consistent with the mechanical process under control.
8. **Multiple Alarm Annunciation.** Each workstation on the network shall receive alarms within 5 seconds of other workstations.
9. **Reporting Accuracy.** System shall report values with minimum end-to-end accuracy listed in Table 1.

Control Stability and Accuracy. Control loops shall maintain measured variable at set point within tolerances listed in Table 2.

Table1
Reporting Accuracy

Measured Variable	Reported Accuracy
Space Temperature	±2°F
Ducted Air	±2°F
Outside Air	±2°F
Dew Point	±3°F
Water Temperature	±2°F
Delta-T	±0.25°F
Relative Humidity	±5% RH
Water Flow	±2% of full scale
Airflow (terminal)	±10% of full scale (see Note 1)
Airflow (measuring stations)	±5% of full scale
Airflow (pressurized spaces)	±3% of full scale
Air Pressure (ducts)	±0.1 in. w.g.
Air Pressure (space)	±0.01 in. w.g.
Water Pressure	±2% of full scale (see Note 2)
Electrical (A, V, W, Power Factor)	±1% of reading (see Note 3)

Carbon Monoxide (CO)	±5% of reading
Carbon Dioxide (CO ₂)	±50 ppm

Note 1: 10% - 100% of scale

Note 2: For both absolute and differential pressure

Note 3: Not including utility-supplied meters

Table 2
Control Stability and Accuracy

Controlled Variable	Control Accuracy	Range of Medium
Air Pressure	±0.2 in. w.g. ±0.01 in. w.g.	0-6 in. w.g. -0.1 to 0.1 in. w.g.
Airflow	±10% of full scale	
Space Temperature	±2.0°F	
Duct Temperature	±3°F	
Humidity	±5% RH	
Fluid Pressure	±1.5 psi ±1.0 in. w.g.	1-150 psi 0-50 in. w.g. differential

1.8 SUBMITTALS

- A. Product Requirements: Provide one electronic copy and 4 hard copies of shop drawings and other submittals on hardware, software, and equipment to be installed or furnished. Begin no work until submittals have been approved for conformity with design intent. If requested, provide drawings as AutoCAD 2014 and 4 prints of each drawing on 8.5 x 11 paper and 1 electronic copy of each drawing. When manufacturer's cut sheets apply to a product series rather than a specific product, **clearly indicate applicable data by highlighting** or by other means. Clearly reference covered specification and drawing on each submittal. General catalogs shall not be accepted as cut sheets to fulfill submittal requirements. Select and show submittal quantities appropriate to scope of work. Submittal approval does not relieve Contractor of responsibility to supply sufficient quantities to complete work. Provide submittals on the following:

1. Direct Digital Control System Hardware
 - a. Complete bill of materials indicating quantity, manufacturer, model number, and relevant technical data of equipment to be used.
 - b. Manufacturer's description and technical data such as performance curves, product specifications, and installation and maintenance instructions for items listed below and for relevant items not listed below:
 1. Direct digital controllers (controller panels)
 2. Transducers and transmitters
 3. Sensors (include accuracy data)
 4. Actuators
 5. Valves

6. Dampers
 7. Relays and switches
 8. Control panels
 9. Power supplies
 10. Batteries
 11. Operator interface equipment
 12. Wiring
- c. Wiring diagrams and layouts for each control panel. Show termination numbers.
 - d. Floor plan schematic diagrams indicating field sensor and controller locations.
 - e. Riser diagrams showing control network layout, communication protocol, and wire types.
2. Central System Hardware and Software
- a. Complete bill of material indicating quantity, manufacturer, model number, and relevant technical data of equipment used.
 - b. Manufacturer's description and technical data such as product specifications and installation and maintenance instructions for items listed below and for relevant items furnished under this contract not listed below:
 1. Central Processing Unit (CPU) or web server
 2. Monitors
 3. Keyboards
 4. Power supplies
 5. Battery backups
 6. Interface equipment between CPU or server and control panels
 7. Operating System software
 8. Operator interface software
 9. Color graphic software
 10. Third-party software
 - c. Schematic diagrams of control, communication, and power wiring for central system installation. Show interface wiring to control system.

- d. Network riser diagrams of wiring between central control unit and control panels.
3. Controlled Systems
 - a. Schematic diagram of each controlled system. Label control points with point names. Graphically show locations of control elements.
 - b. Schematic wiring diagram of each controlled system. Label control elements and terminals. Where a control element is also shown on control system schematic, use the same name.
 - c. Instrumentation list (Bill of Materials) for each controlled system. List each control system element in a table. Show element name, type of device, manufacturer, model number, and product data sheet number.
 - d. Complete description of control system operation including sequences of operation. Include and reference schematic diagram of controlled system. List I/O points and software points specified. Indicate alarmed and trended points.
 4. Description of process, report formats, and checklists to be used in Section 23 09 23 Article 3.15 (Control System Demonstration and Acceptance).
- B. Schedules
1. Within two months of contract award, provide schedule of work indicating:
 - a. Intended sequence of work items
 - b. Start date of each work item
 - c. Duration of each work item
 - d. Planned delivery dates for ordered material and equipment and expected lead times
 - e. Milestones indicating possible restraints on work by other trades or situations
 2. Monthly written status reports indicating work completed and revisions to expected delivery dates. Include updated schedule of work.
- C. Project Record Documents. Submit 8 copies of record (as-built) documents upon completion of installation for approval prior to final completion. Submittal shall consist of:
1. Project Record Drawings. As-built versions of submittal shop drawings provided as AutoCAD 2016 and 6 prints of each drawing on 8 ½" x 11" paper.
 2. Testing and Commissioning Reports and Checklists. Completed versions of reports, checklists, and trend logs used to meet requirements of (Control System Demonstration and Acceptance).
 3. Operation and Maintenance (O&M) Manual. Printed, electronic, or online help documentation of the following:

- a. As-built versions of submittal product data.
 - b. Names, addresses, and telephone numbers of installing contractors and service representatives for equipment and control systems.
 - c. Operator's manual with procedures for operating control systems: logging on and off, handling alarms, producing point reports, trending data, overriding computer control, and changing setpoints and variables.
 - d. Programming manual or set of manuals with description of programming language and syntax, of statements for algorithms and calculations used, of point database creation and modification, of program creation and modification, and of editor use.
 - e. Engineering, installation, and maintenance manual or set of manuals that explains how to design and install new points, panels, and other hardware; how to perform preventive maintenance and calibration; how to debug hardware problems; and how to repair or replace hardware.
 - f. Documentation of programs created using custom programming language including setpoints, tuning parameters, and object database. Electronic copies of programs shall meet this requirement if control logic, setpoints, tuning parameters, and objects can be viewed using furnished programming tools.
 - g. Graphic files, programs, and database on magnetic or optical media.
 - h. List of recommended spare parts with part numbers and suppliers.
 - i. Complete original-issue documentation, installation, and maintenance information for furnished third-party hardware including computer equipment and sensors.
 - j. Complete original-issue copies of furnished software, including operating systems, custom programming language, operator workstation or web server software, and graphics software.
 - k. Licenses, guarantees, and warranty documents for equipment and systems.
 - l. Recommended preventive maintenance procedures for system components, including schedule of tasks such as inspection, cleaning, and calibration; time between tasks; and task descriptions.
- D. Training Materials: The contractor shall provide training to owner personnel in a laboratory classroom environment. Each student shall be provided with a dedicated computer workstation utilizing a simulated BAS software platform that is installed for this project. The instructor's shall have CEU accreditation for all training courses offered. Provide documentation for this requirement in the initial BAS submittal. If contractor does not have CEU instructor or offer these courses locally include cost for tuition, travel and boarding to send students to manufacturer training facility. The owner shall receive free training for the life of the system.

1. Operator Overview – Consists of general system navigation, scheduling functions, setpoint modifications and parameter adjustments.
2. Advanced Topics Overview – Detailed analysis of trend setup/configuration, trend historian, alarm setup, alarm actions (email, printing, etc.), point renaming, and detailed analysis of equipment parameters.
3. Program/Logic Manipulation – Modify system programs as needed for additions and modifications.
4. Graphic Manipulation – Modify system graphics as needed for additions and modifications.
5. Hardware Troubleshooting – Classroom setup shall have HVAC mock-up systems. Operators shall be able to interact with this live system through the BAS utilized for this project. Class will provide students the ability to identify and repair common problems regularly encountered.
6. Software Troubleshooting - Classroom setup shall have HVAC mock-up systems. Operators shall be able to interact with this live system through the BAS utilized for this project. Class will provide students the ability to identify and repair common issues that can be utilized via software modifications.
7. Central Plant Operation – At a minimum the instructor shall thoroughly explain different types of central plant equipment and proper system modifications that can be made to enhance system performance and energy savings.
8. HVAC System Training – Objective of this class is to provide basic HVAC system knowledge of various types of systems including types of air side distribution and water side distribution. Topics such as thermodynamics, psychometrics, de-humidification, and demand control ventilation shall be thoroughly explained.

1.9 WARRANTY

A. Warrant work as follows:

1. Warrant materials for specified control system and peripheral control devices free from defects for a period of **3 years** after certificate of substantial completion. Warrant all labor for a period of **1 year** after final acceptance. Control system failures during warranty period shall be adjusted, repaired, or replaced at no additional cost or reduction in service to Owner. Respond during normal business hours within 24 hours of Owner's warranty service request. Additionally contractor shall offer 24/7 after-hours support to include alarm monitoring and associated dispatch service.
2. Provide graphic modifications for a period of 3 years from date of substantial completion. This shall include room number and equipment modifications as requested by the owner.
3. Provide telephone support free to the owner for a period of 3 years after substantial completion. This service includes technical support for all BAS equipment and shall include troubleshooting and problem resolution via the telephone or web services. Service shall be available during the hours of 7am to 5pm Monday – Friday.

4. Work shall have a single warranty date, even if Owner receives beneficial use due to early system start-up. If specified work is split into multiple contracts or a multi-phase contract, each contract or phase shall have a separate warranty start date and period.
5. Provide updates to operator workstation or web server software, project-specific software, graphic software, database software, and firmware that resolve Contractor or Owner identified software deficiencies at no charge during warranty period. If available, Owner can purchase in-warranty service agreement to receive upgrades for functional enhancements associated with above-mentioned items. Do not install updates or upgrades without Owner's written authorization.
6. Exception: Contractor shall not be required to warranty existing devices except those that have been rebuilt or repaired during installation.

1.10 OWNERSHIP OF PROPRIETARY MATERIAL

- A. Project-specific software and documentation shall become Owner's property. This includes, but is not limited to:
 1. Graphics
 2. Record drawings
 3. Database
 4. Application programming code
 5. Documentation

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Provide new products the manufacturer is currently manufacturing and selling for use in new installations. Do not use this installation as a product test site unless explicitly approved in writing by Owner. Spare parts shall be available for at least five years after completion of this contract.

2.2 COMMUNICATION

- A. Control products, communication media, connectors, repeaters, hubs, and routers shall comprise a BACnet internetwork. Controller and operator interface communication shall conform to ASHRAE/ANSI Standard 135-2016, BACnet.
- B. Use existing Ethernet backbone for network segments marked "existing" on project drawings.
- C. Each controller shall have a communication port for temporary connection to a laptop computer or other operator interface. Connection shall support memory downloads and other commissioning and troubleshooting operations.
- D. Internetwork operator interface and value passing shall be transparent to internetwork architecture.

1. An operator interface connected to a controller shall allow the operator to interface with each internetwork controller as if directly connected. Controller information such as data, status, and control algorithms shall be viewable and editable from each internetwork controller.
 2. Inputs, outputs, and control variables used to integrate control strategies across multiple controllers shall be readable by each controller on the internetwork. Program and test all cross-controller links required to execute control strategies specified in Sequence of Operations. An authorized operator shall be able to edit cross-controller links by typing a standard object address or by using a point-and-click interface.
- E. Controllers with real-time clocks shall use the BACnet Time Synchronization service. System shall automatically synchronize system clocks daily from an operator-designated controller via the internetwork. If applicable, system shall automatically adjust for daylight saving and standard time.
- F. System shall be expandable to at least twice the required input and output objects with additional controllers, associated devices, and wiring.
- G. System shall support Web services data exchange with any other system that complies with XML (extensible markup language) and SOAP (simple object access protocol) standards specified by the Web Services Interoperability Organization (WS-I) Basic Profile 1.0 or higher. Web services support shall as a minimum be provided at the workstation or web server level and shall enable the system to both read and write data.
1. System shall support Web services read data requests by retrieving requested trend data or point values (I/O hardware points, analog value software points, or binary value software points) from any system controller or from the trend history database.
 2. System shall support Web services write data request to each analog and binary object that can be edited through the system operator interface by downloading a numeric value to the specified object.
 3. For read or write requests, the system shall require user name and password authentication and shall support SSL (Secure Socket Layer) or equivalent data encryption.

2.3 OPERATOR INTERFACE

- A. Operator Interface. Web server shall reside on high-speed network with building controllers. Each standard browser connected to server shall be able to access all system information. Existing manufacturer's BAS web server and workstation can be utilized. In addition to the primary operator interface, the system shall include a secondary interface compatible with a locally available commercial wireless network and viewable on a commercially available wireless device such as a Wireless Access Protocol (WAP) enabled cellular telephone or personal digital assistant (PDA). This secondary interface may be text-based and shall provide a summary of the most important data. As a minimum, the following capabilities shall be provided through this interface:
1. An operator authentication system that requires an operator to log in before viewing or editing any data, and which can be configured to limit the privileges of an individual operator.

2. The ability to view and acknowledge any alarm in the system. Alarms or links to alarms shall be provided on a contiguous list so the operator can quickly view all alarms.
 3. A summary page or pages for each piece of equipment in the system. This page shall include the current values of all critical I/O points and shall allow the operator to lock binary points on or off and to lock analog points to any value within their range.
 4. Navigation links that allow the operator to quickly navigate from the home screen to any piece of equipment in the system, and then return to the home screen. These links may be arranged in a hierarchical fashion, such as navigating from the home screen to a particular building, then to a specific floor in the building, and then to a specific room or piece of equipment.
- B. Communication. Web server or workstation and controllers shall communicate using BACnet protocol. Web server or workstation and control network backbone shall communicate using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol and BACnet/IP addressing as specified in ASHRAE/ANSI 135-2016, BACnet Annex J.
- C. Hardware. If providing a new server, each workstation or web server shall consist of the following:
1. Hardware Base. Industry-standard hardware shall meet or exceed DDC system manufacturer's recommended specifications and shall meet response times specified in Section 23 09 23 Paragraph 1.8. Hard disk shall have sufficient memory to store system software, one year of data for trended points specified in Sequences of Operation, and a system database at least twice the size of the existing database at system acceptance. Configure computers and network connections if multiple computers are required to meet specified memory and performance. Web server shall be Compaq Rack Mounted Server (or equal) with a minimum of:
 - a. Dual Processor Intel Pentium 3.66 GHz processor
 - b. 1 GB RAM
 - c. 80 GB hard disk providing data at 100 MB/sec
 - d. RAID 5 Configuration
 - e. 128x CD-ROM drive
 - f. Most Current Windows Server Operating System
 - g. Serial, parallel, and network communication ports and cables required for proper system operation.
 2. If providing a server the server shall support one or more the following database types:
 - a. SQL Server 2012 R2
 - b. PostgreSQL
 - c. MySQL

d. MS Access

D. Operator Functions. Operator interface shall allow each authorized operator to execute the following functions as a minimum:

1. Log In and Log Out. System shall require user name and password to log in to operator interface.
2. Point-and-click Navigation. Operator interface shall be graphically based and shall allow operators to access graphics for equipment and geographic areas using point-and-click navigation.
3. View and Adjust Equipment Properties. Operators shall be able to view controlled equipment status and to adjust operating parameters such as setpoints, PID gains, on and off controls, and sensor calibration.
4. View and Adjust Operating Schedules. Operators shall be able to view scheduled operating hours of each schedulable piece of equipment on a weekly or monthly calendar-based graphical schedule display, to select and adjust each schedule and time period, and to simultaneously schedule related equipment. System shall clearly show exception schedules and holidays on the schedule display.
5. View and Respond to Alarms. Operators shall be able to view a list of currently active system alarms, to acknowledge each alarm, and to clear (delete) unneeded alarms.
6. View and Configure Trends. Operators shall be able to view a trend graph of each trended point and to edit graph configuration to display a specific time period or data range. Operator shall be able to create custom trend graphs to display on the same page data from multiple trended points.
7. View and Configure Reports. Operators shall be able to run preconfigured reports, to view report results, and to customize report configuration to show data of interest.
8. Manage Control System Hardware. Operators shall be able to view controller status, to restart (reboot) each controller, and to download new control software to each controller.
9. Manage Operator Access. Typically, only a few operators are authorized to manage operator access. Authorized operators shall be able to view a list of operators with system access and of functions they can perform while logged in. Operators shall be able to add operators, to delete operators, and to edit operator function authorization. Operator shall be able to authorize each operator function separately.

E. System Software.

1. Operating System: Web server or workstation shall have an industry-standard professional-grade operating system. Acceptable systems include Microsoft Windows XP Pro, Red Hat Linux, or Sun Solaris.
2. System Graphics: Operator interface shall be graphically based and shall include at least one graphic per piece of equipment or occupied zone, graphics for each chilled water and hot water system, and graphics that summarize conditions on

each floor of each building included in this contract. Indicate thermal comfort on floor plan summary graphics using dynamic colors to represent zone temperature relative to zone setpoint. Graphics shall

- a. **Functionality:** Graphics shall allow operator to monitor system status, to view a summary of the most important data for each controlled zone or piece of equipment, to use point-and-click navigation between zones or equipment, and to edit setpoints and other specified parameters.
 - b. **Animation:** Graphics shall be able to animate by displaying different image files for changed object status.
 - c. **Alarm Indication:** Indicate areas or equipment in an alarm condition using color or other visual indicator.
 - d. **Format.** Graphics shall be saved in an industry-standard format such as BMP, JPEG, or GIF. Web-based system graphics shall be viewable on browsers compatible with World Wide Web Consortium browser standards. Web graphic format shall require no plug-in (such as HTML and JavaScript) or shall require widely available no-cost plug-ins (such as Active-X and Macromedia Flash).
- F. **System Tools.** System shall provide the following functionality to authorized operators as an integral part of the operator interface or as stand-alone software programs. If furnished as part of the interface, the tool shall be available from each workstation or web browser interface. If furnished as a stand-alone program, software shall be installable on standard IBM-compatible PCs with no limit on the number of copies that can be installed under the system license.
1. **Automatic System Database Configuration.** Each workstation or web server shall store on its hard disk a copy of the current system database, including controller firmware and software. Stored database shall be automatically updated with each system configuration or controller firmware or software change.
 2. **Controller Memory Download.** Operators shall be able to download memory from the system database to each controller.
 3. **System Configuration.** Operators shall be able to configure the system.
 4. **Online Help.** Context-sensitive online help for each tool shall assist operators in operating and editing the system.
 5. **Security.** System shall require a user name and password to view, edit, add, or delete data.
 - a. **Operator Access.** Each user name and password combination shall define accessible viewing, editing, adding, and deleting functions in each system application, editor, and object. Authorized operators shall be able to vary and deny each operator's accessible functions based on equipment or geographic location.
 - b. **Automatic Log Out.** Automatically log out each operator if no keyboard or mouse activity is detected. Operators shall be able to adjust automatic log out delay.

- c. Encrypted Security Data. Store system security data including operator passwords in an encrypted format. System shall not display operator passwords.
6. System Diagnostics. System shall automatically monitor controller and I/O point operation. System shall annunciate controller failure and I/O point locking (manual overriding to a fixed value).
7. Alarm Processing. System input and status objects shall be configurable to alarm on departing from and on returning to normal state. Operator shall be able to enable or disable each alarm and to configure alarm limits, alarm limit differentials, alarm states, and alarm reactions for each system object. Configure and enable alarm points as specified in Section 23 09 93. Alarms shall be BACnet alarm objects and shall use BACnet alarm services.
8. Alarm Messages. Alarm messages shall use an English language descriptor without acronyms or mnemonics to describe alarm source, location, and nature.
9. Alarm Reactions. Operator shall be able to configure (by object) actions workstation or web server shall initiate on receipt of each alarm. As a minimum, workstation or web server shall be able to log, print, start programs, display messages, send e-mail, send page, and audibly annunciate.
10. Alarm Maintenance. Operators shall be able to view system alarms and changes of state chronologically, to acknowledge and delete alarms, and to archive closed alarms to the workstation or web server hard disk from each workstation or web browser interface.
11. Trend Configuration. Operator shall be able to configure trend sample or change of value (COV) interval, start time, and stop time for each system data object and shall be able to retrieve data for use in spreadsheets and standard database programs. Controller shall sample and store trend data and shall be able to archive data to the hard disk. The contractor shall configure all physical control points and software control points to accumulate trend data. Analog values shall be configured utilizing time-based intervals and digital values shall be configured for COV. Provide at a minimum of 250 samples per control point. If data can be stored locally at the controller level this information shall be archived at the central server or all BAS workstations.
12. Object and Property Status and Control. Operator shall be able to view, and to edit if applicable, the status of each system object and property by menu, on graphics, or through custom programs.
13. Reports and Logs. Operator shall be able to select, to modify, to create, and to print reports and logs. Operator shall be able to store report data in a format accessible by standard spreadsheet and word processing programs.
14. Standard Reports. Furnish the following standard system reports:
 - a. Objects. System objects and current values filtered by object type, by status (in alarm, locked, normal), by equipment, by geographic location, or by combination of filter criteria.
 - b. Alarm Summary. Current alarms and closed alarms. System shall retain closed alarms for an adjustable period.

- c. Logs. System shall log the following to a database or text file and shall retain data for an adjustable period:
 1. Alarm History.
 2. Trend Data. Operator shall be able to select trends to be logged.
 3. Operator Activity. At a minimum, system shall log operator log in and log out, control parameter changes, schedule changes, and alarm acknowledgment and deletion. System shall date and time stamp logged activity.
15. Custom Reports. Operator shall be able to create custom reports that retrieve data, including archived trend data, from the system, that analyze data using common algebraic calculations, and that present results in tabular or graphical format. Reports shall be launched from the operator interface.
16. Graphics Generation. Graphically based tools and documentation shall allow Operator to edit system graphics, to create graphics, and to integrate graphics into the system. Operator shall be able to add analog and binary values, dynamic text, static text, and animation files to a background graphic using a mouse.
17. Graphics Library. Complete library of standard HVAC equipment graphics shall include equipment such as chillers, boilers, air handlers, terminals, fan coils, and unit ventilators. Library shall include standard symbols for other equipment including fans, pumps, coils, valves, piping, dampers, and ductwork. Library graphic file format shall be compatible with graphics generation tools.
18. Custom Application Programming. Operator shall be able to create, edit, debug, and download custom programs. System shall be fully operable while custom programs are edited, compiled, and downloaded. Programming language shall have the following features:
 - a. Language. Language shall be graphically based or English language oriented. If graphically based, language shall use function blocks arranged in a logic diagram that clearly shows control logic flow. Function blocks shall directly provide functions listed below, and operators shall be able to create custom or compound function blocks. If English language oriented, language shall be based on the syntax of BASIC, FORTRAN, C, or PASCAL, and shall allow for free-form programming that is not column-oriented or "fill-in-the-blanks."
 - b. Programming Environment. Tool shall provide a full-screen, cursor-and-mouse-driven programming environment that incorporates word processing features such as cut and paste. Operators shall be able to insert, add, modify, and delete custom programming code, and to copy blocks of code to a file library for reuse in other control programs.
 - c. Independent Program Modules. Operator shall be able to develop independently executing program modules that can disable, enable and exchange data with other program modules.
 - d. Debugging and Simulation. Operator shall be able to step through the program observing intermediate values and results. Operator shall be

able to adjust input variables to simulate actual operating conditions. Operator shall be able to adjust each step's time increment to observe operation of delays, integrators, and other time-sensitive control logic. Debugger shall provide error messages for syntax and for execution errors.

- e. Conditional Statements. Operator shall be able to program conditional logic using compound Boolean (AND, OR, and NOT) and relational (EQUAL, LESS THAN, GREATER THAN, NOT EQUAL) comparisons.
- f. Mathematical Functions. Language shall support floating-point addition, subtraction, multiplication, division, and square root operations, as well as absolute value calculation and programmatic selection of minimum and maximum values from a list of values.
- g. Variables: Operator shall be able to use variable values in program conditional statements and mathematical functions.
 - 1. Time Variables. Operator shall be able to use predefined variables to represent time of day, day of the week, month of the year, and date. Other predefined variables or simple control logic shall provide elapsed time in seconds, minutes, hours, and days. Operator shall be able to start, stop, and reset elapsed time variables using the program language.
 - 2. System Variables. Operator shall be able to use predefined variables to represent status and results of Controller Software and shall be able to enable, disable, and change setpoints of Controller Software as described in Controller Software section.

- 19. BACnet. Web server or workstation shall have demonstrated interoperability during at least one BMA Interoperability Workshop and shall substantially conform to BACnet Operator Workstation (B-OWS) device profile as specified in ASHRAE/ANSI 135-2016, BACnet Annex L.

2.4 CONTROLLER SOFTWARE

- A. Building and energy management application software shall reside and operate in system controllers. Applications shall be editable through operator workstation, web browser interface, or engineering workstation.
- B. System Security. See Paragraph 2.3.F.5 (Security) and Paragraph 2.3.F.14.c.3 (Operator Activity).
- C. Scheduling. See Paragraph 2.3.D.4 (View and Adjust Operating Schedules). System shall provide the following schedule options as a minimum:
 - 1. Weekly. Provide separate schedules for each day of the week. Each schedule shall be able to include up to 5 occupied periods (5 start-stop pairs or 10 events).
 - 2. Exception. Operator shall be able to designate an exception schedule for each of the next 365 days. After an exception schedule has executed, system shall discard and replace exception schedule with standard schedule for that day of the week.

3. Holiday. Operator shall be able to define 24 special or holiday schedules of varying length on a scheduling calendar that repeats each year.
- D. System Coordination. Operator shall be able to group related equipment based on function and location and to use these groups for scheduling and other applications.
- E. Binary and Analog Alarms. See Paragraph 2.3.F.7 (Alarm Processing).
- F. Alarm Reporting. See Paragraph 2.3.F.9 (Alarm Reactions).
- G. Remote Communication. System shall automatically contact operator workstation or server on receipt of critical alarms. If no network connection is available, system shall use a modem connection.
- H. Maintenance Management. System shall generate maintenance alarms when equipment exceeds adjustable runtime, equipment starts, or performance limits. Configure and enable maintenance alarms as specified in Section 23 09 93.
- I. Sequencing. Application software shall sequence chillers, boilers, and pumps as specified in Section 23 09 93.
- J. PID Control. System shall provide direct- and reverse-acting PID (proportional-integral-derivative) algorithms. Each algorithm shall have anti-windup and selectable controlled variable, setpoint, and PID gains. Each algorithm shall calculate a time-varying analog value that can be used to position an output or to stage a series of outputs.
- K. Staggered Start. System shall stagger controlled equipment restart after power outage. Operator shall be able to adjust equipment restart order and time delay between equipment restarts.
- L. Energy Calculations.
 1. System shall accumulate and convert instantaneous power (kW) or flow rates (gpm) to energy usage data.
 2. System shall calculate a sliding-window average (rolling average). Operator shall be able to adjust window interval to 15 minutes, 30 minutes, or 60 minutes.
 3. System shall calculate a fixed-window average. Window interval start shall be defined by utility meter digital input signal to synchronize system's and utility's fixed-window averages.
- M. Anti-Short Cycling. Binary output objects shall be protected from short cycling by means of adjustable minimum on-time and off-time settings.
- N. On and Off Control with Differential. System shall provide direct- and reverse-acting on and off algorithms with adjustable differential to cycle a binary output based on a controlled variable and setpoint.
- O. Runtime Totalization. System shall provide an algorithm that can totalize runtime for each binary input and output. Operator shall be able to enable runtime alarm based on exceeded adjustable runtime limit. Configure and enable runtime totalization and alarms as specified.

2.5 CONTROLLERS

- A. General. Provide Building Controllers (BC), Advanced Application Controllers (AAC), Application Specific Controllers (ASC), and Smart Actuators (SA) as required to achieve performance specified in Section 23 09 23 Article 1.8 (System Performance).
- B. BACnet.
 - 1. Building Controllers (BCs). Each BC shall have demonstrated interoperability during at least one BMA Interoperability Workshop and shall substantially conform to BACnet Building Controller (B-BC) device profile as specified in ASHRAE/ANSI 135-2016, BACnet Annex L.
 - 2. Advanced Application Controllers (AACs). Each AAC shall conform to BACnet Advanced Application Controller (B-AAC) device profile as specified in ASHRAE/ANSI 135-2016, BACnet Annex L and shall be listed as a certified B-AAC in the BACnet Testing Laboratories (BTL) Product Listing.
 - 3. Application Specific Controllers (ASCs). Each ASC shall conform to BACnet Application Specific Controller (B-ASC) device profile as specified in ASHRAE/ANSI 135-2016, BACnet Annex L and shall be listed as a certified B-ASC in the BACnet Testing Laboratories (BTL) Product Listing.
 - 4. Smart Actuators (SAs). Each SA shall conform to BACnet Smart Actuator (B-SA) device profile as specified in ASHRAE/ANSI 135-2016, BACnet Annex L and shall be listed as a certified B-SA in the BACnet Testing Laboratories (BTL) Product Listing.
 - 5. BACnet Communication.
 - a. Each BC shall reside on or be connected to a BACnet network using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol and BACnet/IP addressing.
 - b. BACnet routing shall be performed by BCs or other BACnet device routers as necessary to connect BCs to networks of AACs and ASCs.
 - c. Each AAC and ASC shall reside on a BACnet network using the ARCNET or MS/TP Data Link/Physical layer protocol.
 - d. Each SA shall reside on a BACnet network using the ARCNET or MS/TP Data Link/Physical layer protocol.
- C. Communication.
 - 1. Service Port. Each controller shall provide a service communication port for connection to a Portable Operator's Terminal. Connection shall be extended to space temperature sensor ports where shown on drawings.
 - 2. Signal Management. BC and ASC operating systems shall manage input and output communication signals to allow distributed controllers to share real and virtual object information and to allow for central monitoring and alarms.
 - 3. Data Sharing. Each BC and AAC shall share data as required with each networked BC and AAC.

4. Stand-Alone Operation. Each piece of equipment specified in Sequences of Operation shall be controlled by a single controller to provide stand-alone control in the event of communication failure. All I/O points specified for a piece of equipment shall be integral to its controller. Provide stable and reliable stand-alone control using default values or other method for values normally read over the network.
- D. Environment. Controller hardware shall be suitable for anticipated ambient conditions.
1. Controllers used outdoors or in wet ambient conditions shall be mounted in waterproof enclosures and shall be rated for operation at -20°F to 140°F.
 2. Controllers used in conditioned space shall be mounted in dust-protective enclosures and shall be rated for operation at 32°F to 120°F.
- E. Real-Time Clock. Controllers that perform scheduling shall have a real-time clock.
- F. Serviceability.
1. Controllers shall have diagnostic LEDs for power, communication, and processor.
 2. Wires shall be connected to a field-removable modular terminal strip or to a termination card connected by a ribbon cable.
 3. Each BC and AAC shall continually check its processor and memory circuit status and shall generate an alarm on abnormal operation. System shall continuously check controller network and generate alarm for each controller that fails to respond.
- G. Memory.
1. Controller memory shall support operating system, database, and programming requirements.
 2. Each BC and AAC shall retain BIOS and application programming for at least 72 hours in the event of power loss.
 3. Each ASC and SA shall use nonvolatile memory and shall retain BIOS and application programming in the event of power loss. System shall automatically download dynamic control parameters following power loss.
- H. Immunity to Power and Noise. Controllers shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 1 m (3 ft).
- I. Transformer. ASC power supply shall be fused or current limiting and shall be rated at a minimum of 125% of ASC power consumption.

2.6 INPUT AND OUTPUT INTERFACE

- A. General. Hard-wire input and output points to BCs, AACs, ASCs, or SAs.

- B. Protection. Shorting an input or output point to itself, to another point, or to ground shall cause no controller damage. Input or output point contact with up to 24 V for any duration shall cause no controller damage.
- C. Binary Inputs. Binary inputs shall monitor the on and off signal from a remote device. Binary inputs shall provide a wetting current of at least 12 mA and shall be protected against contact bounce and noise. Binary inputs shall sense dry contact closure without application of power external to the controller.
- D. Pulse Accumulation Inputs. Pulse accumulation inputs shall conform to binary input requirements and shall accumulate up to 10 pulses per second.
- E. Analog Inputs. Analog inputs shall monitor low-voltage (0-10 Vdc), current (4-20 mA), or resistance (thermistor or RTD) signals. Analog inputs shall be compatible with and field configurable to commonly available sensing devices.
- F. Binary Outputs. Binary outputs shall send a pulsed low-voltage signal for pulse width modulation control or an on-or-off signal for on and off control. Building Controller binary outputs shall have three-position (on-off-auto) override switches and status lights. Outputs shall be selectable for normally open or normally closed operation.
- G. Analog Outputs. Analog outputs shall send a modulating 0-10 Vdc or 4-20 mA signal as required to properly control output devices. Each Building Controller analog output shall have a two-position (auto-manual) switch, a manually adjustable potentiometer, and status lights. Analog outputs shall not drift more than 0.4% of range annually.
- H. Tri-State Outputs. Control three-point floating electronic actuators without feedback with tri-state outputs (two coordinated binary outputs). Tri-State outputs may be used to provide analog output control in zone control and terminal unit control applications such as VAV terminal units, duct-mounted heating coils, and zone dampers.
- I. Pulse-Width Modulation. Control actuators designed for pulse-width modulation with a single binary output that cycle with variable on and off times as determined by the application software. Pulse-width modulation may be used to provide analog output control in zone control and terminal unit control applications such as VAV terminal units, duct-mounted heating coils, and zone dampers.
- J. Universal Inputs and Outputs. Inputs and outputs that can be designated as either binary or analog in software shall conform to the provisions of this section that are appropriate for their designated use.

2.7 POWER SUPPLIES AND LINE FILTERING

- A. Power Supplies. Control transformers shall be UL listed. Furnish Class 2 current-limiting type or furnish over-current protection in primary and secondary circuits for Class 2 service in accordance with NEC requirements. Limit connected loads to 80% of rated capacity.
 - 1. DC power supply output shall match output current and voltage requirements. Unit shall be full-wave rectifier type with output ripple of 5.0 mV maximum peak-to-peak. Regulation shall be 1.0% line and load combined, with 100-microsecond response time for 50% load changes. Unit shall have built-in over-voltage and over-current protection and shall be able to withstand 150% current overload for at least three seconds without trip-out or failure.

- a. Unit shall operate between 0°C and 50°C (32°F and 120°F). EM/RF shall meet FCC Class B and VDE 0871 for Class B and MILSTD 810C for shock and vibration.
 - b. Line voltage units shall be UL recognized and CSA listed.
- B. Power Line Filtering.
- 1. Provide internal or external transient voltage and surge suppression for workstations and controllers. Surge protection shall have:
 - a. Dielectric strength of 1000 V minimum
 - b. Response time of 10 nanoseconds or less
 - c. Transverse mode noise attenuation of 65 dB or greater
 - d. Common mode noise attenuation of 150 dB or greater at 40-100 Hz

2.8 AUXILIARY CONTROL DEVICES

- A. Motorized Control Dampers.
- 1. Type. Control dampers shall have linear flow characteristics and shall be parallel- or opposed-blade type as specified below or as scheduled on drawings.
 - a. Outdoor and return air mixing dampers and face-and-bypass dampers shall be parallel-blade and shall direct airstreams toward each other.
 - b. Other modulating dampers shall be opposed-blade.
 - c. Two-position shutoff dampers shall be parallel or opposed-blade with blade and side seals.
 - 2. Frame. Damper frames shall 13 gauge galvanized steel channel or 1/8 in. extruded aluminum with reinforced corner bracing.
 - 3. Blades. Damper blades shall not exceed 8 inches in width or 48 inches in length. Blades shall be suitable for medium velocity (2000 fpm) performance. Blades shall be not less than 16 gauge.
 - 4. Shaft Bearings. Damper shaft bearings shall be as recommended by manufacturer for application, oil impregnated sintered bronze, or better.
 - 5. Seals. Blade edges and frame top and bottom shall have replaceable seals of butyl rubber or neoprene. Side seals shall be spring-loaded stainless steel. Blade seals shall leak no more than (10 cfm per ft²) at (4 in. w.g.) differential pressure. Blades shall be airfoil type suitable for wide-open face velocity of (1500 fpm).
 - 6. Sections. Damper sections shall not exceed 48 in. - 60 in.. Each section shall have at least one damper actuator.
 - 7. Linkages. Dampers shall have exposed linkages.
- B. Electric Damper and Valve Actuators.

1. Stall Protection. Mechanical or electronic stall protection shall prevent actuator damage throughout the actuator's rotation.
2. Spring-return Mechanism. Actuators used for power-failure and safety applications shall have an internal mechanical spring-return mechanism or an uninterruptible power supply (UPS).
3. Signal and Range. Proportional actuators shall accept a 0-10 Vdc or a 0-20 mA control signal and shall have a 2-10 Vdc or 4-20 mA operating range.
4. Wiring. 24 Vac and 24 Vdc actuators shall operate on Class 2 wiring.
5. Manual Positioning. Operators shall be able to manually position each actuator when the actuator is not powered. Non-spring-return actuators shall have an external manual gear release. Spring-return actuators with more than 60 inch -lb torque capacity shall have a manual crank.
6. Acceptable Manufacturers:
 - a. Belimo

C. Control Valves.

1. General. Select body and trim materials in accordance with manufacturer's recommendations for design conditions and service shown.
2. Type. Provide two or three-way control valves for two-position or modulating service as shown.
3. Water Valves.
 - a. Valves providing two-position service shall be quick opening. Two-way valves shall have replaceable disc or ball.
 - b. Close-off (Differential) Pressure Rating. Valve actuator and trim shall provide the following minimum close-off pressure ratings.
 1. Two-way: 100% of total system (pump) head.
 2. Three-way: 300% of pressure differential between ports A and B at design flow or 100% of total system (pump) head.
 - c. Ports. Valves providing modulating service shall have equal percentage ports.
 - d. Sizing.
 1. Two-position service: line size.
 2. Two-way modulating service: select pressure drop equal to the greatest of twice the pressure drop through heat exchanger (load), 50% of the pressure difference between supply and return mains, or 35 kPa (5 psi).

3. Three-way modulating service: select pressure drop equal to the smaller of twice the pressure drop through the coil exchanger (load) or 35 kPa (5 psi).
- e. Fail Position. Water valves shall fail normally open or closed as follows unless otherwise specified.
 1. Water zone valves: normally closed.
 2. Heating coils in air handlers: normally closed.
 3. Chilled water control valves: normally open.
 4. Other applications: as scheduled or as required by sequences of operation.
- f. Acceptable Valve and Actuator Manufacturers:
 1. Belimo
4. Steam Valves.
 - a. Close-off (Differential) Pressure Rating. Valve actuator and trim shall provide minimum close-off pressure rating equal to 150% of operating (inlet) pressure.
 - b. Ports. Valves providing modulating service shall have linear ports.
 - c. Sizing.
 1. Two-position service: select pressure drop equal to 10%-20% of inlet psig.
 2. Modulating service at 100 kPa (15 psig) or less: select pressure drop equal to 80% of inlet psig.
 3. Modulating service at 101-350 kPa (16-50 psig): select pressure drop equal to 50% of inlet psig.
 4. Modulating service at over 350 kPa (50 psig): select pressure drop as scheduled on drawings.
- D. Binary Temperature Devices.
 1. Low-Voltage Space Thermostats. Low-voltage space thermostats shall be 24 V, bimetal-operated, mercury-switch type, with adjustable or fixed anticipation heater, concealed setpoint adjustment, 55°F-85°F setpoint range, 2°F maximum differential, and vented ABS plastic cover.
 2. Line-Voltage Space Thermostats. Line-voltage space thermostats shall be bimetal-actuated, open-contact type or bellows-actuated, enclosed, snap-switch type or equivalent solid-state type, with heat anticipator, UL listing for electrical rating, concealed setpoint adjustment, 55°F-85°F setpoint range, 2°F maximum differential, and vented ABS plastic cover.

3. Low-Limit Thermostats. Low-limit airstream thermostats shall be UL listed, vapor pressure type. Element shall be at least 20 ft long. Element shall sense temperature in each 1 ft section and shall respond to lowest sensed temperature. Low-limit thermostat shall be manual reset only.
- E. Temperature Sensors.
1. Type. Temperature sensors shall be Resistance Temperature Device (RTD) or thermistor.
 2. Duct Sensors. Duct sensors shall be single point or averaging as shown. Averaging sensors shall be a minimum of 5 ft in length per 10 ft² of duct cross-section.
 3. Immersion Sensors. Provide immersion sensors with a separable stainless steel well. Well pressure rating shall be consistent with system pressure it will be immersed in. Well shall withstand pipe design flow velocities.
 4. Space Sensors: Space sensors shall be stainless steel flush plate mounted type.
 5. Differential Sensors. Provide matched sensors for differential temperature measurement.
- F. Humidity Sensors.
1. Duct and room sensors shall have a sensing range of 20%-80%.
 2. Duct sensors shall have a sampling chamber.
 3. Outdoor air humidity sensors shall have a sensing range of 20%-95% RH and shall be suitable for ambient conditions of 40°F-170°F.
 4. Humidity sensors shall not drift more than 1% of full scale annually.
- G. Flow Switches. Flow-proving switches shall be thermal dispersion type (IFM U 40100 or approved equal) or differential pressure type (air or water service). Switches shall be UL listed, SPDT snap-acting, and pilot duty rated (125 VA minimum).
1. Thermal dispersion type switches shall have relay output, wire break output and temperature output.
 2. Differential pressure switches shall have scale range and differential suitable for intended application and NEMA 4 enclosure unless otherwise specified.
- H. Relays.
1. Control Relays. Control relays shall be plug-in type, UL listed, and shall have dust cover and LED "energized" indicator. Contact rating, configuration, and coil voltage shall be suitable for application.
 2. Time Delay Relays. Time delay relays shall be solid-state plug-in type, UL listed, and shall have adjustable time delay. Delay shall be adjustable $\pm 100\%$ from setpoint shown. Contact rating, configuration, and coil voltage shall be suitable for application. Provide NEMA 1 enclosure for relays not installed in local control panel.

- I. Override Timers.
 - 1. Unless implemented in control software, override timers shall be spring-wound line voltage, UL Listed, with contact rating and configuration required by application. Provide 0-6 hour calibrated dial unless otherwise specified. Flush mount timer on local control panel face or where shown.

- J. Current Transmitters.
 - 1. AC current transmitters shall be self-powered, combination split-core current transformer type with built-in rectifier and high-gain servo amplifier with 4-20 mA two-wire output. Full-scale unit ranges shall be 10 A, 20 A, 50 A, 100 A, 150 A, and 200 A, with internal zero and span adjustment. Unit accuracy shall be $\pm 1\%$ full-scale at 500 ohm maximum burden.
 - 2. Transmitter shall meet or exceed ANSI/ISA S50.1 requirements and shall be UL/CSA recognized.
 - 3. Unit shall be split-core type for clamp-on installation on existing wiring.

- K. Current Transformers.
 - 1. AC current transformers shall be UL/CSA recognized and shall be completely encased (except for terminals) in approved plastic material.
 - 2. Transformers shall be available in various current ratios and shall be selected for $\pm 1\%$ accuracy at 5 A full-scale output.
 - 3. Use fixed-core transformers for new wiring installation and split-core transformers for existing wiring installation.

- L. Voltage Transmitters.
 - 1. AC voltage transmitters shall be self-powered single-loop (two-wire) type, 4-20 mA output with zero and span adjustment.
 - 2. Adjustable full-scale unit ranges shall be 100-130 Vac, 200-250 Vac, 250-330 Vac, and 400-600 Vac. Unit accuracy shall be $\pm 1\%$ full-scale at 500 ohm maximum burden.
 - 3. Transmitters shall meet or exceed ANSI/ISA S50.1 requirements and shall be UL/CSA recognized at 600 Vac rating.

- M. Voltage Transformers.
 - 1. AC voltage transformers shall be UL/CSA recognized, 600 Vac rated, and shall have built-in fuse protection.
 - 2. Transformers shall be suitable for ambient temperatures of 4°C-55°C (40°F-130°F) and shall provide $\pm 0.5\%$ accuracy at 24 Vac and 5 VA load.
 - 3. Windings (except for terminals) shall be completely enclosed with metal or plastic.

- N. Power Monitors.
1. Power monitors shall be three-phase type and shall have three-phase disconnect and shorting switch assembly, UL listed voltage transformers, and UL listed split-core current transformers.
 2. Power monitors shall provide selectable output: rate pulse for kWh reading or 4-20 mA for kW reading. Power monitors shall operate with 5 A current inputs and maximum error of $\pm 2\%$ at 1.0 power factor or $\pm 2.5\%$ at 0.5 power factor.
- O. Current Switches.
1. Current-operated switches shall be self-powered, solid-state with adjustable trip current. Select switches to match application current and DDC system output requirements.
- P. Pressure Transducers.
1. Transducers shall have linear output signal and field-adjustable zero and span.
 2. Continuous operating conditions of positive or negative pressure 50% greater than calibrated span shall not damage transducer sensing elements.
 3. Water pressure transducer diaphragm shall be stainless steel with minimum proof pressure of 1000 kPa (150 psi). Transducer shall have 4-20 mA output, suitable mounting provisions, and block and bleed valves.
 4. Water differential pressure transducer diaphragm shall be stainless steel with minimum proof pressure of 1000 kPa (150 psi). Over-range limit (differential pressure) and maximum static pressure shall be 2000 kPa (300 psi.) Transducer shall have 4-20 mA output, suitable mounting provisions, and 5-valve manifold.
- Q. Differential Pressure Switches. Differential pressure switches (air or water service) shall be UL listed, SPDT snap-acting, pilot duty rated (125 VA minimum) and shall have scale range and differential suitable for intended application and NEMA 1 enclosure unless otherwise specified.
- R. Pressure-Electric (PE) Switches. PE switches shall be UL listed, pilot duty rated (125 VA minimum) or motor control rated, metal or neoprene diaphragm actuated, operating pressure rated for 0-175 kPa (0-25 psig), with calibrated scale minimum setpoint range of 14-125 kPa (2-18 psig).
1. Provide one- or two-stage switch action (SPDT, DPST, or DPDT) as required by application.
 2. Switches shall be open type (panel-mounted). Exception: Switches shall be enclosed type for remote installation. Enclosed type shall be NEMA 1 unless otherwise specified.
 3. Each pneumatic signal line to PE switches shall have permanent indicating gauge.
- S. Carbon Monoxide Detector / Controller / Transducer requirements:
1. Approved Manufactures:

- a. U.S. Draft Co.; Model CGM-505
 2. Shall comply with Texas State Boiler code 65.603-2015.
 3. ETL Listed to UL61010-1, CAN/CSA C22.2 No 61010-1, and LADBS Approved.
 4. Boilers shall be individually hard wired.
 5. Shall carry a (2) two year warranty.
 6. Shall be calibrated every (18) eighteen months and a record of calibration shall be posted in a conspicuous place.
 7. Shall be capable of displaying from 0-200 ppm of CO.
 8. NEMA 1 enclosure.
 9. Provide expansion board for additional equipment interlocks.
 10. Provide pre-programmed dry contacts to shut down equipment during unsafe operation.
 11. Fan relay actuation selectable with output for fan relay, alarm relay and 4-20ma signal.
 12. Provide digital display, buzzer, fan delay.
 13. Fan runtime shall have minimum.
 14. Fan relays shall be pilot duty, SPDT, latching or non-latching at 5A, 240 VAC.
 15. 0-10 VDC control signal out, visual alarm and audible alarm.
 16. Alarm relay rating for 0.5A, 120V, 60VA.
 17. Operating Environment from 0°F to 125°F at 10 to 90% RH.
- T. Local Control Panels.
 1. Indoor control panels shall be fully enclosed NEMA 1 construction with hinged door key-lock latch and removable sub-panels. A common key shall open each control panel and sub-panel.
 2. Prewire internal and face-mounted device connections with color-coded stranded conductors tie-wrapped or neatly installed in plastic troughs. Field connection terminals shall be UL listed for 600 V service, individually identified per control and interlock drawings, with adequate clearance for field wiring.
 3. Each local panel shall have a control power source power switch (on-off) with overcurrent protection.

2.9 WIRING AND RACEWAYS

- A. General. Provide copper wiring, plenum cable, and raceways as specified in applicable sections of Division 26.
- B. Insulated wire shall use copper conductors and shall be UL listed for 90°C (200°F) minimum service.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Thoroughly examine project plans for control device and equipment locations. Report discrepancies, conflicts, or omissions to Architect or Engineer for resolution before starting rough-in work.
- B. Inspect site to verify that equipment can be installed as shown. Report discrepancies, conflicts, or omissions to Engineer for resolution before starting rough-in work.
- C. Examine drawings and specifications for work of others. Report inadequate headroom or space conditions or other discrepancies to Engineer and obtain written instructions for changes necessary to accommodate Section 23 09 23 work with work of others. Controls Contractor shall perform at his expense necessary changes in specified work caused by failure or neglect to report discrepancies.

3.2 PROTECTION

- A. Controls Contractor shall protect against and be liable for damage to work and to material caused by Contractor’s work or employees.
- B. Controls Contractor shall be responsible for work and equipment until inspected, tested, and accepted. Protect material not immediately installed. Close open ends of work with temporary covers or plugs during storage and construction to prevent entry of foreign objects.

3.3 COORDINATION

- A. Site.
 - 1. Assist in coordinating space conditions to accommodate the work of each trade where work will be installed near or will interfere with work of other trades. If installation without coordination causes interference with work of other trades, Contractor shall correct conditions without extra charge.
 - 2. Coordinate and schedule work with other work in the same area and with work dependent upon other work to facilitate mutual progress.
- B. Submittals. See Section 23 09 23 Article 1.9 (Submittals).
- C. Test and Balance.
 - 1. Provide Test and Balance Contractor a single set of necessary tools to interface to control system for testing and balancing.
 - 2. Train Test and Balance Contractor to use control system interface tools.

3. Provide a qualified technician to assist with testing and balancing the first 20 terminal units.
 4. Test and Balance Contractor shall return tools undamaged and in working condition at completion of testing and balancing.
- D. Life Safety.
1. Duct smoke detectors required for air handler shutdown are provided and wired under Division 26.
 2. Smoke dampers and actuators required for duct smoke isolation are provided under Division 23 and wired by Division 26.
 3. Fire and smoke dampers and actuators required for fire-rated walls are provided under Division 23. Fire and smoke damper control is provided under Division 26.
- E. Coordination with Other Controls. Integrate with and coordinate controls and control devices furnished or installed by others as follows.
1. Communication media and equipment shall be provided as specified in Section 23 09 23 Article 2.2 (Communication).
 2. Each supplier of a controls product shall configure, program, start up, and test that product to meet the sequences of operation described regardless of where within the contract documents those products are described.
 3. Coordinate and resolve incompatibility issues that arise between control products provided under this section and those provided under other sections or divisions of this specification.
 4. Controls Contractor shall be responsible for integration of control products provided by multiple suppliers regardless of where integration is described within the contract documents.

3.4 GENERAL WORKMANSHIP

- A. Install equipment, piping, and wiring or raceway horizontally, vertically, and parallel to walls wherever possible.
- B. Provide sufficient slack and flexible connections to allow for piping and equipment vibration isolation.
- C. Install equipment in readily accessible locations as defined by National Electrical Code (NEC) Chapter 1 Article 100 Part A.
- D. Verify wiring integrity to ensure continuity and freedom from shorts and ground faults.
- E. Equipment, installation, and wiring shall comply with industry specifications and standards and local codes for performance, reliability, and compatibility.

3.5 FIELD QUALITY CONTROL

- A. Commissioning and start-up of the BAS system shall be performed factory certified employees of the BAS contractor or manufacturer. Under no instances shall electrical subcontractors perform this work.
- B. Work, materials, and equipment shall comply with rules and regulations of applicable local, state, and federal codes and ordinances as identified in Section 23 09 23 Article 1.7 (Codes and Standards).
- C. Continually monitor field installation for code compliance and workmanship quality.
- D. Contractor shall arrange for work inspection by local or state authorities having jurisdiction over the work.

3.6 WIRING

- A. To differentiate BAS wiring from that of other trades, all cable except for underground will have a **yellow outer jacket** (no exceptions).
- B. Division 26 contractor shall supply a dedicated 120vac power to a junction box in each mechanical room for use by the BMCS.
- C. A Conduit fill based on plenum 18 gauge 2 conductor:
 - 1. 1/2 inch - No more than 4 conductors.
 - 2. 3/4 inch - No more than 8 conductors.
 - 3. 1 inch - No more than 12 conductors.
- D. Control and interlock wiring and installation shall comply with national and local electrical codes, Division 26, and manufacturer's recommendations. Where the requirements of Section 23 09 23 differ from Division 26, Section 23 09 23 shall take precedence.
- E. All wires whether control network or device wire shall be marked with Brady-type markers.
- F. NEC Class 1 (line voltage) wiring shall be UL listed in approved raceway as specified by NEC and Division 26.
- G. Low-voltage wiring shall meet NEC Class 2 requirements. Sub-fuse low-voltage power circuits as required to meet Class 2 current limit.
- H. NEC Class 2 (current-limited) wires not in raceway but in concealed and accessible locations such as return air plenums shall be UL listed for the intended application.
- I. Install wiring in raceway where subject to mechanical damage and at levels below 10ft. in mechanical, electrical, or service rooms.
- J. Do not install Class 2 wiring in raceway containing Class 1 wiring. Boxes and panels containing high voltage wiring and equipment may not be used for low-voltage wiring except for the purpose of interfacing the two (e.g., relays and transformers).
- K. Install Class 1 and Class 2 wiring in separate raceways. Boxes and panels containing high-voltage wiring and equipment shall not be used for low-voltage wiring except for the purpose of interfacing the two through relays and transformers.

- L. Do not install wiring in raceway containing tubing.
- M. Run exposed Class 2 wiring parallel to a surface or perpendicular to it and tie neatly at (5 ft) intervals.
- N. Contractor shall install all low voltage communication wiring as per all TIA/EIA communication cabling standards. All cabling shall be installed in dedicated cabling support such as j-hook, d-rings, or saddles. All supports shall be supported directly from building structure. Do not support cabling or supports from ceiling grid wire, conduit, ductwork, piping, or other system cabling. All cabling must be installed in independent support for that given system and may not share supports or run in same conduit or support. All cabling shall be supported every 5'-0" from approved cabling support method. Contractor shall bundle all system cabling and label all wiring for system they serve. All cabling passing thru walls shall require dedicated conduit sleeves with bushing to protect cabling during installation. Contractor shall provide 1 meter service loops at all device termination locations and 3 meter service loops at all head end termination locations. All low voltage HVAC control cabling shall be yellow in color unless specified otherwise. Do not use ductwork, electrical raceways, piping, or ceiling suspension systems to support or anchor cables.
- O. Secure raceways with raceway clamps fastened to structure and spaced according to code requirements. Raceways and pull boxes shall not be hung on or attached to ductwork, electrical raceways, piping, or ceiling suspension systems.
- P. Size raceway and select wire size and type in accordance with manufacturer's recommendations and NEC requirements.
- Q. Include one pull string in each raceway 2.5 cm (1 in.) or larger.
- R. Use color-coded conductors throughout.
- S. Locate control and status relays in designated enclosures only. Do not install control and status relays in packaged equipment control panel enclosures containing Class 1 starters.
- T. Conceal raceways except within mechanical, electrical, or service rooms. Maintain minimum clearance of 15 cm (6 in.) between raceway and high-temperature equipment such as steam pipes or flues.
- U. Adhere to requirements in Division 26 where raceway crosses building expansion joints.
- V. Install insulated bushings on raceway ends and enclosure openings. Seal top ends of vertical raceways.
- W. Terminate control and interlock wiring related to the work of this section. Maintain at the job site updated (as-built) wiring diagrams that identify terminations.
- X. Flexible metal raceways and liquid-tight flexible metal raceways shall not exceed 1 m (3 ft) in length and shall be supported at each end. Do not use flexible metal raceway less than ½ in. electrical trade size.
- Y. Install raceway rigidly, support adequately, ream at both ends, and leave clean and free of obstructions. Join raceway sections with couplings and according to code. Make terminations in boxes with fittings. Make terminations not in boxes with bushings.

3.7 COMMUNICATION WIRING

- A. Communication wiring shall be low-voltage Class 2 wiring and shall comply with Article 3.7 (Wiring).
- B. Install communication wiring in separate raceways and enclosures from other Class 2 wiring.
- C. During installation do not exceed maximum cable pulling, tension, or bend radius specified by the cable manufacturer.
- D. Verify entire network's integrity following cable installation using appropriate tests for each cable.
- E. Install lightning arrestor according to manufacturer's recommendations between cable and ground where a cable enters or exits a building.
- F. Each run of communication wiring shall be a continuous length without splices when that length is commercially available. Runs longer than commercially available lengths shall have as few splices as possible using commercially available lengths.
- G. Label communication wiring to indicate origination and destination.
- H. Ground coaxial cable according to NEC regulations article on "Communications Circuits, Cable, and Protector Grounding."

3.8 FIBER OPTIC CABLE

- A. During installation do not exceed maximum pulling tensions specified by cable manufacturer. Post-installation residual cable tension shall be within cable manufacturer's specifications.
- B. Install cabling and associated components according to manufacturers' instructions. Do not exceed minimum cable and unjacketed fiber bend radii specified by cable manufacturer.

3.9 INSTALLATION OF SENSORS

- A. Install sensors according to manufacturer's recommendations.
- B. Mount sensors rigidly and adequately for operating environment.
- C. Install room temperature sensors on concealed junction boxes properly supported by wall framing.
- D. Air seal wires attached to sensors in their raceways or in the wall to prevent sensor readings from being affected by air transmitted from other areas.
- E. Use averaging sensors in mixing plenums and hot and cold decks. Install averaging sensors in a serpentine manner vertically across duct. Support each bend with a capillary clip.

- F. Install mixing plenum low-limit sensors in a serpentine manner horizontally across duct. Support each bend with a capillary clip. Provide 1 ft. of sensing element for each 1 ft. ² of coil area.
- G. Install pipe-mounted temperature sensors in wells. Install liquid temperature sensors with heat-conducting fluid in thermal wells.
- H. Install outdoor air temperature sensors on north wall at designated location with sun shield.
- I. Differential Air Static Pressure.
 - 1. Supply Duct Static Pressure. Pipe high-pressure tap to duct using a pitot tube. Make pressure tap connections according to manufacturer's recommendations.
 - 2. Return Duct Static Pressure. Pipe high-pressure tap to duct using a pitot tube. Make pressure tap connections according to manufacturer's recommendations.
 - 3. Building Static Pressure. Pipe pressure sensor's low-pressure port to the static pressure port located on the outside of the building through a high-volume accumulator. Pipe high-pressure port to a location behind a thermostat cover.
 - 4. Piping to pressure transducer pressure ports shall contain a capped test port adjacent to transducer.
 - 5. Pressure transducers, except those controlling VAV boxes, shall be located in control panels, not on monitored equipment or on ductwork. Mount transducers in a vibration-free location accessible for service without use of ladders or special equipment.
 - 6. Mount gauge tees adjacent to air and water differential pressure taps. Install shut-off valves before tee for water gauges.
- J. Smoke detectors, freezestats, high-pressure cut-offs, and other safety switches shall be hard-wired to de-energize equipment as described in the sequence of operation. Switches shall require manual reset. Provide contacts that allow DDC software to monitor safety switch status.

3.10 FLOW SWITCH INSTALLATION

- A. Adjust flow switch according to manufacturer's instructions.

3.11 ACTUATORS

- A. General. Mount actuators and adapters according to manufacturer's recommendations.
- B. Electric and Electronic Damper Actuators. Mount actuators directly on damper shaft or jackshaft unless shown as a linkage installation. Link actuators according to manufacturer's recommendations.
 - 1. For low-leakage dampers with seals, mount actuator with a minimum 5° travel available for damper seal tightening.
 - 2. To compress seals when spring-return actuators are used on normally closed dampers, power actuator to approximately 5° open position, manually close the damper, and then tighten linkage.

3. Check operation of damper-actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.
4. Provide necessary mounting hardware and linkages for actuator installation.

3.12 IDENTIFICATION OF HARDWARE AND WIRING

- A. Label wiring and cabling, including that within factory-fabricated panels, with control system address or termination number at each end within 5 cm (2 in.) of termination.
- B. Label pneumatic tubing at each end within 5 cm (2 in.) of termination with a descriptive identifier.
- C. Permanently label or code each point of field terminal strips to show instrument or item served.
- D. Label control panels with minimum 1 cm (½ in.) letters on laminated plastic nameplates.
- E. Label each control component with a permanent label. Label plug-in components such that label remains stationary during component replacement.
- F. Label valves with nameplates.
- G. Manufacturers' nameplates and UL or CSA labels shall be visible and legible after equipment is installed.
- H. Label identifiers shall match record documents.

3.13 PROGRAMMING

- A. Point Naming. Name points as shown on the equipment points list provided with each Sequence of Operation. Where multiple points with the same name reside in the same controller, each point name may be customized with its associated Program Object number. For example, "Zone Temp 1" for Zone 1, "Zone Temp 2" for Zone 2.
- B. All DDC programming shall be accomplished through graphical programming, line code is unacceptable
- C. Software Programming. Programming shall provide actions for each possible situation. Graphic- or parameter-based programs shall be documented.
 1. Application Programming. Provide application programming that adheres to sequences of operation specified in Section 23 09 93. Program documentation or comment statements shall reflect language used in sequences of operation.
 2. System Programming. Provide system programming necessary for system operation.
- D. Operator Interface.
 1. Standard Graphics. Provide graphics as specified in Section 23 09 23 Article 2.3 Paragraph E.2 (System Graphics). Show on each equipment graphic input and output points and relevant calculated points such as indicated on the applicable

Points List located in the Sequence of Operation. Point information on graphics shall dynamically update.

2. Install, initialize, start up, and troubleshoot operator interface software and functions (including operating system software, operator interface database, and third-party software installation and integration required for successful operator interface operation) as described in Section 23 09 23.
3. DDC screen graphic room numbers shall be based on final room graphics package. Obtain Architect/Owner approval of final room numbers prior to programming.

3.14 CONTROL SYSTEM CHECKOUT AND TESTING

- A. Startup Testing. Complete startup testing to verify operational control system before notifying Owner of system demonstration. Provide Owner with schedule for startup testing. Owner may have representative present during any or all startup testing.
1. Calibrate and prepare for service each instrument, control, and accessory equipment furnished under Section 23 09 23.
 2. Verify that control wiring is properly connected and free of shorts and ground faults. Verify that terminations are tight.
 3. Enable control systems and verify each input device's calibration. Calibrate each device according to manufacturer's recommendations.
 4. Verify that binary output devices such as relays, solenoid valves, two-position actuators and control valves, and magnetic starters, operate properly and that normal positions are correct.
 5. Verify that analog output devices such as I/Ps and actuators are functional, that start and span are correct, and that direction and normal positions are correct. Check control valves and automatic dampers to ensure proper action and closure. Make necessary adjustments to valve stem and damper blade travel.
 6. Prepare a log documenting startup testing of each input and output device, with technician's initials certifying each device has been tested and calibrated.
 7. Verify that system operates according to sequences of operation. Simulate and observe each operational mode by overriding and varying inputs and schedules. Tune PID loops and each control routine that requires tuning.
 8. Alarms and Interlocks.
 - a. Check each alarm with an appropriate signal at a value that will trip the alarm.
 - b. Trip interlocks using field contacts to check logic and to ensure that actuators fail in the proper direction.
 - c. Test interlock actions by simulating alarm conditions to check initiating value of variable and interlock action.

3.15 CONTROL SYSTEM DEMONSTRATION AND ACCEPTANCE

- A. Demonstration. Prior to acceptance, perform the following performance tests to demonstrate system operation and compliance with specification after and in addition to tests specified in Article 3.15 (Control System Checkout and Testing). Provide Engineer with log documenting completion of startup tests.
1. Preliminary Review: At least 7 days prior to on-site demonstration, provide read-only username and password to Engineer for preliminary system review to be performed remotely. Engineer will review to verify all systems are connected and communicating and all points are reading properly and graphics are complete. The Engineer will provide a report of any deficiencies. The contractor shall correct all deficiencies prior to on-site demonstration.
 2. On-site Demonstration: Engineer, Owner, contractor(s) and any/all factory authorized equipment representatives shall be present to perform, observe and review system demonstration. Notify Engineer/Architect at least 10 days before system demonstration is scheduled.
 - a. Demonstration shall follow process submitted and approved under Section 23 09 23 Article 1.9 (Submittals). Complete approved checklists and forms for each system as part of system demonstration.
 - b. Demonstrate actual field operation of each sequence of operation as specified in Section 23 09 93. Provide at least two persons equipped with two-way communication. Demonstrate calibration and response of any input and output points requested by Engineer. Provide and operate test equipment required to prove proper system operation.
 - c. Demonstrate compliance with sequences of operation through each operational mode.
 - d. Demonstrate complete operation of operator interface.
 - e. Demonstrate each of the following.
 - f. DDC loop response. Supply graphical trend data output showing each DDC loop's response to a setpoint change representing an actuator position change of at least 25% of full range. Trend sampling rate shall be from 10 seconds to 3 minutes, depending on loop speed. Each sample's trend data shall show setpoint, actuator position, and controlled variable values. Engineer will require further tuning of each loop that displays unreasonably under- or over-damped control.
 - g. Demand limiting. Supply trend data output showing demand-limiting algorithm action. Trend data shall document action sampled each minute over at least a 30-minute period and shall show building kW, demand-limiting setpoint, and status of setpoints and other affected equipment parameters.
 - h. Building fire alarm system interface.
 - i. Trend logs for each system. Trend data shall indicate setpoints, operating points, valve positions, and other data as specified in the points list provided with each sequence of operation in Section 23 09 93.

Each log shall cover three 48-hour periods and shall have a sample frequency not less than 10 minutes or as specified on its points list. Logs shall be accessible through system's operator interface and shall be retrievable for use in other software programs as specified in Section 23 09 23 Article 2.3 Paragraph F.11 (Trend Configuration).

3. Tests that fail to demonstrate proper system operation shall be repeated after Contractor makes necessary repairs or revisions to hardware or software to successfully complete each test.
- B. Acceptance.
1. After tests described in this specification are performed to the satisfaction of both Engineer and Owner, Engineer will accept control system as meeting completion requirements. Engineer may exempt tests from completion requirements that cannot be performed due to circumstances beyond Contractor's control. Engineer will provide written statement of each exempted test. Exempted tests shall be performed as part of warranty.
 2. System shall not be accepted until completed demonstration forms and checklists are submitted and approved as required in Section 23 09 23 Article 1.9 (Submittals).

3.16 CLEANING

- A. Each day clean up debris resulting from work. Remove packaging material as soon as its contents have been removed. Collect waste and place in designated location.
- B. On completion of work in each area, clean work debris and equipment. Keep areas free from dust, dirt, and debris.
- C. On completion of work, check equipment furnished under this section for paint damage. Repair damaged factory-finished paint to match adjacent areas. Replace deformed cabinets and enclosures with new material and repaint to match adjacent areas.

3.17 SUPPLEMENTAL OPERATIONAL SOFTWARE

- A. Utility reporting Software
 1. Scope of Work: Power monitoring will be accomplished by accessing existing ERCOT grade revenue metering and/or by the installation of a separate power meter/switch gear interface. Write programming for server based data extraction software. Install software onto Web-Access server. Verify and commission program functionality from the central site computer. Utility reporting will monitor and record consumption at user definable increments. Utility reporting will generate reports based on user definable timeframes. Monitoring Data shall be extracted from the server, through the World Wide Web, via xml / SOAP. Data shall be collected at 15-minute intervals. Data shall be assimilated in a user definable format, reflecting, at a minimum, the following values, per building, per user definable time frame:
 - a. KW
 - b. KWh

- c. Plant run times
 - d. Outside Air Temperature
 2. Facility data shall be input to the database. This data shall be assimilated by the BAS contractor by site survey. Data from drawings or schedules is unacceptable on its own, and must be field verified.
 - a. Building square footage
 - b. Building population
 - c. Current electric utility rate structure
 3. Reports shall be generated which configure the data in a user-friendly format. All reports shall be easily sorted to identify excessive energy consumption. User definable alarm thresholds shall be enabled. Data, and alarm thresholds shall be normalized for degree-days. At a minimum, the reports will consist of the following:
 - a. Budget Report - Comparative analysis of budgeted energy costs versus actual energy costs.
 - b. Trend Report - Trend KWH for each day of a user defined period. Display in graphic format.
 - c. Board Report - Data is sorted by the following criteria: facility type, raw KWH, KWH per square foot, cost per square foot, and cost per occupant and plant runtime accumulation.
 - d. ECM report - Comparative data based on consumption history before, and consumption history after, an Energy Conservation Measure is executed
 - e. Summary Report - All report data shall be assimilated in this single report.

B. Power Meter Monitoring Service

1. Scope of Work: During the Warranty Period, the BAS contractor will provide a supplemental monitoring service to assure the optimization of the Power Meter Monitoring Service. The Power Meter Monitoring Service shall be continually utilized to identify Energy Conservation Measures. BAS Contractor will apply the following resources to this service:
 - a. Certified energy Manager (CEM)
 - b. Engineering and software support
 - c. Daily inspections from the BAS Contractor help desk
 - d. Regular field inspections by BAS Contractor technicians
2. Requirements of this contract require the BAS contractor to perform the following requirements.

- a. Establish alarming thresholds and building benchmark
- b. Receive all alarms if weekly thresholds are exceeded.
- c. Perform a regular data extraction.
- d. Identify to owner any instances where the alarm threshold has been exceeded.
- e. Perform a preliminary analysis and remediate where possible.
- f. Continually search for opportunities in the way of energy curtailment measures (ECMs).
- g. Publish a monthly report, complete with analysis and recommendation for ECMs, presented in both hardcopy and digital media.

END OF SECTION

SECTION 23 22 00

CONDENSATE PIPING

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

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: Pipe and pipe fitting materials, joining methods and pipe insulation for the following systems:
 - 1. Condensate equipment drains and over flows.
- B. Related Sections:
 - 1. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment: Product requirements for pipe hangers and supports and fire stopping for placement by this section.

1.3 REFERENCES

- A. American Society of Mechanical Engineers:
 - 1. ASME B16.3 - Malleable Iron Threaded Fittings.
 - 2. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
 - 3. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
 - 4. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes.
 - 5. ASME B31.1 – Power Piping.
 - 6. ASME B31.5 - Refrigeration Piping.
 - 7. ASME B31.9 - Building Services Piping.
 - 8. ASME Section IX - Boiler and Pressure Vessel Code - Welding and Brazing Qualifications.
- B. ASTM International (ASTM):
 - 1. ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

2. ASTM A234 - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
 3. ASTM A536 – Standard Specification for Ductile Iron Castings.
 4. ASTM B32 - Standard Specification for Solder Metal.
 5. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
- C. American Welding Society:
1. AWS A5.8 - Specification for Filler Metals for Brazing and Braze Welding.
 2. AWS D1.1 - Structural Welding Code - Steel.

1.4 SYSTEM DESCRIPTION

- A. Where more than one piping system material is specified, provide compatible system components and joints. Provide flanges, union, and couplings at locations requiring servicing.
- B. Provide unions, flanges, and couplings downstream of valves and at equipment or apparatus connections.
- C. Provide non-conducting dielectric connections whenever jointing dissimilar metals in open systems.
- D. Do not use direct welded or threaded connections to valves, equipment or other apparatus.

1.5 ACTION SUBMITTALS

- A. Submit in accordance with Division 1 - General Requirements.
- B. Shop Drawings: Indicate layout of piping systems, including equipment, critical dimensions, and sizes. Indicate schematic layout of refrigeration system, including equipment, critical dimensions, and sizes.
- C. Product Data: Submit data on pipe materials and fittings. Submit manufacturers catalog information.
- D. Design Data: Indicate pipe sizes. Indicate pipe sizing methods. Indicate calculations used.
- E. Test Reports: Indicate results of refrigerant leak test and acid test.
- F. Welders’ Certificate: Include welders’ certification of compliance with ASME Section IX.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

- B. Welding certificates.
- C. Field quality-control test reports.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Installers of Pressure-Sealed Joints: Installers shall be certified by the pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.
- B. Steel Support Welding: Qualify processes and operators according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
 - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- D. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- E. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three (3) years experience.
- F. Installer: Company specializing in performing Work of this section with minimum three (3) years experience approved by manufacturer.
- G. Design piping systems under direct supervision of Professional Engineer experienced in design of this Work and licensed at Project location.
- H. All pipe and accessories shall be of United States domestic manufacture.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. In accordance with Division 1 - General Requirements.
- B. Furnish temporary end caps and closures on piping and fittings. Maintain in place until installation.
- C. Protect piping from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system Protect.

- D. Contractor shall adequately protect material from damage after delivery to the project. Piping shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.
- E. Do not deliver Piping to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

1.9 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.10 WELDING

- A. Welding Procedures: Conform to latest recommendations of American Welding Society and Code for Pressure Piping, ANSI B31.1, and current edition. Welding and stress relieving procedures shall conform to Appendix, Section VI, and "Standard Qualifications for Welding Procedures, Welders and Welding Operators."
- B. Locations for Welding: Welding shall not be permitted within occupied area of the building. When the building or a portion of the building is in use as a permanent occupancy welding shall be permitted only in areas physically separated from occupied spaces by fire rated or non-combustible walls to deck or on completely gutted and unoccupied floors.
- C. Fire Protection and Smoke Venting: The Contractor shall provide all manpower and equipment required to protect the building structure and site occupants, other Contractors, etc., from hazards and to remove welding fumes from the building conform to the latest requirements of NFPA 51B.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tubing: ASTM B 88, Type K (ASTM B 88M, Type B).
- B. Wrought-Copper Fittings: ASME B16.22.
 - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - A. Anvil International, Inc.
 - B. S. P. Fittings; a division of Star Pipe Products.
 - C. Victaulic Company.
- C. Copper or Bronze Pressure-Seal Fittings:

1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - A. Stadler-Viega.
 2. Housing: Copper.
 3. O-Rings and Pipe Stops: EPDM.
 4. Tools: Manufacturer's special tools.
 5. Minimum 200-psig (1379-kPa) working-pressure rating at 250 deg F (121 deg C).
- D. Wrought-Copper Unions: ASME B16.22.

2.2 STEEL PIPE AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, Seamless galvanized steel with plain ends; schedule 40, 0.375 inch wall.
- B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125.
- C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150.
- D. Malleable-Iron Unions: ASME B16.39; Classes 150.
- E. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.

2.3 JOINING MATERIALS

- A. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- B. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BA9-1, silver alloy for joining copper with bronze or steel.
- C. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Unions:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - A. Capitol Manufacturing Company.
 - B. Hart Industries International, Inc.
 - C. Jomar International Ltd.
 - D. Matco-Norca, Inc.

- E. McDonald, A. Y. Mfg. Co.
- F. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- G. Wilkins; a Zurn company.

2. Description:

- A. Standard: ASSE 1079.
- B. Pressure Rating: 125 psig minimum at 180 deg F.
- C. End Connections: Solder-joint copper alloy and threaded ferrous.

2.5 PIPING INSULATION

- A. High density factory molded fiberglass insulation with factory applied, all service, and reinforced vapor retarder jacket. Provide with a factory applied pressure sensitive tape closure system and matching butt strips. 1" thick for all pipe sizes and locations.
 - 1. Thermal conductivity "k" of 0.23 of Btu-in / hr-sq.ft. Degree F at 75 degree mean temperature.
 - 2. Maximum jacket permeance shall be 0.02.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - A. Johns Manville.
 - B. Owens Corning
 - C. Knauf.
 - D. CertainTeed
- C. Aluminum Jacket: General Requirements: Provide aluminum jacketing for all condensate drain piping located outdoors.
 - A. Jacket for piping shall be 0.016 inch thick type 3105 aluminum with factory applied one mil polykraft moisture barrier.
 - B. Fitting covers shall be factory made 0.024 inch type 1100 aluminum to match pipe covering.

PART 3 - EXECUTION

3.1 PIPE JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

- D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- E. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- F. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- G. Mechanically Formed, Copper-Tube-Outlet Joints: Use manufacturer-recommended tool and procedure, and brazed joints.
- H. Pressure-Sealed Joints: Use manufacturer-recommended tool and procedure. Leave insertion marks on pipe after assembly.

3.2 PIPING INSTALLATION

- A. Route piping parallel to building structure and maintain gradient.
- B. Install piping to conserve building space, and not interfere with use of space.
- C. Sleeve pipe passing through partitions, walls and floors. Refer to Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
- D. Install piping free of sags and bends.
- E. Install piping to allow application of insulation.

3.3 INSULATION INSTALLATION

- A. Ensure that all pipe and fitting surfaces over which insulation is to be installed are clean and dry.
- B. Ensure that insulation is clean, dry and in good mechanical condition with all factory-applied vapor or weather barriers intact and undamaged. Wet, dirty, or damaged insulation shall not be acceptable for installation.
- C. Ensure that pressure testing of piping and fittings has been completed prior to installing insulation.
- D. Install all insulation materials and accessories in accordance with manufacturer's published instructions and recognized industry practices to ensure that it will serve its intended purpose.

- E. Install insulation on piping subsequent to installation of heat tracing, painting, and acceptance tests.
- F. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with single cut piece to complete run. Do not use cut pieces or scraps abutting each other. Butt insulation joints firmly to ensure complete, tight fit over all piping surfaces.
- G. Maintain the integrity of factory-applied vapor barrier jacketing on all pipe insulation, protecting it against puncture, tears or other damage. All staples used on cold pipe insulation shall be coated with suitable sealant to maintain vapor barrier integrity.
- H. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.
- I. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- J. Apply insulation with longitudinal seams at top and bottom of horizontal pipe runs.
- K. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- L. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.
- M. Keep insulation materials dry during application and finishing.
- N. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.
- O. Apply insulation with the least number of joints practical.
- P. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic.
- Q. Apply insulation continuously through hangers and around anchor attachments.
- R. For insulation application where vapor retarder are indicated, extend insulation on anchor legs at least 12 inches from point of attachment to pipe and taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
- S. Install insert materials and apply insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by the insulation material manufacturer.
- T. Insulation Terminations: For insulation application where vapor retarder is indicated, taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.

END OF SECTION

SECTION 23 31 13

METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Single-wall round and Flat Oval ducts and fittings.
3. Double-wall rectangular ducts and fittings.
4. Double-wall round and Flat Oval ducts and fittings.
5. Insulated Flexible Ducts
6. Sheet metal materials.
7. Sealants and gaskets.
8. Duct coating requirement for Natatoriums.
9. Hangers and supports.

- B. Related Sections:

1. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.
3. Division 23 Section "Duct Insulation" for internal duct liner.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible".
- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.4 ACTION SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Product Data: For each type of the following products:
 - 1. Adhesives.
 - 2. Sealants and gaskets.
- C. Shop Drawings:
 - 1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
 - 2. Factory- and shop-fabricated ducts and fittings.
 - 3. $\frac{1}{4}'' = 1'-0''$ Scale Duct layout drawings indicating sizes, configuration, liner material, static-pressure classes, and bottom of duct elevations. Duct shop drawings shall be superimposed on the architectural backgrounds with the reflected ceiling plans.
 - 4. Dimensions of main duct runs from building grid lines.
 - 5. Fittings.
 - 6. Reinforcement and spacing.
 - 7. Seam and joint construction.
 - 8. Penetrations through fire-rated and other partitions.
 - 9. Equipment installation based on equipment being used on Project.
 - 10. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
 - 11. Hangers and supports, including methods for duct and building attachment, and vibration isolation.
- D. Delegated-Design Submittal:
 - 1. Sheet metal thicknesses.
 - 2. Joint and seam construction and sealing.
 - 3. Reinforcement details and spacing.
 - 4. Materials, fabrication, assembly, and spacing of hangers and supports.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.

2. Suspended ceiling components.
3. Structural members to which duct will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Penetrations of smoke barriers and fire-rated construction.
6. Items penetrating finished ceiling including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 - f. Perimeter moldings.

B. Welding certificates.

C. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports, AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports, and AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
 3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.
- C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."
- D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Open ends of ductwork shall be factory shrink wrapped air and water tight before shipment to jobsite.
- B. Contractor shall adequately protect ductwork from damage after delivery to the project. Ductwork shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.

- C. Do not deliver ductwork to the project site until progress of construction has reached the stage where ductwork is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. Manufacturers:
 - 1. McCorvey Sheet Metal
 - 2. DuctDirect
 - 3. Gurry Mechanical L.P.
 - 4. Letsos Company
 - 5. Mason Road Sheet Metal Inc.
 - 6. Telkin Sheetmetal, Inc.
 - 7. Tomball Sheet Metal Co.
 - 8. McGill AirFlow LLC.
 - 9. Texas Duct Systems
 - 10. SEMCO Incorporated
 - 11. Lindab Inc.
- B. Fabricate ducts with indicated dimensions for the inner duct.
- C. Sheet Metal Connectors, Inc
- D. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- E. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- F. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- G. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 SINGLE-WALL ROUND AND FLAT OVAL DUCTS AND FITTINGS

- A. Manufacturers:
1. McCorvey Sheet Metal
 2. DuctDirect
 3. Gurry Mechanical L.P.
 4. Letsos Company
 5. Mason Road Sheet Metal Inc.
 6. Telkin Sheetmetal, Inc.
 7. Tomball Sheet Metal Co.
 8. Commercial Duct Systems, LLC
 9. Texas Duct Systems
 10. McGill AirFlow LLC.
 11. SEMCO Incorporated
 12. Lindab Inc.
- B. Fabricate ducts with indicated dimensions for the inner duct.
- C. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
- D. Triple-Rib shall be acceptable for single wall spiral lockseam ducts: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).
- E. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
1. Transverse Joints in Ducts Larger Than 60 Inches (1524 mm) in Diameter: Flanged.
- F. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
1. Fabricate round ducts larger than 90 inches (2286 mm) in diameter with butt-welded longitudinal seams.
 2. Fabricate flat-oval ducts larger than 72 inches (1830 mm) in width (major dimension) with butt-welded longitudinal seams.
- G. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 DOUBLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. Manufacturers:
1. McCorvey Sheet Metal
 2. Gurry Mechanical L.P.
 3. Letsos Company
 4. Mason Road Sheet Metal Inc.
 5. Telkin Sheetmetal, Inc.
 6. Tomball Sheet Metal Co.
 7. Commercial Duct Systems, LLC
 8. Texas Duct Systems
 9. McGill AirFlow LLC.
 10. SEMCO Incorporated
 11. Lindab Inc.
- B. Rectangular Ducts: Fabricate ducts with indicated dimensions for the inner duct.
- C. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- D. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- E. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- F. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
1. Maximum Thermal Conductivity: $K = 0.23$ at 75 deg F mean temperature.
 2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
 3. Coat insulation with antimicrobial coating.
 4. Cover insulation with polyester film complying with UL 181, Class 1.
- G. Interstitial Insulation: Flexible elastomeric duct liner complying with ASTM C 534, Type II for sheet materials, and with NFPA 90A or NFPA 90B.
1. Maximum Thermal Conductivity: $K = 0.23$ at 75 deg F mean temperature.
- H. Inner Duct: Minimum 0.028-inch perforated galvanized sheet steel having 3/32-inch- diameter perforations, with overall open area of 23 percent.

- I. Formed-on Transverse Joints (Flanges): Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Traverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- J. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.4 DOUBLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS

- A. Manufacturers:
 - 1. McCorvey Sheet Metal
 - 2. Gurry Mechanical L.P.
 - 3. Letsos Company
 - 4. Mason Road Sheet Metal Inc.
 - 5. Telkin Sheetmetal, Inc.
 - 6. Tomball Sheet Metal Co.
 - 7. Commercial Duct Systems, LLC
 - 8. Texas Duct Systems
 - 9. McGill AirFlow LLC.
 - 10. SEMCO Incorporated
 - 11. Lindab Inc.
- B. Fabricate ducts with indicated dimensions for the inner duct.
- C. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension) of the inner duct.
- D. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on static-pressure class unless otherwise indicated.
 - 1. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - a. Transverse Joints in Ducts Larger Than 60 Inches Diameter: Flanged.
 - 2. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - a. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.

- b. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.
 3. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- E. Inner Duct: Minimum 0.028-inch perforated galvanized sheet steel having 3/32-inch- diameter perforations, with overall open area of 23 percent.
- F. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
 1. Maximum Thermal Conductivity: $K = 0.23$ at 75 deg F mean temperature.
 2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
 3. Coat insulation with antimicrobial coating.
 4. Cover insulation with polyester film complying with UL 181, Class 1.
- G. Interstitial Insulation: Flexible elastomeric duct liner complying with ASTM C 534, Type II for sheet materials, and with NFPA 90A or NFPA 90B.
 1. Maximum Thermal Conductivity: $K = 0.23$ at 75 deg F mean temperature.

2.5 INSULATED FLEXIBLE DUCTS

- A. Manufacturers:
 - a. Thermaflex Type M-KE.
 - b. Atco
- B. Product Description: UL 181, Class 1, CPE fabric attached to helical wound spring galvanized steel wire; fiberglass insulation; aluminized vapor barrier film.
 - a. Pressure Rating: six (6) inches wg positive and four (4) inches wg negative.
 - b. Maximum Velocity: 4,000 fpm.
 - c. Temperature Range: -20 degrees Fahrenheit to 210 degrees Fahrenheit.
 - d. Thermal Resistance: Minimum R-6 installed.
 - e. Maximum flexible duct length shall not exceed 6'-0".
- C. Provide Flexible Duct Elbow Supports at each diffuser. Refer to "23 33 00 Air Duct Accessories"; 2.10 Flexible Duct Elbow Supports.

2.6 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction

methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G60 (Z180).
 - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. PVC-Coated, Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G60 (Z180).
 - 2. Minimum Thickness for Factory-Applied PVC Coating: 4 mils thick on sheet metal surface of ducts and fittings exposed to corrosive conditions, and minimum 1 mil thick on opposite surface.
 - 3. Coating Materials: Acceptable to authorities having jurisdiction for use on ducts listed and labeled by an NRTL for compliance with UL 181, Class 1.
- D. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.
- E. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.
- F. Aluminum Sheets: Comply with ASTM B 209 (ASTM B 209M) Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.
- G. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
 - 1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- H. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches.

2.7 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Water-Based Joint and Seam Sealant:
 - 1. Application Method: Brush on.
 - 2. Solids Content: Minimum 65 percent.
 - 3. Shore A Hardness: Minimum 20.
 - 4. Water resistant.
 - 5. Mold and mildew resistant.

6. VOC: Maximum 75 g/L (less water).
 7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
 8. Service: Indoor or outdoor.
 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- C. Flanged Joint Sealant: Comply with ASTM C 920.
1. General: Single-component, acid-curing, silicone, elastomeric.
 2. Type: S.
 3. Grade: NS.
 4. Class: 25.
 5. Use: O.
 6. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- D. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
- E. Round Duct Joint O-Ring Seals:
1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg (0.14 L/s per sq. m at 250 Pa) and shall be rated for 10-inch wg (2500-Pa) static-pressure class, positive or negative.
 2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
 3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.8 DUCT COATING REQUIREMENTS FOR NATATORIUMS

- A. General Coating Requirements: For any Metal Supply, Return, Outside Air, and Mixing Plenum duct including turning vanes and access doors; all surfaces shall be completely coated externally and internally prior to installation of insulation.
1. Inner liner and duct work: Amercoat PSX® 700 ETC.
 - a. Application Procedure: Adhere to all application instructions, precautions, conditions, and limitation to obtain the maximum performance. Contact PPG representative for manufacturer's recommendations.
 - b. Surface Preparation: Prior to coating, primed surface must be clean, dry, undamaged and free of all contaminants. Remove all loose rust, dirt, grease, oil, etc. or any other contaminants.
 - c. Environmental Conditions: Surface temperatures must be at least 5°F above dewpoint to prevent condensation during application and initial dry through.
 1. Air Temperature: 40°F - 120°F
 2. Surface Temperature: 40°F - 120°F
 3. Relative Humidity: 40% minimum

2.9 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
- D. Duct straps shall be wrapped from the top cord of joists; straps wrapped from the bottom chord will not be accepted.
- E. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- F. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
- G. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- H. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- I. Trapeze and Riser Supports:
 - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
 - 2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
 - 3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install round ducts in maximum practical lengths.
- D. Install ducts with fewest possible joints.
- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
- K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 Section "Air Duct Accessories" for fire and smoke dampers.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."
- M. Ductwork installed on the roof shall be installed and supported such that the roof may be maintained / repaired without the need to disassemble any ductwork.
- N. Dryer exhaust ducts for clothes dryers shall be smooth, rigid galvanized duct and shall terminate on the outside of the building and shall be equipped with a backdraft damper. Ducts shall not be connected or installed with sheet metal screws or other fasteners that will obstruct the exhaust flow. Clothes dryer exhaust ducts shall not be connected to a vent connector, vent or chimney. Clothes dryer exhaust ducts shall not extend into or through ducts or plenums. Provide weather resistant stainless steel wall cap at duct / wall penetration and a minimum 8" relief hood at roof penetration with roof curb, flashing and counter flashing.

3.2 INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 ADDITIONAL INSTALLATION REQUIREMENTS FOR COMMERCIAL KITCHEN HOOD EXHAUST DUCT

- A. Install commercial kitchen hood exhaust ducts without dips and traps that may hold grease, and sloped a minimum of 2 percent to drain grease back to the hood.
- B. Install fire-rated access panel assemblies at each change in direction and at maximum intervals of 20 feet in horizontal ducts, and at every floor for vertical ducts, or as indicated on Drawings. Locate access panel on top or sides of duct a minimum of 1-1/2 inches from bottom of duct.
- C. Do not penetrate fire-rated assemblies except as allowed by applicable building codes and authorities having jurisdiction.

3.4 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

3.5 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Where practical, install concrete inserts before placing concrete.
 - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
 - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
 - 5. For fastening of sheet metal support straps on each side of the duct, provide (2) two sheet metal screws on the side of the duct and (1) one on the bottom of the duct for a total of (6) six sheet metal screws for maximum fastening of strap to sheet metal duct.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet (5 m).

- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.6 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.7 PAINTING

- A. Paint all exposed ductwork and exterior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer; refer to paint manufacturer's instructions to prevent peeling. Coordinate final paint color with architect. Paint materials and application requirements are specified in Division 09 painting Sections.

3.8 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Leakage Tests:
 - 1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
 - 2. Test the following systems:
 - a. Ducts with a Pressure Class Higher Than 3-Inch wg: Test representative duct sections totaling no less than 25 percent of total installed duct area for each designated pressure class.
 - 3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
 - 4. Test for leaks before applying external insulation.
 - 5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
 - 6. Give seven days advanced notice for testing.
- C. Duct System Cleanliness Tests:
 - 1. Visually inspect duct system to ensure that no visible contaminants are present.

2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
 - a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.

- D. Duct system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.9 DUCT CLEANING

- A. Clean new duct system(s) before testing, adjusting, and balancing.
- B. Use service openings for entry and inspection.
 1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Division 23 Section "Air Duct Accessories" for access panels and doors.
 2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
 3. Remove and reinstall ceiling to gain access during the cleaning process.
- C. Particulate Collection and Odor Control:
 1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
 2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.
- D. Clean the following components by removing surface contaminants and deposits:
 1. Air outlets and inlets (registers, grilles, and diffusers).
 2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
 3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
 4. Coils and related components.
 5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
 6. Supply-air ducts, dampers, actuators, and turning vanes.

7. Dedicated exhaust and ventilation components and makeup air systems.

E. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans according to NADCA ACR 2006. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide drainage and cleanup for wash-down procedures.
7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

3.10 START UP

- A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

3.11 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:
 1. Underground Ducts: Concrete-encased, PVC-coated, galvanized sheet steel with thicker coating on duct exterior.
 2. All exposed ducts in spaces such as but not limited to; Gymnasiums, Natatoriums, and Cafeteria's: Double wall insulated round ductwork.
- B. Supply Ducts:
 1. Ducts Connected to Fan Coil Units, Split-DX System Air Units, Furnaces, Heat Pumps, and Terminal Units:
 - a. Pressure Class: Positive 1-inch wg.
 - b. Minimum SMACNA Seal Class: C.
 - c. SMACNA Leakage Class for Rectangular: 24.
 - d. SMACNA Leakage Class for Round: 12.

2. Ducts Connected to Constant-Volume Air-Handling and Rooftop Units:
 - a. Pressure Class: Positive 2-inch wg.
 - b. Minimum SMACNA Seal Class: B.
 - c. SMACNA Leakage Class for Rectangular: 12.
 - d. SMACNA Leakage Class for Round: 6.
 3. Ducts Connected to Variable-Air-Volume Air-Handling and Rooftop Units:
 - a. Pressure Class: Positive 4-inch wg.
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: 6.
 - d. SMACNA Leakage Class for Round: 3.
- C. Return and Outside Air Ducts:
1. Ducts Connected to Fan Coil Units, Split-DX System Air Units Furnaces, Heat Pumps, and Terminal Units:
 - a. Pressure Class: Positive or negative 1-inch wg.
 - b. Minimum SMACNA Seal Class: C.
 - c. SMACNA Leakage Class for Rectangular: 24.
 - d. SMACNA Leakage Class for Round: 12.
 2. Ducts Connected to Air-Handling and Rooftop Units:
 - a. Pressure Class: Positive or negative 2-inch wg.
 - b. Minimum SMACNA Seal Class: B.
 - c. SMACNA Leakage Class for Rectangular: 12.
 - d. SMACNA Leakage Class for Round: 6.
- D. Exhaust Ducts:
1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
 - a. Pressure Class: Negative 1-inch wg.
 - b. Minimum SMACNA Seal Class: C if negative pressure, and A if positive pressure.
 - c. SMACNA Leakage Class for Rectangular: 12.
 - d. SMACNA Leakage Class for Round: 6.
 2. Ducts Connected to Air-Handling and Rooftop Units:
 - a. Pressure Class: Positive or negative 2-inch wg.
 - b. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.
 - c. SMACNA Leakage Class for Rectangular: 12.
 - d. SMACNA Leakage Class for Round: 6.
 3. Ducts Connected to Commercial Kitchen Hoods: Comply with NFPA 96.
 - a. Exposed to View: 18 gauge Type 304, stainless-steel sheet, No. 4 finish.
 - b. Concealed: 16 gauge Carbon-steel sheet.
 - c. Continuously welded seams and joints
 - d. Pressure Class: Positive or negative 2-inch wg.
 - e. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.

- f. SMACNA Leakage Class: 3.
4. Ducts Connected to Dishwasher Hoods:
- a. 18 gauge Type 304, stainless-steel sheet.
 - b. Exposed to View: No. 4 finish.
 - c. Concealed: No. 2D finish.
 - d. Continuously welded seams and joints
 - e. Pressure Class: Positive or negative 2-inch wg.
 - f. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
 - g. SMACNA Leakage Class: 3.
5. Ducts Connected to Shower Return air grilles:
- a. 18 gauge Type 304, stainless-steel sheet.
 - b. Exposed to View: No. 4 finish.
 - c. Concealed: No. 2D finish.
 - d. Continuously welded seams and joints
 - e. Pressure Class: Positive or negative 2-inch wg.
 - f. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
 - g. SMACNA Leakage Class: 3.
6. Ducts Connected to Fans Exhausting Laboratory and Process (ASHRAE 62.1, Class 3 and 4) Air:
- a. Type 316, stainless-steel sheet.
 - 1. Exposed to View: No. 4 finish.
 - 2. Concealed: No. 2D finish.
 - b. Continuously welded seams and joints
 - c. Pressure Class: Positive or negative 3-inch wg.
 - d. Minimum SMACNA Seal Class: A.
 - e. SMACNA Leakage Class: 3.
7. Ducts Connected to Chlorine and Acid Rooms (ASHRAE 62.1, Class 3 and 4) Air:
- a. Type 316, stainless-steel sheet.
 - 1. Exposed to View: No. 4 finish.
 - 2. Concealed: No. 2D finish.
 - b. Continuously welded seams and joints
 - c. Pressure Class: Positive or negative 3-inch wg.
 - d. Minimum SMACNA Seal Class: A.
 - e. SMACNA Leakage Class: 3.
8. Ducts Connected to Fans Exhausting Welding Fumes (ASHRAE 62.1, Class 3 and 4) Air:
- a. Type 316, stainless-steel sheet.
 - 1. Exposed to View: No. 4 finish.
 - 2. Concealed: No. 2D finish.

- b. Continuously welded seams and joints
- c. Pressure Class: Positive or negative 3-inch wg.
- d. Minimum SMACNA Seal Class: A.
- e. SMACNA Leakage Class: 3.

E. Intermediate Reinforcement:

- 1. Galvanized-Steel Ducts: Galvanized steel or carbon steel coated with zinc-chromate primer.
- 2. PVC-Coated Ducts:
 - a. Exposed to Airstream: Match duct material.
 - b. Not Exposed to Airstream: Match duct material.
- 3. Stainless-Steel Ducts:
 - a. Exposed to Airstream: Match duct material.
 - b. Not Exposed to Airstream: Match duct material.
- 4. Aluminum Ducts: Aluminum or galvanized sheet steel coated with zinc chromate.

F. Elbow Configuration:

- 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
 - a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
- 2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."
 - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
 - 1. Radius-to Diameter Ratio: 1.5.
 - b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
 - c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam or welded.

G. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
 - a. Rectangular Main to Rectangular Branch: 45-degree entry.
 - b. Rectangular Main to Round Branch: Spin in.

2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
 - a. Velocity 1,000 fpm or Lower: 90-degree tap.
 - b. Velocity 1,000 to 1,500 fpm: Conical tap.
 - c. Velocity 1,500 fpm or Higher: 45-degree lateral.

END OF SECTION

SECTION 23 33 00

AIR DUCT ACCESSORIES

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Back-draft dampers.
2. Combination fire-and-smoke dampers.
3. Duct access doors.
4. Fire dampers.
5. Smoke dampers.
6. Volume control dampers.
7. Flexible duct connections
8. Duct Taps
9. Duct test holes
10. Flexible duct elbow supports

B. Related Sections:

1. Section 23 31 13 – Metal Ducts: Requirements for duct construction and pressure classifications.

1.2 SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Shop Drawings: Indicate shop fabricated assemblies including volume control dampers, duct access doors, and duct test holes.
- C. Product Data: Submit data for shop fabricated assemblies including fire dampers including locations and ratings, smoke dampers including locations and ratings, backdraft dampers, flexible duct connections, volume control dampers, duct access doors, duct test holes and hardware used. Include electrical characteristics and connection requirements.
- D. Manufacturer's Installation Instructions: Submit for Fire, Smoke and Combination Fire/Smoke Dampers.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Protect dampers from damage to operating linkages and blades.

1.5 COORDINATION

- A. Coordinate Work where appropriate with building control Work.
- B. Coordinate fire alarm wiring requirements with Division 26.

1.6 WARRANTY

- A. Furnish five (5) year manufacturer warranty for duct accessories.

1.7 EXTRA MATERIALS

- A. Furnish two (2) of each size and type of fusible link for fire rated dampers.

PART 2 - PRODUCTS

2.1 BACK-DRAFT DAMPERS

- A. Manufacturers:
 - 1. Arrow United Industries
 - 2. American Warming and Ventilating
 - 3. Ruskin
 - 4. Air Balance
 - 5. NCA
 - 6. Pottorff
 - 7. Greenheck
- B. Product Description: Multi-Blade, back-draft dampers: Parallel-action, gravity-balanced, Galvanized 16 gage thick steel, or extruded aluminum. Blades, maximum 6 inch width, center pivoted, with felt or flexible vinyl sealed edges. Blades linked together in rattle-free manner with 90-degree stop, steel ball bearings, and plated steel pivot pin. Furnish dampers with adjustment device to permit setting for varying differential static pressure.

2.2 COMBINATION FIRE AND SMOKE DAMPERS

- A. Manufacturers:
 - 1. Cesco
 - 2. NCA
 - 3. Ruskin
 - 4. Nailor
 - 5. Pottorff
 - 6. Greenheck
- B. Fabricate in accordance with NFPA 90A, UL 555, and UL 555S. Dampers shall be Leakage Class 1. Damper shall include a factory installed sleeve.
- C. Construction: Fabricate with 16 gage roll formed, galvanized steel hat-shaped channel frame. Furnish stainless steel sleeve bearings and plated steel axles, stainless steel jamb seals, concealed linkage, and 1/2 inch actuator shaft. Blades shall be airfoil type, 14 gauge equivalent. Blade edge seals shall be mechanically fastened to blade.

- D. Operators: UL listed and labeled two-position, fail close, electric type suitable for 120 volts, single phase, 60 Hz. Furnish end switches to indicate damper position. Locate damper operator on exterior of sleeve and link to damper operating shaft.
- E. Temperature rating: 250°F.
- F. Normally Closed Smoke Responsive Fire Dampers: Curtain type, opening by gravity upon actuation of Electro thermal link, flexible stainless steel blade edge seals to produce constant sealing pressure.
- G. Coordinate fire alarm control wiring with Division 26.
- H. Rating: 1-1/2 hours in wall rated at less than three (3) hours.
- I. Normally Open Smoke Responsive Fire Dampers: Curtain type, closing upon actuation of Electro thermal link, flexible stainless steel blade edge seals to produce constant sealing pressure, stainless steel springs with locking devices to maintain positive closure for units mounted horizontally.
- J. Electric Fuse Link: Heat actuated, quick detecting to release at 165 degrees Fahrenheit, UL listed and labeled. Controlled closing and locking of damper in 7-15 seconds to allow duct pressure to equalize. Instantaneous closure is not acceptable. Manual reset at damper.

2.3 DUCT ACCESS DOORS

- A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.
- B. Fabrication: Rigid and close fitting of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ductwork, furnish minimum 1 inch thick insulation with sheet metal cover.
 - 1. Less Than 12 inches square, secure with sash locks.
 - 2. Up to 18 inches Square: Furnish two hinges and two (2) sash locks.
 - 3. Up to 24 x 48 inches: Three hinges and two compression latches with outside handles.
 - 4. Larger Sizes: Furnish additional hinge.
 - 5. Access panels with sheet metal screw fasteners are not acceptable.

2.4 FIRE DAMPERS

- A. Manufacturers:
 - 1. Cesco
 - 2. NCA
 - 3. Ruskin
 - 4. Nailor
 - 5. Pottorff
 - 6. Greenheck

- B. Fabricate in accordance with NFPA 90A and UL 555, and manufacturer's condition of listing. Permanently mark dampers for use in dynamic systems.
- C. Ceiling Fire Dampers: Galvanized steel, 24 gage frame and 24 gage blades with UL classified insulation if required. Provide with radiation blanket.
- D. Curtain Type Dampers: 20 gage Galvanized steel frame with interlocking 24 gage galvanized steel blades. Furnish stainless steel closure springs and latches for horizontal installations and closure under airflow conditions. Configure with blades out of air stream.
- E. Multiple Blade Dampers: 16 gage galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, 1/8 x 1/2 inch plated steel concealed linkage, stainless steel closure spring, blade stops, and lock.
- F. Fusible Links: UL 33, separate at 165 degrees Fahrenheit.
- G. Rating: 1-1/2 hours in wall rated at less than three (3) hours.

2.5 SMOKE DAMPERS

- A. Manufacturers:
 - 1. Cesco
 - 2. NCA
 - 3. Ruskin
 - 4. Nailor
 - 5. Pottorff
 - 6. Greenheck
- B. Fabricate in accordance with UL 555S, Leakage Class I.
- C. Construction: Fabricate with 16 gage roll formed, galvanized steel hat-shaped channel frame. Furnish self-lubricating stainless steel sleeve bearings and plated steel axles, stainless steel jamb seals, concealed linkage and 1/2 inch actuator shaft. Blades shall be airfoil type, 14 gauge equivalent. Blade edge seals shall be mechanically fastened to blade.
- D. Operators: UL listed and labeled two-position, fail close, electric type suitable for 120 volts, single phase, 60 Hz. Furnish end switches to indicate damper position. Actuator to be mounted internally or externally as required.
- E. Temperature rating: 250°F.
- F. Coordinate fire alarm control wiring with Division 26.

2.6 VOLUME CONTROL DAMPERS

- A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated on Drawings.
- B. Splitter Dampers:
 - 1. Material: Same gage as duct to 24 inches size in both dimensions, and two gages heavier for sizes over 24 inches.

2. Blade: Fabricate of single thickness sheet metal secured with continuous hinge or rod with end bearings.
 3. Operator: Minimum 1/4 inch diameter rod in self aligning, universal joint action, flanged bushing with set screw.
- C. Single Blade Dampers: Fabricate for duct height up to 12".
- D. Multi-Blade Damper: Opposed blade interlocking type pattern for duct height 12" and greater. Assemble blades in galvanized frame channel with suitable hardware and linkage concealed in frame. Provide multiple section dampers for sizes larger than 48 inch x 72 inch. Provide jack shafting configuration and crossovers.
- E. Damper Blades:
1. Provide 16 gauge galvanized steel center and edge grooved blade type where velocities do not exceed 1500 FPM.
 2. Provide 14 gage galvanized steel. Roll formed airfoil blade type where velocities exceed 1500 FPM.
 3. Maximum leakage shall be 8 CFM per square foot of damper area at four (4) inches wg pressure.
- F. End Bearings: Except in round ductwork 12 inches and smaller, furnish end bearings. On multiple blade dampers, furnish oil-impregnated nylon or bronze bearings. Furnish closed end bearings on ducts having pressure classification over two (2) inches wg.
- G. Quadrants:
1. Furnish locking, indicating quadrant regulators on single and multi-blade dampers that do not have actuators.
 2. On insulated ducts mount quadrant regulators on 2" standoff mounting brackets, bases, or adapters.
 3. Where rod lengths exceed 30 inches furnish regulator at both ends.
 4. Provide remote damper operators for concealed dampers. Operator shall utilize miter gears, worm gears and couplings or be cable operated. Coordinate operator trim and location with Architect / Engineer.
- H. Actuators:
1. Maximum damper area per actuator shall be 24 square feet face area.
 2. Actuators shall be two position or modulating spring return type.
 3. Duct mounted dampers shall have actuators mounted outside of air stream.
 4. Coordinate with Section 23 09 23 – Direct-Digital Control System for HVAC.

2.7 FLEXIBLE DUCT CONNECTIONS

- A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.
- B. Connector: Fabric crimped into metal edging strip.
 - 1. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric conforming to NFPA 90A, minimum density 30 oz per sq yd.
 - 2. Net Fabric Width: Approximately six (6) inches wide.
 - 3. Metal: Three (3) inch wide, galvanized steel. Same gage as connecting duct.
 - 4. Install flexible connections with a minimum of one (1) inch between metal edges.
 - 5. Provide flexible duct connections at every duct connection to equipment.
- C. Application:
 - 1. Flexible duct connectors are not permitted on duct connections to internally isolated equipment. Internal isolation shall be in accordance with Section 15070.

2.8 DUCT TAPS

- A. Provide 24 gauge galvanized steel conical fittings with integral balancing damper for duct taps serving single ceiling diffuser. Balancing damper shall consist of 24 gauge, 3/8" steel axel and nylon end bearings with 2" standoff quadrant mount.
- B. Provide 24 gauge galvanized steel 45 degree, rectangular to round, side takeoff fitting with integral balancing damper when airflow is less than or equal to 20 percent of main duct airflow. Balancing damper shall consist of 24 gauge, 3/8" steel axel and nylon end bearings with 2" standoff quadrant mount.
- C. Provide tee split with radius elbow when takeoff or branch duct airflow is greater than 20 percent of main duct. Square throat elbows are acceptable in areas of limited clearances. Provide splitter damper. Refer to Section 23 31 00 - HVAC Duct and Casings.
- D. Provide volume damper at all takeoffs in constant volume systems and at all takeoffs downstream of terminal units in variable volume systems.

2.9 DUCT TEST HOLES

- A. Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Furnish extended neck fittings to clear insulation.
- B. Coordinate test hole locations and requirements with TAB contractor. If additional test holes are required for TAB, contractor will provide at no additional cost.

2.10 FLEXIBLE DUCT ELBOW SUPPORTS

- A. Elbow supports shall be constructed of durable composite material and be fully adjustable to support flexible duct diameters 6" – 16". Elbow supports shall be UL listed for use in return air plenum spaces.
- B. Provide elbow supports at each diffuser connection.
- C. Manufactured by Thermaflex – FlexFlow Elbow

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify rated walls are ready for fire damper installation.
- B. Verify ducts and equipment is ready for accessories.
- C. Check location of air outlets and inlets and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement.

3.2 INSTALLATION.

- A. Install in accordance with NFPA 90A, and follow SMACNA HVAC Duct Construction Standards Metal and Flexible. Refer to Section 23 31 00 - HVAC Duct and Casings for duct construction and pressure class.
- B. Install back-draft dampers on exhaust fans or exhaust ducts nearest to outside if motorized dampers are not shown on plans.
- C. Install duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, combination fire and smoke dampers, and as indicated on Drawings. Install at locations for cleaning kitchen exhaust ductwork in accordance with NFPA 96. Install minimum 8 x 8 inch size for hand access, 18 x 18 inch size for shoulder access, and as indicated on Drawings. Review locations prior to fabrication.
- D. Install temporary duct test holes required for testing and balancing purposes. Cut or drill in ducts. Cap with neoprene plugs, threaded plugs, threaded or twist-on metal caps.
- E. Provide fire dampers, combination fire and smoke dampers and smoke dampers at locations as indicated on Drawings. Install with required perimeter mounting angles, sleeves and breakaway duct connections.
- F. Install smoke dampers and combination fire and smoke dampers in accordance with NFPA 92A.
- G. Install volume dampers at points on supply, return, outside air and exhaust systems where branches extend from larger ducts. For air systems with common return air plenum provide volume dampers in both outside air and return air ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
 - 1. Install steel volume dampers in steel ducts.

2. Install aluminum volume dampers in aluminum ducts.
3. Install stainless steel volume dampers in stainless steel ducts.
4. Install aluminum volume dampers in natatoriums.

3.3 DEMONSTRATION

- A. Demonstrate re-setting of fire dampers, fire and smoke dampers and smoke dampers to Owner's representative.

END OF SECTION

SECTION 23 34 00

HVAC FANS

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SUMMARY

- A. Provide complete, fully operational fans where indicated on Drawings.
- B. Section Includes:
 - 1. Hooded propeller roof fans
 - 2. Upblast centrifugal roof fans
 - 3. Downblast centrifugal roof fans
 - 4. Upblast centrifugal roof fans – Grease exhaust
 - 5. Centrifugal filtered supply fans
 - 6. Inline Fans
 - 7. Side Wall Propeller Fans
 - 8. High Volume, Low Speed Fans
- C. Related Sections:
 - 1. Section 23 31 13 – Metal Ducts- Ducts: Product requirements for hangers for placement by this section.
 - 2. Section 23 33 00 - Air Duct Accessories: Product requirements for duct accessories for placement by this section.
 - 3. Coordinate work in this Section with Division 7.

1.2 SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Shop Drawings: Indicate size and configuration of fan assembly, mountings, weights, and ductwork and accessory connections.
- C. Product Data: Submit data on each type of fan and include accessories, fan curves with specified operating point plotted, power, RPM, sound power levels for both fan inlet and outlet at rated capacity, electrical characteristics and connection requirements.
- D. Manufacturer's Installation Instructions: Submit fan manufacturer's instructions.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Submit instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

1.4 QUALITY ASSURANCE

- A. Performance Ratings: Conform to AMCA 210 and bear AMCA Certified Rating Seal.
- B. Sound Ratings: AMCA 301, tested to AMCA 300, and bear AMCA Certified Sound Rating Seal.
- C. UL Compliance: UL listed and labeled, designed, manufactured, and tested in accordance with UL 705 and UL 762 for kitchen exhaust.
- D. Balance Quality: Conform to AMCA 204.
- E. Energy Recovery Unit Wheel Energy Transfer Rating: Meet ARI 1060.

1.5 WARRANTY

- A. Furnish one (1) year manufacturer's warranty for fans. Warranty shall begin from date of Certificate of Substantial Completion. Warranty start date from shipment or start up will not be acceptable.

1.6 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Spare materials shall be provided by equipment manufacturer and not by the installing mechanical contractor.
 - 1. Fan Belts: Two (2) sets for each belt-driven fan.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Fans shall be factory wrapped by the manufacturer prior to shipment to prevent damage due to weather and road debris during transportation and thereafter while in storage awaiting installation. Protection of the complete unit from rusting and water migration must be handled as best suits the circumstances. Store in a place protected from construction traffic and weather.
- B. All equipment shall remain in manufacturer's protective shipping wrap during construction. Openings must remain protected and covered during construction. If protective wrap has been damaged, the contractor shall provide additional protective wrap as directed by engineer.
- C. Contractor shall adequately protect equipment from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.
- D. Do not deliver Equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no

additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

PART 2 - PRODUCTS

2.1 HOODED PROPELLER ROOF FANS

- A. Manufacturers:
 - 1. Acme Engineering and Manufacturing Corp.
 - 2. Greenheck Corp.
 - 3. Loren Cook Company
 - 4. PennBarry
- B. Unit shall be a low profile, hooded, roof mounted, belt driven or direct drive, propeller supply ventilator. Coordinate drive with fan schedule on drawings.
- C. Fan shall be constructed in accordance with UL 705. Fan shall bear the AMCA certified ratings seal for air performance.
- D. Construction: The fan shall be of bolted and welded construction utilizing corrosion resistant fasteners. The motor, bearings and drives shall be mounted on a welded tubular steel power assembly. The power assembly shall be rigidly secured to the fan housing. The powder coated steel fan housing shall include a minimum 14 gauge base with integral spun venturi and continuously welded or application of butyl tape to inside of the curb cap for maximum leak protection. The fan shall be enclosed with a minimum 18 gauge galvanized steel hood bolted to the fan housing. The hood shall have a removable top cap to allow unobstructed access to the motor and power assembly without removing entire hood. The fan outlet shall be protected from entry of foreign material by ½" x ½" galvanized steel screen. Unit shall bear an engraved aluminum nameplate and shall be shipped in ISTA certified transit tested packaging.
- E. Coating: All ungalvanized steel fan components shall be treated with an electrostatically applied, baked polyester powder coating. Each component shall be subject to a five stage environmentally friendly wash system, followed by a minimum 2 mil thick baked powder finish. Paint must exceed 1,000 hour salt spray under ASTM B117 test method.
- F. Propeller: Propeller shall be a high-efficiency fabricated steel design with blades securely fastened to a minimum 7 gauge steel hub. The hub shall be keyed and locked to the fan shaft utilizing two setscrews. Propeller shall be balanced in accordance with AMCA Standard 204-96, Balance Quality and Vibration Levels for Fans.
- G. Motor: Motor shall be heavy duty type with permanently lubricated sealed ball bearings and furnished at the specified voltage, phase and enclosure.
- H. Bearings: Bearings shall be designed and tested specifically for use in air handling applications. Construction shall be heavy duty regreasable ball type in a cast iron housing selected for a minimum L50 life in excess of 200,000 hours at maximum cataloged operating speed.
- I. Belts and Drives: Belts shall be oil and heat resistant, non-static type. Drives shall be precision machined cast iron type, keyed and securely attached to the wheel and motor shafts. Drives shall be sized for 150% of the installed motor horsepower. The variable pitch motor drive must be factory set to the specified fan RPM.

- J. Roof Curb: 12 inch high of 18 gauge galvanized steel construction with continuously welded seams, built-in cant strips, 1-1/2 inch insulation, damper tray, hinged curb adapter for access to dampers, and factory installed nailer strip. Coordinate installation with Division 7.
- K. Accessories:
 - 1. Motorized damper in damper tray of roof curb. Actuator shall be same voltage as motor in fan. Damper shall energize fan through integral end switch.
 - 2. Disconnect Switch: Coordinate with Division 26. Provide factory wired disconnect switch on 120v motor only. Factory provided disconnect switches shall be rated for outdoor use. Three phase combination disconnect/starter shall be provided by Division 26.
 - 3. Direct drive units shall be provided with motor speed control option.

2.2 UPBLAST CENTRIFUGAL ROOF FANS

- A. Manufacturers:
 - 1. Acme Engineering and Manufacturing Corp.
 - 2. Greenheck Corp.
 - 3. Loren Cook Company
 - 4. PennBarry
- B. Fan shall be a spun aluminum, roof mounted, belt driven or direct drive, upblast centrifugal ventilator. Coordinate drive with fan schedule on drawings.
- C. Fan shall be constructed in accordance with UL 705. Fan shall bear the AMCA certified ratings seal for air performance.
- D. Construction: The fan shall be of bolted and welded construction utilizing corrosion resistant fasteners. The spun aluminum structural components shall be constructed of minimum 16 gauge marine alloy aluminum, bolted to a rigid aluminum support structure. The aluminum base shall have sealed curb cap corners by continuous weld or application of butyl tape to inside of the curb cap for maximum leak protection. The windband shall have a rolled bead for added strength. A two piece top cap shall have stainless steel quick release latches to provide access into the motor compartment without the use of tools. An integral conduit chase shall be provided into the motor compartment to facilitate wiring connections. The motor, bearings and drives shall be mounted on a minimum 14 gauge steel power assembly, isolated from the unit structure with rubber vibration isolators. These components shall be enclosed in a weather-tight compartment, separated from the exhaust airstream. Lifting lugs shall be provided to help prevent damage from improper lifting. Unit shall bear an engraved aluminum nameplate and shall be shipped in ISTA certified transit tested packaging.
- E. Wheel: Wheel shall be centrifugal backward inclined, constructed of 100 percent aluminum, including a precision machined cast aluminum hub. Wheel inlet shall overlap an aerodynamic aluminum inlet cone to provide maximum performance and efficiency. Wheel shall be balanced in accordance with AMCA Standard 204-96, Balance Quality and Vibration Levels for Fans.

- F. Motor: Motor shall be heavy duty type with permanently lubricated sealed ball bearings and furnished at the specified voltage, phase and enclosure.
- G. Bearings: Bearings shall be designed and individually tested specifically for use in air handling applications. Construction shall be heavy duty regreasable ball type in a cast iron pillow block housing selected for a minimum L50 life in excess of 200,000 hours at maximum cataloged operating speed.
- H. Belts & Drives: Belts shall be oil and heat resistant, non-static type. Drives shall be precision machined cast iron type, keyed and securely attached to the wheel and motor shafts. Drives shall be sized for 150 percent of the installed motor horsepower. The variable pitch motor drive must be factory set to the specified fan RPM.
- I. Roof Curb: 12 inch high of 18 gauge galvanized steel construction with continuously welded seams, built-in cant strips, 1-1/2 inch insulation, damper tray, hinged curb adapter for access to dampers, and factory installed nailer strip. Coordinate installation with Division 7.
- J. Accessories:
 - 1. Motorized damper in damper tray of roof curb. Actuator shall be same voltage as motor in fan. Damper shall energize fan through integral end switch.
 - 2. Disconnect Switch: Coordinate with Division 26. Provide factory wired disconnect switch on 120v motor only. Factory provided disconnect switches shall be rated for outdoor use. Three phase combination disconnect/starter shall be provided by Division 26.
 - 3. Direct drive units shall be provided with motor speed control option.

2.3 DOWNBLAST CENTRIFUGAL ROOF FANS

- A. Manufacturers:
 - 1. Acme Engineering and Manufacturing Corp.
 - 2. Greenheck Corp.
 - 3. Loren Cook Company
 - 4. PennBarry
- B. Fan shall be a spun aluminum, roof mounted, belt driven, and downblast centrifugal ventilator.
- C. Fan shall be constructed in accordance with UL 705. Fan shall bear the AMCA certified ratings seal for air performance.
- D. Construction: The fan shall be of bolted and welded construction utilizing corrosion resistant fasteners. The spun aluminum structural components shall be constructed of minimum 16 gauge marine alloy aluminum, bolted to a rigid aluminum support structure. The aluminum base shall have sealed curb cap corners by continuous weld or application of butyl tape to inside of the curb cap for maximum leak protection. The windband shall have a rolled bead for added strength. A two piece top cap shall have stainless steel quick release latches to provide access into the motor compartment without the use of tools. An integral conduit chase shall be provided into the motor compartment to facilitate wiring connections. The motor, bearings and drives shall be mounted on a minimum 14 gauge steel power assembly, isolated from the unit structure with rubber vibration

isolators. These components shall be enclosed in a weather-tight compartment, separated from the exhaust airstream. Lifting lugs shall be provided to help prevent damage from improper lifting. Unit shall bear an engraved aluminum nameplate and shall be shipped in ISTA certified transit tested packaging.

- E. Wheel: Wheel shall be centrifugal backward inclined, constructed of 100 percent aluminum, including a precision machined cast aluminum hub. Wheel inlet shall overlap an aerodynamic aluminum inlet cone to provide maximum performance and efficiency. Wheel shall be balanced in accordance with AMCA Standard 204-96, Balance Quality and Vibration Levels for Fans.
- F. Motor: Motor shall be heavy duty type with permanently lubricated sealed ball bearings and furnished at the specified voltage, phase and enclosure.
- G. Bearings: Bearings shall be designed and individually tested specifically for use in air handling applications. Construction shall be heavy duty regreasable ball type in a cast iron pillow block housing selected for a minimum L50 life in excess of 200,000 hours at maximum cataloged operating speed.
- H. Belts & Drives: Belts shall be oil and heat resistant, non-static type. Drives shall be precision machined cast iron type, keyed and securely attached to the wheel and motor shafts. Drives shall be sized for 150 percent of the installed motor horsepower. The variable pitch motor drive must be factory set to the specified fan RPM.
- I. Roof Curb: 12 inch high of 18 gauge galvanized steel construction with continuously welded seams, built-in cant strips, 1-1/2 inch insulation, damper tray, hinged curb adapter for access to dampers, and factory installed nailer strip. Coordinate installation with Division 7.
- J. Accessories:
 - 1. Motorized damper in damper tray of roof curb. Actuator shall be same voltage as motor in fan. Damper shall energize fan through integral end switch.
 - 2. Disconnect Switch: Coordinate with Division 26. Provide factory wired disconnect switch on 120v motor only. Factory provided disconnect switches shall be rated for outdoor use. Three phase combination disconnect/starter shall be provided by Division 26.
 - 3. Direct drive units shall be provided with motor speed control option.

2.4 UPBLAST CENTRIFUGAL ROOF FANS - GREASE EXHAUST

- A. Manufacturers:
 - 1. Acme Engineering and Manufacturing Corp.
 - 2. Greenheck Corp.
 - 3. Loren Cook Company
 - 4. PennBarry
- B. Unit shall be a low profile, hooded, roof mounted, belt driven or direct drive, propeller supply ventilator. Coordinate drive with fan schedule on drawings.
- C. Unit shall be constructed in accordance with UL 762. Fan shall bear the AMCA certified ratings seal for sound and air performance.

- D. Construction: The fan shall be of bolted and welded construction utilizing corrosion resistant fasteners. The aluminum base shall have sealed curb cap corners by continuous weld or application of butyl tape to inside of the curb cap for maximum leak protection. The windband shall have a rolled bead for added strength. A two piece top cap shall have stainless steel quick release latches to provide access into the motor compartment without the use of tools. An external wiring compartment to facilitate wiring connections. The motor, bearings and drives shall be mounted on a 14 gauge steel power assembly. These components shall be enclosed in a weather-tight compartment, separated from the exhaust airstream. A one (1) inch thick, three pound density foil back heat shield shall be utilized to protect the motor and drive components from excessive heat. Lifting lugs shall be provided to help prevent damage from improper lifting. Unit shall bear an engraved aluminum nameplate and shall be shipped in ISTA certified transit tested packaging.
- E. Wheel: Wheel shall be centrifugal backward inclined, constructed of 100 percent aluminum, including a precision machined cast aluminum hub. Wheel inlet shall overlap an aerodynamic aluminum inlet cone to provide maximum performance and efficiency.
- F. Motor: Motor shall be heavy duty type with permanently lubricated sealed ball bearings and furnished at the specified voltage, phase and enclosure.
- G. Bearings: Heavy duty regreasable ball type in a cast iron pillow block housing selected for a minimum L50 life in excess of 200,000 hours.
- H. Belts and Dives: Belts shall be oil and heat resistant, non-static type. Drives shall be precision machined cast iron type, keyed and securely attached to the wheel and motor shafts. Drives shall be sized for 150 percent of the installed motor horsepower. The variable pitch drive must be factory set to the specified fan RPM.
- I. Roof Curb: 12 inch high of 18 gauge galvanized steel construction with continuously welded seams, built-in cant strips, 1-1/2 inch insulation, damper tray, hinged curb adapter for access to dampers, and factory installed nailer strip. Coordinate installation with Division 7.
- J. Accessories:
 - 1. Disconnect Switch: Coordinate with Division 26.
 - 2. Direct drive units shall be provided with motor speed control option.
 - 3. Gravity actuated back-draft damper with adjustable counter weight.
 - 4. Provide minimum 10" tall vented curb extension.
 - 5. Provide grease trap with drain connection.
 - 6. Provide heat baffle.
 - 7. Provide Clean-Out Port.

2.5 CENTRIFUGAL FILTERED SUPPLY FAN - KITCHEN HOOD

- A. Manufacturers:
 - 1. Acme Engineering and Manufacturing Corp.
 - 2. Greenheck Corp.
 - 3. Loren Cook Company
 - 4. PennBarry
- B. Unit shall be a low profile, hooded, roof mounted, belt driven or direct drive, propeller supply ventilator. Coordinate drive with fan schedule on drawings.

- C. Description: Fan shall be a side intake, roof mounted, belt driven, centrifugal filtered supply fan.
- D. Fan shall be constructed in accordance with UL 705. Fan shall bear the AMCA certified ratings seal for air performance.
- E. Construction: The fan shall be of bolted construction utilizing corrosion resistant fasteners. Housing shall be minimum 18 gauge galvanized steel, bolted to a minimum 16 gauge steel fan base with pre-punched mounting holes. Unit shall be provided with an insulated top cover and 1" washable permanent aluminum filter. Internal blower and motor assembly shall be mounted on rubber vibration isolators. Unit shall bear an engraved aluminum nameplate and shall be shipped in ISTA certified transit tested packaging.
- F. Wheel: Wheel shall be DWDI centrifugal forward curved type, constructed of painted steel. Wheel shall be balanced in accordance with AMCA Standard 204-96, Balance Quality and Vibration Levels for Fans.
- G. Motor: Motor shall be heavy duty type with permanently lubricated sealed ball bearings and furnished at the specified voltage, phase and enclosure.
- H. Bearings: Bearings shall be permanently lubricated, sealed ball type selected for a minimum L50 life in excess of 200,000 hours at maximum cataloged operating speed.
- I. Belts and Drives: Belts shall be oil and heat resistant, non-static type. Drives shall be precision machined cast iron type, keyed and securely attached to the wheel and motor shafts. Drives shall be sized for 150% of the installed motor horsepower. The variable pitch motor drive must be factory set to the specified fan RPM.
- J. Roof Curb: 12 inch high of 18 gauge galvanized steel construction with continuously welded seams, built-in cant strips, 1-1/2 inch insulation, damper tray, hinged curb adapter for access to dampers, and factory installed nailer strip. Coordinate installation with Division 7.
- K. Accessories:
 - 1. Motorized damper in damper tray of roof curb. Actuator shall be same voltage as motor in fan. Damper shall energize fan through integral end switch.
 - 2. Disconnect Switch: Coordinate with Division 26. Provide factory wired disconnect switch on 120v motor only. Factory provided disconnect switches shall be rated for outdoor use. Three phase combination disconnect/starter shall be provided by Division 26.
 - 3. Direct drive units shall be provided with motor speed control option.

2.6 INLINE FANS

- A. Manufacturers:
 - 1. Acme Engineering and Manufacturing Corp.
 - 2. Greenheck Corp.
 - 3. Loren Cook Company
 - 4. PennBarry

- B. Fan shall be a duct mounted, centrifugal, belt driven or direct drive, inline type supply or exhaust ventilator.
- C. All fans shall bear the AMCA Certified Ratings Seal for both sound and air performance.
- D. Construction: The fan housing shall be of the square design constructed of heavy gauge galvanized steel and shall include square duct mounting collars. Fan construction shall include two removable access panels located perpendicular to the motor mounting panel. The access panels must be of sufficient size to permit easy access to all interior components. Each fan shall bear a permanently affixed manufacturer's nameplate containing the model number and individual serial number for future identification.
- E. Coating: For fans serving Natatoriums or corrosive environments provide epoxy coating on all inside and outside surfaces including fan wheel and pulley.
- F. Wheel: The fan wheels shall be centrifugal backward inclined, constructed of aluminum and shall include a wheel cone carefully matched to the inlet cone for precise running tolerances. Wheels shall be statically and dynamically balanced.
- G. Motor: Motors shall be heavy duty ball bearing type, carefully matched to the fan load and furnished at the specified voltage, phase, and enclosure. Motor Pulleys shall be adjustable for system balancing.
- H. Bearings: Precision ground and polished shafts shall be mounted in permanently sealed, lubricated pillow block ball bearings. Bearings shall be selected for a minimum (L10) life in excess of 100,000 hours at maximum catalogued operating speed.
- I. Belts & Drives: Drives shall be sized for a minimum of 150% of driven horsepower. Pulleys shall be of the fully machined cast iron type, keyed and securely attached to the wheel and motor shafts.
- J. Accessories:
 - 1. Disconnect Switch: Coordinate with Division 26. Provide factory wired disconnect switch on 120v motor only. Three phase combination disconnect/starter shall be provided by Division 26.
 - 2. Gravity actuated back-draft damper with adjustable counter weight.
 - 3. Direct drive units shall be provided with motor speed control option.
 - 4. Companion Flanges: For inlet and outlet duct connections.
 - 5. Fan Guards: 1/2 by 1-inch mesh of galvanized steel in removable frame. Provide guard for inlet or outlet for units not connected to ductwork.
 - 6. Motor and Drive Cover (Belt Guard): Epoxy-coated steel.

2.7 SIDE WALL PROPELLER FANS

- A. Manufacturers:
 - 1. Acme Engineering and Manufacturing Corp.

2. Greenheck Corp.
 3. Loren Cook Company
 4. PennBarry
- B. Housing: Galvanized-steel sheet with flanged edges and integral orifice ring with baked-enamel finish coat applied after assembly.
- C. Steel Fan Wheels: Formed-steel blades riveted to heavy-gage steel spider bolted to cast-iron hub.
- D. Fan Wheel: Replaceable, fabricated steel, airfoil blades fastened to cast-aluminum hub; factory set pitch angle of blades.
- E. Fan Drive: Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing.
- F. Fan Drive:
1. Resiliently mounted to housing.
 2. Statically and dynamically balanced.
 3. Selected for continuous operation at maximum rated fan speed and motor horsepower, with final alignment and belt adjustment made after installation.
 4. Extend grease fitting to accessible location outside of unit.
 5. Service Factor Based on Fan Motor Size: 1.4.
 6. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
 7. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
 8. Ball-Bearing Rating Life: ABMA 9, L10 of 100,000 hours.
 9. Pulleys: Cast iron with split tapered bushing; dynamically balanced at factory.
 10. Motor Pulleys: Adjustable pitch for use with motors through 5 hp; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
 11. Belts: Oil resistant, non-sparking, and non-static; matched sets for multiple belt drives.
 12. Belt Guards: Fabricate of steel for motors mounted on outside of fan cabinet.
- G. Accessories:
1. Long wall housing, flush exterior with OSHA guard.
 2. Motor-Side Back Guard: Galvanized steel, complying with OSHA specifications, removable for maintenance.
 3. Wall Sleeve: Galvanized steel to match fan and accessory size.

4. Weather shield Hood: Galvanized steel to match fan and accessory size with bird screen.
5. Weather shield Front Guard: Galvanized steel with expanded metal screen.
6. Direct drive units shall be provided with motor speed control option.
7. Provide factory damper mounted with damper actuator. Actuator shall be same voltage as the motor in the fan. Damper shall energize the fan through an integral end switch.
8. Disconnect Switch: factory provided and wired disconnect switch on 120 volt motors only; Non-fusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.

2.8 HIGH VOLUME, LOW SPEED FANS

- A. Manufacturers:
 1. Big Ass Fans – Essence Model
- B. Construction: Fan shall TUV certified and built pursuant to the construction guidelines set forth by the UL standard 507 and CSA standard 22.2. No. 113. The fan shall be designed to move an effective amount of air for cooling and destratification in commercial applications. The fan shall incorporate a direct drive system designed specifically for high volume, low speed fans to ensure silent operation. The sound levels from the fan operating at maximum speed shall not exceed 40 dBA (measured 20' or below the blades and 20' or horizontally from the center of the fan).
- C. Air Foils: The fan shall be equipped with eight (8) high volume, low speed airfoils of precision extruded, anodized aluminum alloy. Each airfoil shall be of the high performance mini-elipto design. The airfoils shall be connected to the hub and interlocked with eight (8) stainless steel retainers and two (2) sets of stainless steel bolts and washers per airfoil.
- D. Winglets: The fan shall be equipped with eight (8) unswept winglets designed to redirect outward airflow downward, thereby enhancing the efficiency and effectiveness of the fan. The winglets shall be molded of high strength polymer and shall be attached at the tip of each airfoil with a stainless steel screw. The standard color of the winglets shall be silver or black.
- E. Trim: The fan shall be equipped with trim inserts that nest between the hub and the inner edge of the foil. The trim inserts (8 each) shall provide a cleaner fit between the airfoils and the hub to help reduce the drag, turbulence and the noise. Trim inserts shall be black.
- F. Motor: The fan motor shall be a permanent magnet brushless motor rated for continuous operation at maximum speed with the capability of modulating the fan speed from 0-100% without the use of a gearbox or other mechanical means of control. The motor shall operate from any voltage ranging from 100-120 VAC, 1 PH, 60 HZ, without requiring adapters or customer selection. The motor shall be non-ventilated, heat sink design with the capability of continuous operation in -13° to 131°F ambient conditions. The standard color of the motor shall be white with silver trim or silver with black trim.

- G. Hub: The fan hub shall be constructed of zinc plated steel for high strength and durability. The hub shall be precision machined to achieve a well-balanced and solid rotating assembly.
- H. Mounting System: The fan mounting system shall be designed for quick and secure installation from a variety of structural supports. All components in the mounting system shall be of formed metal design using low-carbon steel no less than 3/16" thick and containing no critical welds. The mounting system shall be powder coated for appearance and resistance to corrosion. All mounting bolts shall be metric stainless steel or equivalent. No mounting hardware substitutions, including cast aluminum are acceptable. The fan extension tube shall be a round, extruded aluminum tube. The extension tube shall include a chrome plate with forward and reverse controls and a fan status indicator light that is visible from the floor.
- I. Safety Cables: The fan shall be equipped with upper and lower safety cables. The upper safety cable shall provide an additional means of securing the fan assembly to the building structure. The lower safety cable shall provide an additional means of securing the motor unit to the mounting system. All safety cables shall be 3/16" diameter and fabricated out of 7x19 stranded galvanized steel. The loops must be secured with swaged Nicopress fittings, pre-loaded and tested to 3,000 lbs. Field construction of safety cables in not permitted.
- J. Controller: The controller shall be incorporated into the fan assembly. The controller shall be factory programmed to minimize starting and breaking torques. The controller shall be housed in an enclosure to prevent accidental contact with the enclosed equipment and to prevent entry of unwanted substances.
- K. Wall Control: The fan shall be equipped with a low voltage wired remote wall control providing control of all fan functions. The wall control shall be capable of mounting to a standard electrical box or directly to a wall surface. The wall control shall include a rotary style dial for controlling the fans power and speed and an LED light to identify and relay faults in the system. Communication with the fan drive and controller shall be a standard, commercially available CAT 5 (or higher) Ethernet cable that is field installed and provided by the installer.
- L. Warranty:

Furnish five (5) year manufacturer's warranty for high volume low speed fans. Warranty shall begin from date of Certificate of Substantial Completion. Warranty start date from shipment or startup will not be acceptable.

The manufacturer shall replace any products or components defective in material or workmanship, free of charge to the customer (including all transportation charges).
- M. Accessories:
 - 1. Provide clear lockable enclosure for wall controller with two sets of keys.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify roof curbs are installed and dimensions are as shown on shop drawings.

3.2 INSTALLATION

- A. Secure roof fans with cadmium plated steel lag screws to roof curb structure.
- B. Install power ventilators level and plumb.
- C. Install dampers in roof curb damper tray.
- D. Provide hinged curb adapter to permit access to dampers and duct connection.
- E. Install safety screen where inlet or outlet is exposed.
- F. Provide sheaves required for final air balance.
- G. Install units with clearances for service and maintenance.
- H. Label units according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."

3.3 CLEANING

- A. Vacuum clean inside of fan cabinet.

3.4 DEMONSTRATION

- A. Demonstrate fan operation and maintenance procedures.

3.5 PROTECTION OF FINISHED WORK

- A. Do not operate fans until ductwork is clean, bearings are lubricated, and fan has been test run under observation.

END OF SECTION

SECTION 23 37 13

DIFFUSERS, REGISTERS, AND GRILLES

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Air devices.

1.2 REFERENCES

- A. Air Movement and Control Association International, Inc.:
 - 1. AMCA 500 - Test Methods for Louvers, Dampers, and Shutters.
- B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
 - 1. ASHRAE 70 - Method of Testing for Rating the Performance of Air Outlets and Inlets.
- C. Sheet Metal and Air Conditioning Contractors:
 - 1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated, include the following:
 - 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
 - 2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.
- B. Samples for Verification: For diffusers, registers, and grilles, in manufacturer's standard sizes to verify color selected.
- C. Test Reports: Rating of air outlet and inlet performance.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of air outlets and inlets.

1.5 QUALITY ASSURANCE

- A. Test and rate diffuser, register, and grille performance in accordance with ASHRAE 70.

- B. Test and rate louver performance in accordance with AMCA 500.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Air Devices shall be factory wrapped by the manufacturer prior to shipment to prevent damage due to weather and road debris during transportation and thereafter while in storage awaiting installation. Protection of the complete unit from rusting and water migration must be handled as best suits the circumstances. Store in a place protected from construction traffic and weather.
- B. All equipment shall remain in manufacturer’s protective shipping wrap during construction. Openings must remain protected and covered during construction. If protective wrap has been damaged, the contractor shall provide additional protective wrap as directed by engineer.
- C. Contractor shall adequately protect equipment from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer’s original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.
- D. Do not deliver equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

PART 2 - PRODUCTS

2.1 AIR DEVICES

- A. Manufacturers:
 - 1. Krueger
 - 2. Titus
 - 3. Price
 - 4. Nailor
- B. Mounting:
 - 1. Plaster Surfaces: Provide with plaster frames or plaster rings to make air tight seal against mounting surface.
 - 2. “T” Bar Ceilings: Lay-in type.
 - 3. Gyp Board and Wall surfaces: 1-1/2” overlap flange.
- C. Fire rated diffusers for fire rated roof/ceiling assembly: Refer to diffuser schedule for fire rated assembly requirement.

1. UL classified fire rated ceiling diffuser assembly listed in The Underwriters Laboratories "Fire Resistance Directory".
 2. Shall have a fire resistance rating of 3 hours.
 3. Heavy Gauge Steel Diffusers shall be tested in accordance with UL 263 and must meet NFPA 90A requirements. Diffusers must be able to operate in (3) three hour fire rated ceiling and must be installed in accordance with the installation instructions.
 4. UL 555C Fire resistance rating: 3-hour ceiling radiation damper with fusible link assembly. Fire closure temperature of 165°F.
 5. UL listed thermal blanket insulation, mineral fiber around entire diffuser.
 6. Complete fire rated damper assembly with blanket shall be provided and submitted by/with Diffusers, Registers, and Grilles.
- D. Source Quality Control
1. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."
- E. Accessories:
1. Square to round neck adapter.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify inlet and outlet locations.
- B. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.
- D. Verify ceiling and wall systems are ready for installation.
- E. Refer to Architectural Code Information and Fire Rated Assemblies Drawing to verify if ceiling is fire rated. If ceiling is fire rated provide U.L. tested radiation damper with thermal blanket for all ceiling mounted supply and return air grilles.

3.2 INSTALLATION

- A. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers
- B. Install balancing dampers on duct take-off to diffusers, grilles, and registers, whether or not dampers are furnished as part of diffuser, grille, and register assembly. Refer to Section 23 33 00 – Air Duct Accessories.

- C. Install diffusers, registers, and grilles level and plumb.
- D. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- E. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.
- F. Paint visible portion of ductwork behind air outlets and inlets matte black. Refer to Section 09 91 00.

3.3 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

3.4 INTERFACE WITH OTHER PRODUCTS

- A. Check location of outlets and inlets and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement.

3.5 SCHEDULES:

- A. Refer to Drawings.

END OF SECTION

SECTION 23 37 23

HVAC GRAVITY VENTILATORS

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SUMMARY

- A. Provide complete, fully operational fans where indicated on Drawings.
- B. Section Includes:
 - 1. Dryer vent roof cap
 - 2. Roof mounted intake hood
 - 3. Roof mounted relief hood
- C. Related Sections:
 - 1. Section 23 31 00 - HVAC Duct and Casings: Product requirements for hangers for placement by this section.
 - 2. Section 23 33 00 - Air Duct Accessories: Product requirements for duct accessories for placement by this section.
 - 3. Coordinate work in this Section with Division 7.

1.2 SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Shop Drawings: Indicate size and configuration of fan assembly, mountings, weights, ductwork and accessory connections.
- C. Product Data: Submit data on each type of fan and include accessories, fan curves with specified operating point plotted, power, RPM, sound power levels for both fan inlet and outlet at rated capacity, electrical characteristics and connection requirements.
- D. Manufacturer's Installation Instructions: Submit fan manufacturer's instructions.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Submit instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

1.4 QUALITY ASSURANCE

- A. Performance Ratings: Conform to AMCA 210 and bear AMCA Certified Rating Seal.
- B. Sound Ratings: AMCA 301, tested to AMCA 300, and bear AMCA Certified Sound Rating Seal.

- C. UL Compliance: UL listed and labeled, designed, manufactured, and tested in accordance with UL 705 and UL 762 for kitchen exhaust.
- D. Balance Quality: Conform to AMCA 204.
- E. Energy Recovery Unit Wheel Energy Transfer Rating: Meet ARI 1060.

1.5 WARRANTY

- A. Furnish one (1) year manufacturer's warranty. Warranty shall begin from date of Certificate of Substantial Completion. Warranty start date from shipment or start up will not be acceptable.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Ventilators shall be factory wrapped by the manufacturer prior to shipment to prevent damage due to weather and road debris during transportation and thereafter while in storage awaiting installation. Protection of the complete unit from rusting and water migration must be handled as best suits the circumstances. Store in a place protected from construction traffic and weather.
- B. All equipment shall remain in manufacturer's protective shipping wrap during construction. Openings must remain protected and covered during construction. If protective wrap has been damaged, the contractor shall provide additional protective wrap as directed by engineer.
- C. Contractor shall adequately protect equipment from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.
- D. Do not deliver equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

PART 2 - PRODUCTS.

2.1 DRYER VENT ROOF CAP

- A. Manufacturers:
 - 1. Acme Engineering and Manufacturing Corp.
 - 2. Greenheck Corp.
 - 3. Loren Cook Company
 - 4. Penn Ventilation
- B. Unit shall be a spun aluminum, roof mounted gravity ventilator.

- C. Construction: The unit shall be of bolted and welded construction utilizing corrosion resistant fasteners. The spun aluminum structural components shall be constructed of minimum 16 gauge marine alloy aluminum, bolted to a rigid aluminum support structure. The aluminum base shall have continuously welded curb cap corners for maximum leak protection. The spun aluminum baffle shall have a rolled bead for added strength. Unit shall bear an engraved aluminum nameplate and shall be shipped in ISTA certified transit tested packaging.
- D. Roof Curb: 12 inch high of 18 gauge galvanized steel construction with continuously welded seams, built-in cant strips, 1-1/2 inch insulation, damper tray, hinged curb adapter for access to dampers, and factory installed nailer strip. Coordinate installation with Division 7.
- E. Accessories: Gravity actuated back-draft damper with adjustable counter weight.

2.2 ROOF MOUNTED INTAKE HOOD

- A. Manufacturers:
 - 1. Acme Engineering and Manufacturing Corp.
 - 2. Greenheck Corp.
 - 3. Loren Cook Company
 - 4. Penn Ventilation
 - 5. Twin City
- B. Unit shall be an aluminum roof mounted intake hood.
- C. Construction: The unit shall be of bolted and welded construction utilizing corrosion resistant fasteners. The aluminum hood shall be constructed of minimum 14 gauge marine alloy aluminum, bolted to a minimum 8 gauge aluminum support structure. The aluminum base shall have sealed curb cap corners by continuous weld or application of butyl tape to inside of the curb cap for maximum leak protection. Birdscreen constructed of 1/2" mesh shall be mounted across the intake opening. Unit shall bear an engraved aluminum nameplate and shall be shipped in ISTA certified transit tested packaging.
- D. Roof Curb: 12 inch high of 18 gauge galvanized steel construction with continuously welded seams, built-in cant strips, 1-1/2 inch insulation, damper tray, hinged curb adapter for access to dampers, and factory installed nailer strip. Coordinate installation with Division 7.
- E. Accessories:
 - 1. Motorized damper in damper tray of roof curb. Actuator shall be low voltage for control wiring from DDC controller. Damper shall include integral end switch.

2.3 ROOF MOUNTED RELIEF HOOD

- A. Manufacturers:
 - 1. Acme Engineering and Manufacturing Corp.
 - 2. Greenheck Corp.
 - 3. Loren Cook Company
 - 4. Penn Ventilation
 - 5. Twin City

- B. Unit shall be an aluminum roof mounted relief hood.
- C. Construction: The unit shall be of bolted and welded construction utilizing corrosion resistant fasteners. The aluminum hood shall be constructed of minimum 14 gauge marine alloy aluminum, bolted to a minimum 8 gauge aluminum support structure. The aluminum base shall have sealed curb cap corners by continuous weld or application of butyl tape to inside of the curb cap for maximum leak protection. Bird screen constructed of 1/2" mesh shall be mounted across the intake opening. Unit shall bear an engraved aluminum nameplate and shall be shipped in ISTA certified transit tested packaging.
- D. Roof Curb: 12 inch high of 18 gauge galvanized steel construction with continuously welded seams, built-in cant strips, 1-1/2 inch insulation, damper tray, hinged curb adapter for access to dampers, and factory installed nailer strip. Coordinate installation with Division 7.
- E. Accessories:
 - 1. Gravity actuated back-draft damper with adjustable counter weight.
 - 2. Motorized damper; actuator shall be low voltage for control wiring from DDC controllers. Damper shall include integral end switch.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify roof curbs are installed and dimensions are as shown on shop drawings.

3.2 INSTALLATION

- A. Secure intake/relief hoods with cadmium plated steel lag screws to roof curb structure.
- B. Install dampers in roof curb damper tray.
- C. Provide hinged curb adapter to permit access to dampers and duct connection.
- D. Install safety screen where inlet or outlet is exposed.

3.3 MANUFACTURER'S FIELD SERVICES

- A. Furnish services of factory trained representative for minimum of one (1) day to start-up, calibrate controls, and instruct Owner on operation and maintenance.

3.4 CLEANING

- A. Vacuum clean inside of fan cabinet.

3.5 DEMONSTRATION

- A. Demonstrate fan operation and maintenance procedures.

3.6 PROTECTION OF FINISHED WORK

- A. Do not operate until ductwork is clean, bearings are lubricated, and fan has been test run under observation.

END OF SECTION

SECTION 23 74 13

PACKAGED, OUTDOOR, CENTRAL-STATION AIR HANDLING UNITS

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

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 packaged, outdoor, central-station air-handling units with the following components and accessories such as but not limited to:
 - 1. Direct-expansion cooling.
 - 2. Hot-gas re-heat.
 - 3. Electric-heating coils.
 - 4. Integral, space temperature controls.
 - 5. Roof curbs.
- B. Electrical characteristics: Coordinate with electrical plans prior to submitting equipment; provide single point power connections.

1.3 ACTION SUBMITTALS

- A. Product Data: Include manufacturer's technical data for each RTU, including rated capacities, dimensions, required clearances, characteristics, furnished specialties, and accessories.
- B. Provide line-by-line specification review annotated to certify compliance or deviation.
- C. Shop Drawings:
 - 1. Include plans, elevations, sections, and attachment details.
 - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, and required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Prepare the following by or under the supervision of a qualified professional engineer:
 - a. Mounting Details: For securing and flashing roof curb to roof structure. Indicate coordinating requirements with roof membrane system.
 - b. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Roof-curb mounting details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Structural members to which RTUs will be attached.
 - 2. Roof openings
 - 3. Roof curbs and flashing.
- B. Required roof penetrations for ducts, pipes, and electrical raceways, including size and location of each penetration.
- C. Startup service reports.
- D. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For units to include in emergency, operation, and maintenance manuals.

1.6 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Spare materials shall be provided by equipment manufacturer and not by the installing mechanical contractor.
 - 1. Fan Belts: One (1) for each belt-driven fan.
 - 2. Filters: One (1) set for each unit.

1.7 QUALITY ASSURANCE

- A. ARI Compliance:
 - 1. Comply with ARI 210/240 and ARI 340/360 for testing and rating energy efficiencies for RTUs.
 - 2. Comply with ARI 270 for testing and rating sound performance for RTUs.
- B. ASHRAE Compliance:
 - 1. Comply with ASHRAE 15 for refrigeration system safety.
 - 2. Comply with ASHRAE 33 for methods of testing cooling and heating coils.
 - 3. Comply with applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

- C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."
- D. NFPA Compliance: Comply with NFPA 90A and NFPA 90B.
- E. UL Compliance: Comply with UL 1995.
- F. 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.

1.8 WARRANTY

- A. The manufacturer shall provide a full machine parts, labor, and refrigerant warranty for a period of one (1) year. Warranty shall begin from date of Certificate of Substantial Completion. Provide a sample of manufacturer's warranty certificates as described below within equipment submittal. Warranty start dates from shipment or start up will not be accepted.
- B. Provide an extended four (4) year FULL machine parts, labor and refrigerant warranty for rooftop units. All components to be included such as but not limited to: refrigerant, compressors, evaporator coils, condenser coils, electric heaters, gas-fired heaters, roof curbs, motors, starters, variable frequency drives, controls, etc. In the event of failure, the manufacturer shall provide a new motor, compressor, fan, evaporator coil, condenser coil, and controllers, drive assembly, etc. Local or field rebuilt motors, compressors, drive assemblies etc. are not acceptable.
- C. In addition to full machine parts, labor and refrigerant, the Standard and Extended warranty shall include miscellaneous materials, travel time, incidental expenses, normal freight/shipping, refrigerant, oils, lubricants, belts, filters, insulation and any expenses related to service calls required to diagnose and correct warranty issues.
- D. The manufacturer shall provide factory certificates for each Rooftop Unit listing at a minimum the model, serial number and warranty information as specified above. Payment to contractor may be held if warranty certificates are not provided in a timely manner.
- E. All warranty work shall be performed by factory direct service technician. Warranty work shall not be performed by installing mechanical contractor.

1.9 MAINTENANCE SERVICE

- A. Furnish service and maintenance of units for period of five (5) years from Date of Substantial Completion.
- B. Include, on a quarterly basis, systematic examination, required adjustments, lubrication of unit and controls calibration. Repair or replace parts in accordance with manufacturer's operating and maintenance data. Use new parts produced by manufacturer of original equipment.
- C. Perform work without removing units from service during building normal occupied hours. Off-line work must be coordinated with Owner.

- D. At an additional cost to owner provide emergency call back service at all hours during this maintenance period.
- E. Maintain locally adequate stock of parts for replacement or emergency purposes. Have personnel available to ensure fulfillment of this maintenance service, without unreasonable loss of time.
- F. Perform maintenance work using authorized factory trained technicians.
- G. Do not assign or transfer maintenance service to agent or subcontractor without prior written consent of Owner.

1.10 FACTORY TESTING

- A. All units shall be factory assembled, internally wired, fully charged with refrigerant, and 100% tested prior to leaving the factory. Certified factory testing report shall be sent to owner and engineer upon request. The factory test shall include a refrigerant circuit test, a unit control system operations checkout, a unit refrigerant leak test and a final unit inspection. If unit fails any portion of the certified test, failures shall be corrected before unit leaves the factory.
- B. If for any reason unit does not meet the manufacturer's standards, those items shall be corrected and re-tested prior to leaving the factory with no additional cost to the owner.

1.11 DELIVERY, STORAGE, AND HANDLING

- A. Units shall be factory wrapped by the manufacturer prior to shipment to prevent damage due to weather and road debris during transportation and thereafter while in storage awaiting installation. Protection of the complete unit from rusting and water migration must be handled as best suits the circumstances. Store in a place protected from construction traffic and weather.
- B. All equipment shall remain in manufacturer's protective shipping wrap during construction. Openings must remain protected and covered during construction. If protective wrap has been damaged, the contractor shall provide additional protective wrap as directed by engineer.
- C. Contractor shall adequately protect equipment from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.
- D. Do not deliver equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.
- E. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.

- F. Protect units from physical damage. Leave factory covers in place until startup of machine.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Aeon
 - 2. Or approved equal
- B. Configuration: Coordinate with project plans and schedules.
- C. Performance Base: Sea level pressure or altitude.
- D. Fabrication: Conform to AMCA 99 and ARI 430. Units shall be factory assembled and ship in one piece where possible. Shipping splits are acceptable provided manufacturer includes gaskets and bolts and performs final unit inspection.

2.2 CASING

- A. General Fabrication Requirements for Casings: Formed and reinforced insulated panels, fabricated to allow removal for access to internal parts and components, with joints between sections sealed.
- B. Construction:
 - 1. Less than 20 tons: Single wall
 - 2. 20 tons and greater: Double wall
- C. Exterior Casing Material: 18 gauge galvanized steel with factory painted finish capable of withstanding at least 2,500 hours, with no visible corrosive effects, when tested in a salt spray and fog atmosphere in accordance with ASTM B 117-95 test procedure. Roof panels shall be pitched with overhangs above access doors, and knockouts with grommet seals for electrical and piping connections and lifting lugs.
- D. Casing Fabrication Requirements:
 - 1. Inside casing: 18 Gauge galvanized steel.
- E. Casing Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.
 - 1. Materials: ASTM C 1071, Type I.
 - 2. Single wall thickness and density: 1 inch, 1.5 lbs. density
 - 3. Double wall thickness and density: 2 inches, 3 lbs. density engineered polymer foam injected.

4. Liner materials shall have air-stream surface coated with an erosion- and temperature-resistant coating or faced with a plain or coated fibrous mat or fabric.
 5. Liner Adhesive: Comply with ASTM C 916, Type I.
- F. Condensate Drain Pans: Formed sections of welded Type 304 stainless-steel sheet, a minimum insulation of two (2) inches deep, and complying with ASHRAE 62.1.
1. Double-Wall Construction: Fill space between walls with foam insulation and seal moisture tight.
 2. Cross break and pitch to drain connection.
 3. Drain Connections: Threaded nipple.
 4. Cooling coils with a finned height greater than 48 inches shall have an intermediate stainless steel IAQ drain pan extending entire length of the coil intermediate drain pan shall have a minimum of two drop tubes to main pan.
 5. Drain pans shall allow no standing water and must be accessible for cleaning.
- G. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- H. Continuous sealing shall be included between panels and between access doors and openings to reduce air leakage. Piping and electrical conduit through cabinet panels shall include sealing to reduce air leakage.
- I. Base Rails: Full perimeter insulated galvanized rails for mounting on roof curb or pad as indicated.
- J. Access for Inspection, Cleaning, and Maintenance: Comply with requirements in ASHRAE 62.1.
- K. Service Doors: Hinged access doors with gaskets. Material and construction of doors shall match material and construction of cabinet in which doors are installed.
- L. Floor: Reinforced, metal surface; reinforced to limit deflection when walked on by service personnel. Insulation shall be below metal walking surface.

2.3 FANS

- A. Refer to equipment schedule for drive / fan type.
- B. Direct-Driven Supply-Air Fans: Single width, single inlet; plenum; with permanently lubricated, multispeed or ECM motor resiliently mounted in the fan inlet. Painted-steel wheels, and galvanized fan scrolls with solid steel shaft.
- C. Belt-Driven Supply-Air Fans: Double width, forward curved, centrifugal; with self aligning permanently lubricated ball bearings, single-speed motor installed on an

adjustable fan base resiliently mounted in the casing. Painted-steel wheels, and galvanized fan scrolls with solid steel shaft.

1. Service Factor for Belt Drive Applications: V-belt drive with matching fan pulley and adjustable motor sheaves and belt assembly with minimum 1.5 service factor.
- D. Direct-Driven Condenser-Coil Fan: Propeller, mounted on shaft of permanently lubricated motor.
1. Low sound operating, PVC coated fan guard, to discharge vertically. FRP construction on condenser fans under 15-tons. Fully dipped and baked epoxy on condenser fan assembly is also acceptable.
 2. Condenser Fan Motor: Totally enclosed air over (TEAO), permanently lubricated ball bearings; resiliently mounted; overload protected. Motors shall be ECM, Electronically Commutated Motors, on all units.
 3. Provide factory installed head pressure control module. Condenser airflow shall continuously modulate based on head pressure and cooling operation shall be allowed down to 35°F with adjustable compressor lockout.
 4. Fan Safety Guards: Steel with corrosion-resistant coating.
- E. Seismic Fabrication Requirements: Fabricate fan section, internal mounting frame and attachment to fans, fan housings, motors, casings, accessories, and other fan section components with reinforcement strong enough to withstand seismic forces defined in Section 230548 "Vibration and Seismic Controls for HVAC Piping and Equipment" when fan-mounted frame and RTU-mounted frame are anchored to building structure.
- F. Supply Fan Motor:
1. Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."
 2. Enclosure: Totally enclosed air over (TEAO).
 3. Electronically Commutated Motors (ECM).
 4. Supply fans shall be provided with a (VFD) variable frequency drive for balancing and soft start purposes. VFD shall be factory provided and installed and wired in a ventilated controls compartment by manufacturer prior to shipment. Externally mounted VFD's shall be provided in NEMA 3R enclosure. VFD's shall be provided with a bypass. Refer to section 23 05 14 'Variable Frequency Drives' for requirements and list of acceptable manufacturers. Refer to schedule for VFD requirement.
 5. Mounting: Locate fan and motor internally on welded or bolted steel base coated with corrosion resistant paint or rust-resistant G90 steel and factory-mounted motor on fan isolation sled with rubber in shear isolators with 2" deflection. Fan wheel and motor shall be dynamically balanced after assembly. Furnish access to motor, drive, and bearings through hinged access doors.

2.4 COILS

- A. Capacity Ratings: Comply with ASHRAE 33 and ARI 410 and coil bearing the ARI label.
- B. Leak Test: Coils shall be leak tested with air underwater.
- C. Supply-Air Refrigerant Coil:
 - 1. Aluminum plate fin and seamless copper tube with brazed joints in galvanized steel casing with equalizing-type vertical distributor.
 - 2. Tube Header Material: Seamless Copper.
 - 3. Fin and Tube Joints: Mechanical bond.
 - 4. Refrigerant Coil Capacity Reduction: Circuit coils for intertwined control.
 - 5. Coating: Coils shall have a factory applied, flexible, epoxy polymer e-coat uniformly applied to all coil surface areas without material bridging between fins. Humidity and water immersion resistance shall be up to a minimum 1,000 and 250 hours respectively (ASTM D2247-92 and ASTM D870-92). Corrosion durability shall be confirmed through testing to no less than 6,000 hours salt spray per ASTM B117-90. Coated coils shall receive a spray-applied, UV-resistant polyurethane topcoat to prevent UV degradation of the e-coat. Coating shall carry a 5 year warranty, from the date of substantial completion. Field applied coatings will not be acceptable.
 - 6. Condensate Drain Pan: Stainless steel formed with pitch and drain connections complying with ASHRAE 62.1.
- D. Outdoor-Air Refrigerant Coil:
 - 1. Aluminum plate fin and seamless copper tube with brazed joints in galvanized steel casing with equalizing-type vertical distributor.
 - 2. Tube Header Material: Seamless Copper.
 - 3. Fin and Tube Joints: Mechanical bond.
 - 4. All condenser coils require louvered panels for added protection of the condenser coils from hail and other physical damage
 - 5. Coating: Coils shall have a factory applied, flexible, epoxy polymer e-coat uniformly applied to all coil surface areas without material bridging between fins. Humidity and water immersion resistance shall be up to a minimum 1,000 and 250 hours respectively (ASTM D2247-92 and ASTM D870-92). Corrosion durability shall be confirmed through testing to no less than 6,000 hours salt spray per ASTM B117-90. Coated coils shall receive a spray-applied, UV-resistant polyurethane topcoat to prevent UV degradation of the e-coat. Coating shall carry a 5 year warranty, from the date of substantial completion. Field applied coatings will not be acceptable.

E. Hot-Gas Reheat Refrigerant Coil:

1. Aluminum plate fin and seamless copper tube with brazed joints in galvanized steel casing with equalizing-type vertical distributor.
2. Tube Header Material: Seamless Copper.
3. Fin and Tube Joints: Mechanical bond.
4. Refrigerant Coil Capacity Reduction: Circuit coils for intertwined control.
5. Coating: Coils shall have a factory applied, flexible, epoxy polymer e-coat uniformly applied to all coil surface areas without material bridging between fins. Humidity and water immersion resistance shall be up to a minimum 1,000 and 250 hours respectively (ASTM D2247-92 and ASTM D870-92). Corrosion durability shall be confirmed through testing to no less than 6,000 hours salt spray per ASTM B117-90. Coated coils shall receive a spray-applied, UV-resistant polyurethane topcoat to prevent UV degradation of the e-coat. Coating shall carry a 5 year warranty, from the date of substantial completion. Field applied coatings will not be acceptable.
6. Shall be available and provided as a factory installed option. Hot-gas reheat coil shall be modulating control. On/off control not acceptable.
7. Lead refrigeration circuit shall be provided with hot gas reheat coil, modulating valves, electronic controller, supply air temperature sensor and a dehumidification control signal terminal which allow the unit to have a dehumidification mode of operation, which includes supply air temperature control to prevent supply air temperature swings and overcooling of the space.
8. Evaporator temperature to be precisely controlled by monitoring the compressor saturated suction temperature.
9. Shall be capable of simultaneously operating both the non hot-gas reheat compressor circuits and hot-gas reheat compressor circuits of multiple compressor units when both the humidity level and the first stage cooling temperature level exceed their set points.
10. Shall be capable of prioritizing a cooling demand over a dehumidification demand and shut off the hot-gas reheat coil circuit(s) to meet the temperature requirements. Shall be able of turning the hot-gas reheat coil back on if the dehumidification demand still exists after the cooling demand has been met.
11. Shall consist of a reheat coil, three-way solenoid valve, a check valve and associated copper piping.
12. Reheat coil shall be constructed with enhanced aluminum fins mechanically bonded to copper tubes. Fin count shall not exceed 14 fins per inch.
13. Reheat coil shall be located on the leaving air side of the evaporator coil.
14. Three way solenoid valves shall be non-modulating type and normally closed for the reheat coil.

15. Check valve shall be provided to prevent reverse flow of refrigerant during cooling operation.

F. Electric-Resistance Heating:

1. Open Heating Elements: Resistance wire of 80 percent nickel and 20 percent chromium, supported and insulated by floating ceramic bushings recessed into casing openings, fastened to supporting brackets, and mounted in galvanized-steel frame. Terminate elements in stainless-steel machine-staked terminals secured with stainless-steel hardware.
2. Over-temperature Protection: Disk-type, automatically reset, thermal-cutout, safety device; serviceable through terminal box.
3. Overcurrent Protection: Manual-reset thermal cutouts, factory wired in each heater stage.
4. Control Panel: Factory mounted with disconnecting means and overcurrent protection. Include the following controls:
 - a. Magnetic contactors.
 - b. SCR Controller: Pilot lights operate on load ratio, a minimum of five steps.
 - c. Time-delay relay.
 - d. Airflow proving switch.

2.5 REFRIGERANT CIRCUIT COMPONENTS

- A. Comply with requirements in ASHRAE 15, "Safety Standard for Refrigeration Systems."
- B. Refrigerant Charge: Factory charged with refrigerant and filled with oil.
- C. Compressors: Scroll compressors mounted on integral vibration isolators, internal overcurrent and high temperature protection, internal pressure relief and crankcase heater.
- D. Refrigerant: R-410A.
 1. Classified as Safety Group A1 according to ASHRAE 34.
 2. Provide unit with operating charge of refrigerant.
- E. Refrigeration System Specialties:
 1. Expansion valve with replaceable thermostatic element.
 2. Refrigerant filter/dryer.
 3. Manual-reset high-pressure safety switch.

4. Automatic-reset low-pressure safety switch.
 5. Minimum off-time relay.
 6. Automatic-reset compressor motor thermal overload.
 7. Brass service valves installed in compressor suction and liquid lines.
 8. Low-ambient kit high-pressure sensor.
 9. Hot-gas reheat solenoid valve with a replaceable magnetic coil.
 10. Hot-gas bypass solenoid valve with a replaceable magnetic coil.
 11. Four-way reversing valve with a replaceable magnetic coil, thermostatic expansion valves with bypass check valves, and a suction line accumulator.
 12. Thermostat for coil freeze-up protection during low ambient temperature operation or loss of air.
- F. Capacity Control:
1. Hot-gas bypass refrigerant control for capacity control with continuous dehumidification on a single compressor.
 2. Rawal APR control with zero to 100 percent modulating capacity control using hot-gas bypass. Evaporator coil shall be continuously active for dehumidification.
 3. Variable speed or Digital Scroll compressors.
- G. Safety Controls:
1. Compressor motor and condenser coil fan motor low ambient lockout.
 2. Overcurrent protection for compressor motor.

2.6 AIR FILTRATION

- A. The filter rack shall be designed to handle a maximum 2" thick high efficiency filter. Filters replaceable through side access, hinged access door.
- B. Replaceable Filter Media: MERV 13 or greater rating in accordance with ASHRAE Test Standard 52.2.
- C. High Capacity Filter: Two (2) inch extended area filters. Air quantities as scheduled, clean pressure drop of 0.10 inches wg; dirty pressure drop of 0.75 inches wg.
- D. Filter Area: Max velocity of 350 FPM.
- E. Acceptable manufacturer: American Air Filter or prior approved equal.

2.7 DAMPERS

- A. Motorized Outside Air Dampers: Factory installed 100% motor operated outside air damper assembly constructed of extruded aluminum, hollow core, airfoil blades with rubber edge and end seals.
- B. Damper blades shall be gear driven and designed to meet smoke damper Class-1 leakage specifications in accordance with U.L. 555S at 4 inches w.g. air pressure differential across the damper.
- C. Damper assembly shall be controlled by spring return, 2 position actuator.
- D. Once set, outdoor air dampers shall open to set position when indoor fan starts. The damper shall close to the full closed position when indoor fan shuts down.
- E. Bird Screen: Provide 1 inch aluminum mesh pre filter upstream of the outside air opening.
- F. Configuration: Designed to inhibit wind-driven rain and snow from entering unit.

2.8 ELECTRICAL POWER CONNECTION

- A. Provide single connection of power to unit with unit mounted disconnect switch accessible from outside unit.
- B. General Electrical Power Connection Requirements: Factory-installed and wired switches, motor controllers, transformers, and other necessary electrical devices shall provide a single-point field power connection to unit.
- C. Convenience Outlet: A GFCI, 120v/15amp, 2 plug, unpowered. Convenience outlet connection shall be a separate electrical feed and not from the main.
- D. Enclosure: NEMA 250, Type 4X, mounted in unit with hinged access door in unit cabinet having a lock and key.
- E. Wiring: Numbered and color-coded to match wiring diagram.
- F. Wiring Location: Install factory wiring outside an enclosure in a raceway.
- G. Power Interface: Field power interface shall be to [wire lugs] [NEMA KS 1, heavy-duty, non-fused disconnect switch].
- H. Factory Wiring: Branch power circuit to each motor and to controls with one of the following disconnecting means:
 - 1. NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 60947-4-1.
 - 2. NEMA KS 1, heavy-duty, non-fusible switch.
 - 3. UL 489, motor-circuit protector (circuit breaker) with field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.

- I. Factory-Mounted, Overcurrent-Protection Service: For each motor.
- J. Transformer: Factory mounted with primary and secondary fuses and sized with enough capacity to operate electrical load plus spare capacity. Convenience outlet shall be a separate electrical connection and not powered from the main electrical feed.
- K. Controls: Factory wire unit-mounted controls where indicated.
- L. Control Relays: Auxiliary and adjustable time-delay relays.
- M. Unit shall be provided with phase and brown out protection which shuts down all motors in the unit if the electrical phases are more than 10% out of balance on voltage, the voltage is more than 10% under design voltage or on phase reversal.

2.9 CONTROLS

- A. Refer to Sequences of Operation within Controls specification.
- B. BAS Interface: Completely integrated microprocessor based Direct Digital Control (DDC) system to control all functions including space temperature, leaving air temperature, space humidity, scheduling, monitoring, unit safety protection, including compressor minimum run and minimum off times and diagnostics. The system shall be provided with all required temperature sensors, pressure sensors, controller and keypad/display operator interface. All microprocessor boards, hardware and software shall be factory provided and installed to enable the BAS to monitor, control, and display unit status and alarms.
- C. Unit shall be completely factory wired with necessary controls and contactor pressure lugs or terminal block for power wiring. Units shall provide an external location for mounting a fused disconnect device. 24-volt electromechanical control circuit shall include control transformer and contactor pressure lugs for power wiring. Unit shall have single point power entry as standard.
- D. Building Automation System Interface: Factory installed hardware and software to enable building automation system to monitor, control, and display status and alarms. BAS shall be able to have read / write access to all system control setpoints including but not limited to space temperature and relative humidity.
 - 1. A factory provided BACnet communication interface card with building automation system shall enable building automation system operator to remotely control and monitor the from an operator workstation. Control features available, and monitoring points displayed, locally at Rooftop Unit control panel shall be available through building automation system.

2.10 ROOF CURBS:

- A. Roof Curb shall be designed to mate with the down flow supply and return openings and provide support and a watertight seal. The roof curb design shall allow field-fabricated rectangular supply/return ductwork to be connected directly to the curb. Curb design shall comply with NRCA requirements. Curbs shall be shipped knocked down for tool less field assembly and include wood nailer strips.
- B. Comply with requirements in "The NRCA Roofing Manual."

- C. Match roof curb to roof slope to provide level surface for RTU mounting.
- D. Provide curb having vertical members insulated with a minimum thermal resistance (R-value) of 6.0 BTU/hr-ft²-°F or greater.
- E. Provide curb with continuous insulation between unit base and roof curb.
- F. Curb height shall be a minimum of 14".
- G. Roof Curb for Horizontal Airflow - Horizontal openings in curb shall be custom designed for return and/or discharge for horizontal air handling. Opening size and location shall be indicated on drawings and/or schedule.
- H. Provide wood nailing strip to which roofer may nail roof flashing.
- I. Ship roof curb loose for field installation prior to unit placement.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for piping, ducts, and electrical systems to verify actual locations of connections before equipment installation.
- C. Examine roof curbs and equipment supports for suitable conditions where units will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's rigging and installation instructions for unloading units and moving to final locations.
- B. Curb Support: Install roof curb on roof structure according to "The NRCA Roofing Manual."
 - 1. Install and secure units on curbs and coordinate roof penetrations and flashing with roof construction.
 - 2. Coordinate size, installation, and structural capacity of roof curbs, equipment supports, and roof penetrations.
 - 3. Coordinate size, location, and installation of unit manufacturer's roof curbs and equipment supports with roof Installer.
- C. Equipment Mounting (Where Applicable): Install floor or on-grade mounted units on cast-in-place concrete equipment bases. Comply with requirements for equipment bases as specified

1. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases.
 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
 3. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base, and anchor into structural concrete floor.
 4. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
 6. Install on 6-inch high concrete base designed to withstand, without damage to equipment, seismic force required by code.
- D. Suspended Units (Where Applicable): Suspend and brace units from structural-steel support frame using threaded steel rods and spring hangers. Comply with requirements for vibration isolation devices specified in Section 23 05 48 "Vibration and Seismic Controls for HVAC Piping and Equipment."
- E. Wall and duct-mounted sensors furnished by equipment manufacturer for field installation. Building Automation Systems Contractor shall provide and install control wiring and make final connections to control devices and unit control panel.
- F. Comply with requirements for gas-fired furnace installation in NFPA 54, "National Fuel Gas Code."
- G. Install separate devices furnished by manufacturer and not factory installed.
- H. Install new filters at completion of equipment installation and before testing, adjusting, and balancing.
- I. Unless shown to come through roof curb to internal drain install drain pipes from unit drain pans to approved roof drain.
1. Pipe Size: Same size as condensate drain pan connection.
 2. Insulate condensate piping according to section 23 07 19 HVAC Piping Insulation.
 3. Installing contractor shall provide rooftop portable pipe supports in 6'-0" maximum intervals. Roof supports shall be manufactured by Advanced Support Products (ASP), model REC-SA (Rubber EcoCurb) with channel or approved equal. Product specifications:
 1. Bases: 100% recycled Vulcanized Rubber with UV inhibitors.
 2. Weight: Base with assembly 9.5 pounds
 3. Dimensions: 9" x 6" x 4"
 4. Height: Adjustable

5. Hot dipped galvanized threaded rods, nuts and washers

3.3 CONNECTIONS

- A. Coordinate installations and specialty arrangements with schematics on Drawings and with requirements specified in piping systems.
- B. Where installing piping adjacent to units, allow space for service and maintenance.
- C. Coordinate duct installation requirements with schematics on Drawings and with requirements specified for duct systems.
- D. Duct Connections:
 - 1. Comply with requirements in Section 23 31 13 "Metal Ducts."
 - 2. Drawings indicate the general arrangement of ducts.
 - 3. Connect ducts to units with flexible duct connectors. Comply with requirements for flexible duct connectors in Section 23 33 00 "Air Duct Accessories."
- E. Electrical Connections: Comply with requirements for power wiring, switches, and motor controls in electrical Sections.
 - 1. Install electrical devices furnished by unit manufacturer but not factory mounted.

3.4 STARTUP SERVICE

- A. A factory-authorized service representative shall perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Inspect units for visible damage to furnace combustion chamber.
 - a. .
 - 3. Inspect units for visible damage to refrigerant compressor, condenser and evaporator coils, and fans.
 - 4. Start refrigeration system when outdoor-air temperature is within normal operating limits and measure and record the following:
 - a. Cooling coil leaving-air, dry- and wet-bulb temperatures.
 - b. Cooling coil entering-air, dry- and wet-bulb temperatures.
 - c. Condenser coil entering-air dry-bulb temperature.
 - d. Condenser coil leaving-air dry-bulb temperature.
 - 5. Simulate maximum cooling demand and inspect the following:
 - a. Compressor refrigerant suction and hot-gas pressures.

- b. Short-circuiting of air through outside coil or from outside coil to outdoor-air intake.
 1. Inspect casing insulation for integrity, moisture content, and adhesion.
 2. Verify that clearances have been provided for servicing.
 3. Verify that controls are connected and operable.
 4. Verify that filters are installed.
 5. Clean coils and inspect for construction debris.
 6. Inspect operation of power vents.
 7. Purge gas line.
 8. Inspect and adjust vibration isolators and seismic restraints.
 9. Verify bearing lubrication.
 10. Clean fans and inspect fan-wheel rotation for movement in correct direction without vibration and binding.
 11. Adjust fan belts to proper alignment and tension.
 12. Start unit.
 13. Inspect and record performance of interlocks and protective devices including response to smoke detectors by fan controls and fire alarm.
 14. Operate unit for run-in period.
 15. Calibrate controls.
 16. Adjust and inspect high-temperature limits.
 17. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.
 18. Verify operational sequence of controls.
 19. Measure and record the following airflows. Plot fan volumes on fan curve.
 - a. Supply-air volume.
 - b. Return-air flow.
 - c. Outdoor-air flow.
- B. After startup, change filters, verify bearing lubrication, and adjust belt tension.

- C. Remove and replace components that do not properly operate and repeat startup procedures as specified above.
- D. Prepare written report of the results of startup services.

3.5 ADJUSTING

- A. Adjust initial temperature and humidity set points.
- B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

3.6 DEMONSTRATION

- A. A factory-authorized service representative shall train Owner's maintenance personnel to adjust, operate, and maintain units.

3.7 COMPLETION AND CLEANUP

- A. Contractor shall comb and vacuum clean coils, inside and outside of unit cabinet prior to start-up.
- B. Install temporary filters during construction and start-up period. Replace with specified filters at Substantial Completion.

3.8 PROTECTION OF FINISHED WORK

- A. Do not operate units until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation

END OF SECTION

**SECTION 26 05 00
COMMON WORK RESULTS FOR ELECTRICAL**

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SUMMARY

- A. Provide all work for electrical systems required in the project to be properly installed, tested and performing their intended function.

1.2 DESCRIPTION OF WORK

- A. The work included under this Section consists of providing all labor, materials, supervision, and construction procedures necessary for the installation of the complete electrical systems required by these specifications and/or shown on the drawings of the contract.
- B. The Contract Drawings are shown in part diagrammatic intended to convey the scope of work, indicating the intended general arrangement of equipment, conduit, and outlets. Follow the drawings in laying out the work and verify spaces for the installation of the materials and equipment based on the dimensions of actual equipment furnished. Whenever a question exists as to the exact intended location of outlets or equipment, obtain instructions from the Architect/Engineer before proceeding with the work.

1.3 QUALITY ASSURANCE

- A. Installers shall have at least 5 years of successful installation experience on projects with electrical installation work similar to that required by the project. All equipment and materials shall be installed in a neat and workmanlike manner and shall be aligned, leveled, and adjusted for satisfactory operation.
- B. Perform all work in accordance with the latest edition of the national electrical code, and local codes.
- C. All electrical materials and distribution, and utilization equipment shall be UL Listed.
- D. All equipment and materials shall be new and unused and of United States Domestic manufacture unless approved otherwise by engineer or owner.
- E. Eliminate any abnormal sources of noise that are considered by the architect not to be an inherent part of the electrical systems as designed.

1.4 REFERENCES

- A. The design, manufacture, testing, and method of installation of all equipment and materials furnished under the requirements of this specification shall conform to all codes, standards and regulations, etc. found in the front end of specifications:
- B. The latest adopted edition by the local and state inspection authorities of all standards and specifications listed in front end shall apply.

- C. Furthermore, the electrical work shall be in accordance with all applicable National and State Standards, and Local Codes and Building Ordinances. The electrical work shall merit the approval of the enforcing authorities having jurisdiction.

1.5 MATERIALS AND EQUIPMENT

- A. Electrical materials and equipment for the entire project shall meet the requirements specified under the Supplementary Conditions Section of this specification.
- B. Equipment and fixtures shall be connected to provide circuit continuity in accordance with applicable Codes whether or not each piece of conductor, conduit, or protective device is shown between such items of equipment or fixtures and the point of circuit origin.
- C. The electrical work includes the installation or connection of certain materials and equipment furnished by others. Verify all connection details.
- D. All equipment over 50 pounds shall be provided with adequate lifting means.

1.6 COORDINATION WITH OTHER TRADES

- A. Coordinate the work of this division with all other divisions to ensure that all components of the electrical system will be installed at the proper time and fit the available space.
- B. Locate and size all openings in work of other trades required for the proper installation of the electrical system components.
- C. Make all electrical connections to all equipment furnished by this division and any other division.
- D. Make all electrical connections from all 120 volt and greater dampers and switches to associated exhaust fan(s) furnished by any other division.

1.7 DRAWINGS

- A. The drawings are schematic in nature, but show the various components of the systems approximately to scale and attempt to indicate how they are to be integrated with other parts of the building. Determine exact locations by review of equipment manufacturer's data, by job site measurements, by checking the requirements of other trades, and by reviewing all Contract Documents. The size of the electrical equipment indicated on the Drawings may be based on the dimensions of a particular manufacturer. While other listed manufacturers will be acceptable, it is the responsibility of the Contractor to determine if the equipment that Contractor proposes to furnish will fit in the space. The drawings are not intended to show exact locations of conduit and wire, or to indicate all wire terminators, connectors, conduit fittings, boxes or supports, but rather to indicate distribution, circuitry, and control.
- B. The Electrical Drawings are necessarily diagrammatic in character and cannot show every connection in detail or conduit in its exact location. These details are subject to the requirements of ordinances and also structural and architectural conditions. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades in order to avoid interference between the various phases of work. Work shall be laid out so that it will be concealed in furred chases and suspended ceilings, etc., in finished portions of the building, unless specifically noted to be exposed.

Work shall be installed to avoid crippling of structural members. All exposed work shall be installed parallel or perpendicular to the lines of the building unless otherwise noted.

- C. When the mechanical and electrical Drawings do not give exact details as to the elevation of pipe, conduit and ducts, physically arrange the systems to fit in the space available at the elevations intended with the proper grades for the functioning of the system involved. Exposed conduit is generally intended to be installed true and square to the building construction, and located as high as possible against the structure in a neat and workmanlike manner. The Drawings do not show all required offsets and their location details. Work shall be concealed in all finished areas.

1.8 SUBMITTALS

- A. Specification Review:
 - 1. Include a paragraph-by-paragraph written specification review for each product listed requiring a submittal. Denote any proposed deviations from specifications.
- B. Submittals shall be submitted in a 3-ring binder with a tab for each specification section requiring a submittal. Submittal shall be complete and arranged in numerical order and contain all product data, test reports, details, diagrams, etc. as specified in each specification section. Partial submittal submittals will be returned un-reviewed. Submittals for long lead or pre purchase items can be submitted for review in a separate binder with the approval of the Architect/Engineer. Full size shop drawings can be submitted separately but must be submitted at the same time as binder. Submittals can also be submitted electronically in PDF format but must be complete and arranged as noted above. Partial submittals will not be reviewed and will be returned un-reviewed.
- C. Operation and Maintenance Manuals: Operation and Maintenance Manuals shall be provided according to Division 1 requirements. In general, during the time of the contract, and before substantial completion of the electrical installation, submit to the Architect/Engineer three (3) copies of descriptive literature, maintenance recommendations (from the equipment manufacturer), data on initial operation, wiring diagrams, performance curves, engineering data and tests, operating procedures, routine maintenance procedures, and parts lists for each item of electrical equipment installed under this contract and submit all manufacturer's guarantees and warranties.
- D. Shop Drawings: The Contractor shall furnish shop drawing portfolios and proper transmittal forms for all materials, equipment, and lighting fixtures to be incorporated in the work in accordance with the General Conditions, Supplementary Conditions, and all other applicable Conditions.
 - 1. Shop drawings on component items forming a system or that are interrelated shall be submitted at one time as a single submittal in order to demonstrate that the items have been properly coordinated and will function properly as a system. A notation shall be made on each shop drawing submitted as to the item's specific use, either by a particular type number referenced on the drawings or in the specifications, by a reference to the applicable paragraph of the specifications, or by a description of its specific location. The shop drawings shall be organized and bound into sets with each set collated.
 - 2. The Architect/Engineer shall have the final authority as to whether the equipment or material submitted is equal to the specified item. Proposed substitutions may be rejected for aesthetic reasons if felt necessary or desirable. In the event the proposed substitutions are rejected, the Contractor shall furnish the specified item.

1.9 EXISTING CONDITIONS

- A. Do all work required to maintain electrical services to the Owner occupied portions of the building during construction.
- B. No connection to existing services or utilities shall be made without Owner's knowledge and permission. All such connections shall be planned and scheduled to minimize the length of service interruption required. Request for shutdown shall be made to Owner at least two (2) weeks in advance and shall be accompanied by detailed written schedule of activities during shutdown and list of materials required for connection and renewal of service. It shall be understood that all such service interruptions shall be made at the Owner's convenience, not the Contractor's. No increase in contract amount will be allowed for reasons of premium time, inefficiency of operations or other considerations not calculated in original bid.
- C. All items removed shall be stored on-site. Schedule a review of the items with the Owner. Remove from site all items the Owner does not choose to keep. Deliver Owner designated items to Owner's storage facility.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- B. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.
- C. Do not deliver items to project before time of installation. Limit shipment of bulk and multiple-use materials to quantities needed for immediate installation.

PART 2 – PRODUCTS

- A. Provide allowance in bid for **ten** 20A/1p circuits of 100 feet in length from source for miscellaneous needs during the course of construction. Include one duplex receptacle per circuit, all associated labor and all necessary accessories (conductor, conduit, supports, etc.) required for proper installation.
- B. Provide allowance in bid for **ten** light switching circuit drops of twenty feet in length for miscellaneous needs during construction. Include one 277V light switch per circuit, all associated labor and all necessary accessories (conductor, conduit, supports, etc.) required for proper installation.
- C. Provide allowance in bid for **five** additional exit signs for miscellaneous needs during construction. Include circuiting, all associated labor and all necessary accessories required for proper installation.

PART 3 - EXECUTION

3.1 ACCESS TO EQUIPMENT

- A. Starters, switches, receptacles, pull boxes, etc. shall be located to provide easy access for operation, repair and maintenance. If the devices listed above are concealed, access doors shall be provided.

3.2 EXISTING WORK

- A. Disconnect electrical systems in walls, floors, and ceilings scheduled for removal.
- B. Provide temporary wiring and connections to maintain existing systems in service during construction.
- C. When performing work on energized equipment or circuits, use personnel experienced and trained in similar operations.
- D. Remove, relocate, and extend existing installations to accommodate new construction.
- E. Repair adjacent construction and finishes damaged during demolition and extension work.

3.3 EXISTING UTILITIES

- A. The Contractor shall verify the location of all existing utilities with the Owner and Utility Companies prior to commencing excavation work. The drawings and survey data of the contract documents indicate the available information on the existing power and communication services, and on new services to be provided to the project by utility companies. Accuracy of this information is not assured.

3.4 ELECTRICAL SERVICE

- A. The Contractor shall provide all material and pay all fees required by the local utility company for the connection of the new electrical service as shown on the plans. The Contractor shall also meet all equipment requirements of the local utility company. The Contractor shall provide all necessary materials for construction of the temporary electrical service and shall coordinate all details with the local utility company.

3.5 CUTTING AND PATCHING

- A. The Electrical Contractor shall be responsible for all cutting and patching of holes in building construction which are required for the passage of electrical work. Cutting and patching shall conform to the requirements of Division 1 and, if applicable, Division 2 of these specifications.
- B. Cutting of structural framing, walls, floors, decks and other members intended to with stand stress is not permitted.

3.6 PAINTING, FINISHING

- A. Painting of electrical work exposed in occupied spaces, except mechanical and electrical machine rooms and maintenance/service spaces; and work exposed on the exterior of the facility is specified and performed under other divisions of these specifications.
- B. Factory finishes, shop priming, and special protective coatings are specified in the individual equipment specification sections.
- C. Where factory finishes are provided on equipment and no additional field painting is specified, all marred or damaged surfaces shall be touched up or refinished so as to leave a smooth, uniform finish at the time of final inspection.

3.7 CONDUITS AND SUPPORT, GENERALLY

- A Conduits, except electrical conduits run in floor construction, shall be run parallel with or perpendicular to lines of the building unless otherwise noted on the drawings. Electrical conduits shall not be hung on hangers with any other service, unless specifically approved by the Engineer. Electrical conduits shall be hung above all other service pipes. Hangers on different service lines running close to and parallel with each other shall be in line with each other and parallel with, or perpendicular to, the lines of the building. Exact location of electric outlets, piping, ducts, and the like shall be coordinated to avoid interferences between lighting fixtures, piping, ducts, and similar items.

3.8 ACCESS PANELS

- A. Furnish and install panels for access to junction boxes and similar items where no other means of access, such as a readily removable, sectional ceiling is shown or specified.
- B. Panels shall not be less than 12-inches by 16-inches in size. Larger panels shall be furnished where required. Panels in tile or other similar patterned ceilings shall have dimensions corresponding to the tile or pattern module.
- C. Access panels shall be flush type and of all steel construction, with a No. 16 gauge wall or ceiling frame for masonry or plaster and a No. 14 gauge panel door. Doors shall be secured with concealed hinges and flush locks of either the cylinder type or approved, positive acting, screwdriver operated type. Doors for wall panels may be secured with suitable clips and countersunk screws. Panels shall be painted with a rust-inhibitive primer at the factory. Panels in rated wall shall also be rated.

3.9 INSTALLATION OF EQUIPMENT

- A. Install and connect all appliances and equipment as specified and indicated for this project, in accordance with the manufacturers' instructions and recommendations. Furnish and install complete electric connections and devices as recommended by the manufacturer or required for proper operation

3.10 COORDINATION

- A. Coordinate the electrical work with work of the different trades so that:
 - 1. Interferences between mechanical, electrical, architectural, and structural work, including existing services, will be avoided.
 - 2. Within the limits indicated on the drawings, the maximum practicable space for operation, repair, removal and testing of electrical and other equipment will be provided.
 - 3. Pipe, conduits, ducts, and similar items, shall be kept as close as possible to ceiling, walls, and columns, to take up a minimum amount of space. Pipes, conduits, ducts, and similar items shall be located so that they will not interfere with the intended use of other equipment.
- B. Furnish and install, without additional expense to the Owner, all offsets, fittings and similar items necessary in order to accomplish the requirements of coordination.
- C. Before any sleeves or inserts are set, or any electrical equipment or foundations are installed, prepare and submit for approval composite coordination drawings for all equipment rooms, and other areas in which work of two or more trades or subcontractors is to be installed and in which the probability of interference exists. Drawings shall show

the work of all trades covered, shall be drawn to a scale not smaller than 1/2" = 1'-0", and shall show clearly in both plan and elevation that all work can be installed without interference.

- D. Any work installed prior to approval of coordination drawings shall be at the Contractor's risk. Subsequent relocations required to avoid interference's shall be made without additional expense to the Owner.

3.11 OWNER INSTRUCTION

- A. Provide on-site Owner training for all new equipment.
- B. Use Operation and Maintenance manuals and actual equipment installed as basis for instruction.
- C. At conclusion of on-site training program have Owner personnel sign written certification they have completed training and understand equipment operation. Include copy of training certificates in final Operation and Maintenance manual submission.

3.12 AS-BUILT DRAWINGS

- A. Contractor shall provide the Owner with as-built drawings for all electrical systems as described in these specifications and/or shown on the Drawings.

END OF SECTION 26 05 00

SECTION 26 05 19
LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SUMMARY

- A. Provide a complete system of building wire and cable to all electrical loads.

1.2 SYSTEM DESCRIPTION

- A. Product Requirements: Provide products as follows:
 - 1. Provide stranded conductors for all wiring.
 - 2. Conductor not smaller than 12 AWG for power and lighting circuits.
 - 3. Conductor not smaller than 16 AWG for control circuits.
 - 4. 10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 75 feet
 - 5. 10 AWG conductors for 20 ampere, 277 volt branch circuits longer than 200 feet.
 - 6. Copper.
- B. Wiring Methods: Provide the following wiring methods:
 - 1. Concealed Dry Interior Locations: Use only Type THHN/THWN insulation, in raceway.
- C. Branch Circuit Conductors: No branch circuit conductors are allowed in any slab or under slab on grade unless specifically indicated on drawings.

1.3 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in the manufacture of electric wire and cable products of types and ratings required, whose products have been in satisfactory use in similar service for not less than 10 years.
- B. Installer: Qualified with at least 5 years of successful installation experience on projects with electrical wiring work similar to that required for this project.

1.4 REFERENCES

- A. NEC Compliance: Comply with NEC as applicable to construction and installation of electrical wire, cable and connectors.
- B. UL Compliance: Comply with UL standards pertaining to wire cable and connectors.
- C. UL Labels: Provide electrical wires, cables and connectors which have been UL-listed and labeled.
- D. NEMA/ICEA Compliance: Comply with applicable portions of NEMA/Insulated Cable Engineers Association Standards pertaining to materials, construction and testing of wire and cable.
- E. ANSI/ASTM: Comply with applicable portions of ANSI/ASTM standards pertaining to construction of wire and cable.

- F. IEEE Compliance: Comply with applicable portions of IEEE standards pertaining to wire and cable.
- G. NECA Compliance: Comply with NECA's "Standard of Installation."

1.5 SUBMITTALS

- A. Specification Review: Provide a complete item by item, line by line specification review indicating compliance with the specifications and note any deviations from the specification with reason for deviation
- B. Submit manufacturer's data on electric wire and cable.

1.6 COORDINATION

- A. Where wire and cable destination is indicated and routing is not shown, determine routing and lengths required.

PART 2 - PRODUCTS

2.1 BUILDING WIRE

- A. Manufacturers:
 - 1. Southwire
 - 2. The Okonite Company
 - 3. Diamond Wire & Cable Co.
 - 4. General Cable Co.
 - 5. Advance Wire and Cable, Inc.
- B. Product Description: Single conductor insulated wire.
- C. Conductor: Copper.
- D. Insulation: NFPA 70; Type THHN/THWN insulation for feeders and branch circuits.

2.2 WIRE, CABLE, AND CONNECTORS

- A. General: Except as otherwise indicated, provide wire, cable and connectors of manufacturer's standard materials, as indicated by published product information; designed and constructed as recommended by manufacturer, and as required for the installation.
- B. WIRE:
 - 1. All conductors shall be 600-volt and shall be copper with insulation of the following types, unless otherwise noted on the drawings or in these specifications.
 - 2. For dry locations, provide Type THHN conductors. Conduit sizes are based on type THHN wire.
 - 3. For damp or wet locations, provide Type THWN conductors.
 - 4. Provide Type THWN conductors for service entrance cabling or feeders direct buried, or installed in underground raceways. Provide Type THWN conductors for branch circuit conductors installed in underground raceways.

5. No wire shall be smaller than No. 12 AWG, except that wiring for signal and pilot control circuits may be No. 14 AWG, and pre-manufactured fixture whips for light fixtures may be No. 14 AWG.
 - a. Use preinsulated connectors 3M Company "Scotchlok," or Ideal Industries, Inc. "super nut," for splices and taps in conductors No. 10 AWG and smaller. All other twist-on connectors must be reviewed by the Architect prior to installation. Use this type of connector for factory-made splices in fixtures or equipment.
 - b. Pressure indent type connectors must be submitted to the Architect for review.
 - c. Tape all splices and joints with vinyl plastic tape manufactured by Minnesota Mining and Manufacturing Company. Use sufficient tape to secure insulation strength equal to that of the conductors joined.
 - d. Keep splices in underground junction boxes to an absolute minimum. Where splices are necessary, use resin pressure splices and resin splicing kits manufactured by the 3M Company, St. Paul, Minnesota, to totally encapsulate the splice. Arrange the splicing kit to minimize the effects of moisture.
6. Connect wire No. 6 AWG and larger to panels and apparatus by means of approved lugs or connectors.
7. All wire shall be stranded.
8. Connectors of the porcelain cup type with or without metal inserts shall not be used, including all splices in fixtures which are made in advance by the fixture manufacturer. Splices in wire No. 8 AWG and larger shall be made with approved solderless lugs. If any type of pressure indent type connector is proposed for use on any size conductor, it shall be specifically submitted for approval prior to use.
9. Wire sizes shown are minimum based on code requirements, voltage drop and/or other considerations. Larger sizes may be installed at the Contractor's option to utilize stock size, provided conduit sizes are increased where necessary to conform to the National Electrical Code. Sizes of wires and cables indicated or specified are American Wire Gage (Brown and Sharpe).

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify interior of building has been protected from weather.
- B. Verify mechanical work likely to damage wire and cable has been completed.
- C. Verify raceway installation is complete and supported.

3.2 EXISTING WORK

- A. Remove exposed abandoned wire and cable, including abandoned wire and cable above accessible ceiling finishes. Patch surfaces where removed cables pass through building finishes.
- B. Disconnect abandoned circuits and remove circuit wire and cable. Remove abandoned boxes when wire and cable servicing boxes is abandoned and removed. Install blank cover for abandoned boxes not removed.

- C. Provide access to existing wiring connections remaining active and requiring access. Modify installation or install access panel.
- D. Extend existing circuits using materials and methods compatible with existing electrical installations, or as specified.

3.3 INSTALLATION

- A. General: Install electric cables, wires and connectors as indicated in compliance with manufacturer's written instructions, applicable requirements of the NEC and NECA's "Standard of Installation", and in accordance with recognized industry practices.
- B. Coordinate cable and wire installation work with electrical raceway and equipment installation work, as necessary for proper interface.
- C. Conductors shall be continuous from outlet to outlet and no splices shall be made except within outlet or junction boxes. Junction boxes may be utilized wherever required.
- D. Splicing: No splicing or joints will be permitted in either feeder or branch circuits except at outlet or accessible junction boxes.
- E. Wire shall not be installed in raceways until the concrete work and plastering is completed and all conduits in which moisture has collected have been swabbed out. Insulation resistance to ground shall not be less than that approved by NEC. Eliminate splices wherever possible.
- F. Use pulling compound or lubricant where necessary. Compound must not deteriorate conductor insulation.
- G. Prior to energization, check cable and wire for continuity of circuitry, and for short circuits. Correct malfunctions when detected.
- H. Conductor Installation: Install all conductors in a single raceway at one time, insuring that conductors do not cross one another while being pulled into raceway. Leave sufficient cable at all fittings or boxes and prevent conductor kinks. Keep all conductors within the allowable tension and exceeding the minimum bending radius.
- I. Conductor Support: Provide conductor supports as required by the code and recommended by the cable manufacturer. Where required, provide cable supports in vertical conduits similar to OZ Type C.M.T., and provide the lower end of conduit with OZ Type KVF ventilators.
- J. Conductor Termination: Provide all power and control conductors, that terminate on equipment or terminal strips, with solderless lugs or fork and flanged tongue terminals. Provide T and B "sta-kon" tongue terminal. This type conductor termination is not required when the equipment is provided with solderless connectors.
- K. Many circuits are shown on the drawings to be provided with dedicated neutral and ground conductors. Carefully review circuiting and the electrical abbreviations and symbols legend and provide the number of conductors indicated.
- L. Route wire and cable to meet Project conditions.
- M. Neatly train and lace wiring inside boxes, equipment, and panelboards.

- N. Identify and color code wire. Identify each conductor with its circuit number or other designation indicated.
- O. Special Techniques - Wiring Connections:
1. Clean conductor surfaces before installing lugs and connectors.
 2. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
 - a. MDF/IDF room branch circuits: All branch circuits shall be dedicated and unspliced. Provide dedicated branch circuit 20 or 30 amperes, #10 and or #12 wire, unspliced from wiring device all the way back to the overcurrent device. Do not share ground with any other circuit.
 - b. Computer branch circuits: All branch circuits shall be dedicated. Provide dedicated branch circuit 20 amperes, #10 and or #12 wire from wiring devices all the way back to the overcurrent device. Do not share neutral with any other circuit.
 - c. Kitchen branch circuits: All branch circuits for 125 volt, single phase, 15 and 20 ampere receptacles shall be dedicated. Provide dedicated branch circuit 20 amperes, #10 and or #12 wire from wiring devices all the way back to the overcurrent device. Do not share neutral or ground with any other circuit.
 3. Tape uninsulated conductors and connectors with electrical tape to 150 percent of insulation rating of conductor.
 4. Install split bolt connectors for copper conductor splices and taps, 6 AWG and larger.
 5. Install solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.
 6. Install insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.

3.4 WIRE COLOR

A. COLOR CODES FOR CONDUCTORS FOR BRANCH CIRCUITS AND FEEDERS

<u>System/Phase</u>	Wire Sizes #10 and Smaller: Use Continuous Color Coded Insulation (Note 01)				Wire Sizes #6 and Smaller: Use Continuous Color Coded Insulation (Note 02)	
	A	B	C	N	G	IG
120/208	Black	Red	Blue	White	Green	Green/Yellow Stripe
120/240	Black	Orange	Blue	White w/color stripe (Note 03)	Green	Green/Yellow Stripe
277/480	Brown	Purple	Yellow	Gray	Green	Green/Yellow Stripe

Table Notes:

1. Wire size #8 and larger, black conductors with color marking tape at each termination and where accessible; colors as noted above.
 2. Wire sizes #4 and larger, black conductor with green marking tape at each termination and where accessible.
 3. Provide white (no stripe) insulation when 120/208V system is not present at this installation.
- B. Neutral Conductors: White. When two or more neutrals are located in one conduit, individually identify each with proper circuit number and provide color coding at each junction box containing more than one neutral.
- C. Branch Circuit Conductors: Install three or four wire home runs with each phase uniquely color coded.
- D. Feeder Circuit Conductors: Uniquely color code each phase.
- E. Ground Conductors:
For 6 AWG and smaller: Green.
For 4 AWG and larger: Identify with green tape at both ends and visible points including junction boxes.

3.5 GROUPING OF CIRCUITS

- A. Limit the number of current carrying conductors per conduit to 6. Neutrals serving computer receptacle branch circuits shall be counted as current carrying. Grounds shall not be counted.
- B. Grouping of different voltages is not allowed.
- C. Grouping of conductors of the same phase in not allowed.
- D. Provide metal box sizes per NEC Table 314.16 (A).
- E. Provide conduit per NEC Annex C.
- F. Neutrals serving branch circuits shall not be shared. Provide dedicated neutral per circuit.

3.6 POWER LIMITED CIRCUIT INSTALLATION

- A. Provide a complete system of raceway and covered junction boxes for all power limited circuits installed exposes in finished spaces and spaces without a ceiling.
- B. Provide raceway for all power limited circuit wiring within wall cavities and above sheet rock, plaster and other "hard" (non-lay-in) ceiling types of construction.
- C. Labeling: Provide label on all junction boxes.
 1. Provide permanent labeling with indelible black marker, in neat, legible print indicating the system wiring name.

END OF SECTION 26 05 19

SECTION 26 05 26
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section

PART 1 - GENERAL

1.1 SUMMARY

- A. Provide a continuous low-impedance grounding system for the entire electrical wiring system.

1.2 REFERENCES

- A. Institute of Electrical and Electronics Engineers:
 - 1. IEEE 142 - Recommended Practice for Grounding of Industrial and Commercial Power Systems.
 - 2. IEEE 1100 - Recommended Practice for Powering and Grounding Electronic Equipment.
 - 3. IEEE Compliance: Comply with applicable requirements of IEEE Standard 241 pertaining to electrical grounding.
- B. NFPA 70 - National Electrical Code.
- C. NEC Compliance: Comply with NEC requirements as applicable to materials and installation of electrical grounding systems, associated equipment and wiring. Provide grounding products which are UL listed and labeled.
- D. UL Compliance: Comply with applicable requirements of UL Standard Nos. 467 and 869 pertaining to electrical grounding and bonding.
- E. IEEE Compliance: Comply with applicable requirements of IEEE Standard 142 and 241 pertaining to electrical grounding.
- F. Utility: Grounding shall be done so as to comply with all applicable grounding requirements and rules of the serving utility.
- G. NECA Compliance: Comply with NECA's "Standard of Installation."

1.3 SYSTEM DESCRIPTION

- A. Grounding systems use the following elements as grounding electrodes:
 - 1. Metal underground water pipe.
 - 2. Metal building frame.
 - 3. Concrete-encased electrode.
 - 4. Ground ring.
 - 5. Rod electrode.
 - 6. Plate electrode.
- B. Applications of grounding work in this Section include the following:
 - 1. Underground Metal Piping
 - 2. Underground Metal Water Piping

3. Metal Building Frames
4. Ground Rods
5. Separately Derived Systems
6. Service Equipment
7. Enclosures
8. Equipment

- C. Requirements of this Section apply to electrical grounding work specified elsewhere in these specifications.

1.4 SUBMITTALS

- A. Specification Review: Provide a complete item by item, line by line specification review indicating compliance with the specifications and note any deviations from the specification with reason for deviation.
- B. Product Data: Submit data on grounding electrodes and connections.

1.5 QUALITY ASSURANCE

- A. Provide grounding materials conforming to requirements of NEC, IEEE 142, and UL labeled.
- B. Manufacturers: Firms regularly engaged in manufacture of electrical connectors, terminals and fittings, of types and ratings required, and ancillary grounding materials, including stranded cable, copper braid and bus, ground rods and plate electrodes, whose products have been of satisfactory use in similar service for not less than three years.
- C. Installer: Qualified with at least three (5) years' experience on projects with electrical grounding work similar to that required for this project.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS: Subject to compliance with the requirements, provide grounding products of one of the following:

- A. B-Line Systems
- B. Burndy Corporation
- C. Crouse Hinds
- D. Copperweld Inc.
- E. Erico Inc.
- F. Electrical Components Div.; Gould Inc.
- G. General Electric Supply Co.
- H. Ideal Industries, Inc.
- I. O-Z Gedney Co.

- J. Thomas and Betts Corp.
- K. VFC
- L. Western Electric Co.

2.2 GROUNDING SYSTEMS:

- A. Except as otherwise indicated, provide electrical grounding systems indicated; with assembly of materials, including but not limited to cables/wires, connectors, terminals, ground rods/electrodes, bonding jumper braid, and additional accessories needed for a complete installation. Where more than one type unit meets indicated requirements, selection is installer's option. Where materials or components are not indicated, provide products complying with NEC, UL, IEEE and established industry standards for applications indicated.

2.3 CONDUCTORS:

- A. Unless otherwise indicated, provide electrical grounding conductors for grounding connections matching power supply wiring materials and sized according to NEC requirements.
- B. Material: Stranded copper.
- C. Foundation Electrodes: #2 AWG.
- D. Grounding Electrode Conductor: Copper conductor bare.
- E. Bonding Conductor: Copper conductor bare.

2.4 ELECTRICAL GROUNDING CONNECTION ACCESSORIES:

- A. Provide electrical insulating tape, heat-shrinkable insulating tubing, welding materials, and bonding straps as recommended by accessories manufacturers for types of service indicated.
- B. UL Listed for grounding applications.
- C. Description: Brass connectors, suitable for grounding and bonding applications, in configurations required for particular installation.

2.5 EXOTHERMIC CONNECTIONS

- A. Manufacturers:
 - 1. Cadweld by Erico, Inc.
- B. Product Description: Exothermic materials, accessories, and tools for preparing and making permanent field connections between grounding system components.

PART 3 – EXECUTION

3.1 GENERAL

- A. Inspection: Installer must examine areas and conditions under which electrical grounding connections are to be made and notify the Architect/Engineer in writing of conditions detrimental to proper completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the installer.
- B. General: Install electrical ground systems where shown, in accordance with applicable portions of the NEC, with NECA's "Standard of Installation", and in accordance with recognized industry practices to ensure that products comply with requirements and serve intended functions.
- C. Coordinate with other electrical work as necessary to interface installation of electrical grounding systems with other work.
- D. Grounding and bonding of electrical installations and specific requirements for systems, circuits and equipment required to be grounded shall be accomplished for temporary and permanent construction.
- E. Provide a separate green equipment ground conductor in all electrical raceways to effectively ground all fixtures, panels, receptacles, controls, motors, disconnect switches, exterior lighting standards and noncurrent carrying metal enclosures. The ground wires shall be connected to the building system ground. NEC Table 250-95 shall be used to size the ground conductor if the size is not shown on the drawings.
- F. To satisfy the "effective grounding" requirements of the NEC the path to ground from circuits, equipment, and conductor enclosures shall be permanent and continuous and shall have ample carrying capacity to conduct safely any currents liable to be imposed on it, and shall have impedance sufficiently low to limit the potential above ground and to facilitate the operation of the overcurrent devices in the circuit.
- G. At the service entrance equipment, bond the utility neutral, building neutral and building ground conductor to a common ground bus (or ground lug). Connect the ground bus to the building domestic cold water pipe with a grounding conductor and an approved clamp and connector. Install the grounding conductor in exposed PVC conduit and make connections readily accessible for inspection. The point of connection to the water service shall be as near the building entrance as possible. Provide a copper wire shunt of the same size as the ground conductor around the water meter and clamp to the water pipe with bronze fittings. Bond the water pipe to the structural steel system of the building and reinforcing bars in footings when such building construction occurs.
- H. In addition to the requirements for service entrance grounding listed above, provide a supplemental grounding electrode consisting of driven ground rods (three 10 foot x 3/4 inch copper-clad steel ground rods).
- I. Clean the contact surfaces of all ground connections. Remove paint, rust, mill oils, and surface contaminants at connection points.
- J. Where separately derived systems occur, ground the system to a grounding electrode acceptable to the code.

- K. Install metallic raceways mechanically and electrically secure at all joints and at all boxes, cabinets, fittings and equipment. At the point of electrical service entrance, bond all metallic raceways together, with a ground conductor, and connect to the system ground bus. Bond all boxes as specified for equipment.
- L. Receptacles: Permanently connect the ground terminal on each receptacle to the green ground conductor.
- M. Motors: Connect the ground conductor to the conduit with an approved grounding bushing, and to the metal frame with a bolted, solderless lug.
- N. Provide a flexible ground strap (No. 6 AWG) at each flexible duct connection to air handlers, exhaust fans, and supply fans. Install straps to preclude vibration.
- O. Provide necessary ground connections to telephone service entrance equipment. Verify requirements with the local telephone company.

3.2 EXISTING WORK

- A. Modify existing grounding system to maintain continuity to accommodate renovations.
- B. Extend existing grounding system using materials and methods compatible with existing electrical installations.

3.3 INSTALLATION

- A. Install in accordance with NEC Article 250. Properly maintain the existing neutral-ground bond. All other neutral busses, bars, etc. on the service voltage system shall be isolated from ground. This system shall be the solid grounded type.
- B. Install grounding and bonding conductors concealed from view.
- C. Install a green equipment grounding conductor in all feeders and branch circuits, minimum size per NEC Table 250.122.
- D. Grounding Busses:
 - 1. Provide a copper bus bar where indicated on Drawings. Provide grounding electrode conductor and connection to the grounding electrode system. AWG No. 2 minimum.
 - 2. Provide in each IDF and MDF room.
 - 3. Provide at each CATV / MATV head-end mounting board.
 - 4. Provide at each building communications rack.
 - 5. Provide at each sound reinforcement equipment rack.

3.6 EQUIPMENT GROUNDING SYSTEM

- A. General: Make a firm bond between all enclosures, equipment and metallic raceway system. Grounding conductors shall be continuous from origin to termination and properly bonded with lugs at both ends. The metallic raceway systems shall be made up properly to form a grounding path that has an impedance back to the main system ground that is as low as can be practically obtained.

- B. Over 250 Volts: Provide locknuts and/or listed fittings per NEC 250-97 for bonding of metal raceways in all circuits of over 250 Volts to ground. In case of oversized, concentric or eccentric knockouts, comply with NEC 250-92(B). The use of snap-in, wedge-type, or pivot-type connectors is prohibited.

3.7 FIELD QUALITY CONTROL

- A. Grounding Tests:
 - 1. Test the electrical system after installation is complete. Inspect and test for stray currents, unintended ground shorts, and proper physical condition of grounding system. Correct any deficiencies and re-test to verify satisfactory installation.
 - 2. Provide written test report to document all findings, test values, work done and certification of grounding system.
 - 3. Use true-RMS meters for all voltage and current measurements.
 - 4. Test telecommunications grounding riser to verify continuity.
 - 5. Check all isolated ground receptacles for correct polarity.
 - 6. Test all sub panels of separately derives systems to verify subpanel neutral is isolated from ground.
 - 7. Test theater isolated power system for the sound reinforcement system to verify isolation of ground system from other building systems.
 - 8. Verify continuity and isolation of audio system ground bus and grounding riser.
 - 9. Perform ground resistance and continuity testing in accordance with IEEE 142.
 - 10. When improper grounding is found on receptacle, check receptacles in entire project and correct. Perform retest.

END OF SECTION 26 05 26

**SECTION 26 05 29
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS**

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Conduit supports.
 - 2. Formed steel channel.
 - 3. Spring steel clips.
 - 4. Sleeves.
 - 5. Mechanical sleeve seals.
 - 6. Firestopping relating to electrical work.
 - 7. Firestopping accessories.
 - 8. Equipment bases and supports.

1.2 REFERENCES

- A. Underwriters Laboratories Inc.:
 - 1. UL 263 - Fire Tests of Building Construction and Materials.
 - 2. UL 723 - Tests for Surface Burning Characteristics of Building Materials.
 - 3. UL 1479 - Fire Tests of Through-Penetration Firestops.
 - 4. UL - Fire Resistance Directory.

1.3 DEFINITIONS

- A. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

1.4 PERFORMANCE REQUIREMENTS

- A. Firestopping: Conform to Building Code and UL for fire resistance ratings and surface burning characteristics.

1.5 SUBMITTALS

- A. Specification Review: Provide a complete item by item, line by line specification review indicating compliance with the specifications and note any deviations from the specification with reason for deviation.
- B. Product Data:
 - 1. Hangers and Supports: Submit manufacturers catalog data including load capacity.

1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with the Building Code.

PART 2 - PRODUCTS

2.1 CONDUIT SUPPORTS

- A. Manufacturers:
 - 1. Allied Tube & Conduit Corp.
 - 2. Electroline Manufacturing Company
 - 3. O-Z Gedney Co.
 - 4. Appleton
- B. Hanger Rods: Threaded high tensile strength galvanized carbon steel with free running threads.
- C. Beam Clamps: Malleable Iron, with tapered hole in base and back to accept either bolt or hanger rod. Set screw: hardened steel.
- D. Conduit clamps for trapeze hangers: Galvanized steel, notched to fit trapeze with single bolt to tighten.
- E. Conduit clamps - general purpose: One hole malleable iron for surface mounted conduits.
- F. Cable Ties: High strength nylon temperature rated to 185 degrees F. Self locking.

2.2 FORMED STEEL CHANNEL

- A. Manufacturers:
 - 1. Allied Tube & Conduit Corp.
 - 2. B-Line Systems
 - 3. Midland Ross Corporation, Electrical Products Division
 - 4. Unistrut Corp.
- B. Product Description: Galvanized 12 gage thick steel. With holes 1-1/2 inches on center.

2.3 SLEEVES

- A. Sleeves for raceway Through Non-fire Rated Floors: 18 gage galvanized steel.
- B. Sleeves for raceway Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage galvanized steel.
- C. Sleeves for raceway Through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Prefabricated fire rated sleeves including seals, UL Listed.
- D. Fire-stopping Insulation: Glass fiber type, non-combustible.

2.4 SPRING STEEL CLIPS

- A. Product Description: Mounting clamp, and screw.

2.5 MECHANICAL SLEEVE SEALS

- A. Manufacturers:
 - 1. Thunderline Link-Seal, Inc.
 - 2. NMP Corporation

- B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.6 FIRESTOPPING

- A. Manufacturers:
 - 1. Dow Corning Corp.
 - 2. Fire Trak Corp.
 - 3. Hilti Corp.
 - 4. International Protective Coating Corp.
 - 5. 3M fire Protection Products .
 - 6. Specified Technology, Inc.
- B. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.
 - 1. Silicone Firestopping Elastomeric Firestopping: Multiple component silicone elastomeric compound and compatible silicone sealant.
 - 2. Foam Firestopping Compounds: Multiple component foam compound.
 - 3. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
 - 4. Fiber Stuffing and Sealant Firestopping: Composite of mineral or ceramic fiber stuffing insulation with silicone elastomer for smoke stopping.
 - 5. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.
 - 6. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.
 - 7. Firestop Pillows: Formed mineral fiber pillows.

2.7 FIRESTOPPING ACCESSORIES

- A. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.
- B. General:
 - 1. Furnish UL Listed products.
 - 2. Select products with rating not less than rating of wall or floor being penetrated.
- C. Non-Rated Surfaces:
 - 1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where conduit is exposed.
 - 2. For exterior wall openings below grade, furnish modular mechanical type seal consisting of interlocking synthetic rubber links shaped to continuously fill annular space between conduit and cored opening or water-stop type wall sleeve.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify openings are ready to receive sleeves.

- B. Verify openings are ready to receive firestopping.

3.2 INSTALLATION - HANGERS AND SUPPORTS

- A. Anchors and Fasteners:
 - 1. Concrete Structural Elements: Provide precast inserts, expansion anchors, powder actuated anchors or preset inserts as required.
 - 2. Steel Structural Elements: Provide beam clamps, spring steel clips, steel ramset fasteners or welded fasteners as required.
 - 3. Concrete Surfaces: Provide self-drilling anchors and expansion anchors as required.
 - 4. Hollow Masonry, Plaster, and Gypsum Board Partitions: Provide toggle bolts or hollow wall fasteners as required.
 - 5. Solid Masonry Walls: Provide expansion anchors or preset inserts as required.
 - 6. Sheet Metal: Provide sheet metal screws.
 - 7. Wood Elements: Provide wood screws.
- B. Inserts:
 - 1. Install inserts for placement in concrete forms.
 - 2. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
 - 3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over four (4) inches.
 - 4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
 - 5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.
- C. Install conduit and raceway support and spacing in accordance with NEC.
- D. Do not fasten supports to suspended ceiling support system, pipes, ducts, mechanical equipment, or conduit.
- E. Install multiple conduit runs on common hangers.
- F. Supports:
 - 1. Fabricate supports from structural steel or formed steel channel. Install hexagon head bolts to present neat appearance with adequate strength and rigidity. Install spring lock washers under nuts.
 - 2. Install surface mounted cabinets and panelboards with minimum of four anchors.
 - 3. In wet and damp locations install steel channel supports to stand cabinets and panelboards one (1) inch off wall.
 - 4. Support vertical conduit at every floor.

3.3 INSTALLATION - FIRESTOPPING

- A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, conduit and other items, requiring firestopping.
- B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.
- C. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating.

- D. Compress fibered material to maximum 40 percent of its uncompressed size.
- E. Place intumescent coating in sufficient coats to achieve rating required.
- F. Remove dam material after firestopping material has cured.
- G. Fire Rated Surface:
 - 1. Seal opening at all rated floors and walls as follows:
 - a. Install sleeve through opening and extending beyond minimum of one (1) inch on both sides of building element.
 - b. Size sleeve allowing minimum of one (1) inch void between sleeve and building element.
 - c. Pack void with backing material.
 - d. Seal ends of sleeve with UL Listed fire resistive silicone compound to meet fire rating of structure penetrated.
 - 2. Where cable tray, bus, or conduit, penetrates fire rated surface, install firestopping product in accordance with manufacturer's instructions.
- H. Non-Rated Surfaces:
 - 1. Seal opening through non-fire rated floors and walls as follows:
 - a. Install sleeve through opening and extending beyond minimum of one (1) inch on both sides of building element.
 - b. Size sleeve allowing minimum of one (1) inch void between sleeve and building element.
 - c. Install type of firestopping material recommended by manufacturer.
 - 2. Install escutcheons where conduit, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.
 - 3. Exterior wall openings below grade: Assemble rubber links of mechanical seal to size of conduit and tighten in place, in accordance with manufacturer's instructions.

3.4 INSTALLATION - SLEEVES

- A. Exterior watertight entries: Provide mechanical sleeve seals.
- B. Interior conduit penetrations not required to be watertight: Sleeve and fill with silicon foam.
- C. Set sleeves in position in forms. Provide reinforcing around sleeves.
- D. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- E. Extend sleeves through floors and walls one (1) inch above finished floor level. Caulk sleeves.

END OF SECTION 26 05 29

**SECTION 26 05 33
RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS**

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes conduit and tubing, wireways, outlet boxes, pull and junction boxes, and handholes.

1.2 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.
 - 2. ANSI C80.3 - Specification for Electrical Metallic Tubing, Zinc Coated.
 - 3. ANSI C80.5 - Aluminum Rigid Conduit - (ARC).
- B. National Electrical Manufacturers Association:
 - 1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
 - 2. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
 - 3. NEMA OS 1 - Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
 - 4. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers, and Box Supports.
 - 5. NEMA RN 1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
 - 6. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Tubing and Conduit.
 - 7. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.
- C. UL Compliance and Labeling:
 - 1. Comply with provisions of UL safety standards pertaining to electrical raceway systems; and provide products and components which have been UL-listed and labeled. Each length of raceway shall bear the Underwriters Laboratories label.
- D. NEC Compliance:
 - 1. Comply with NEC requirements which are applicable to the construction and installation of raceway systems
- E. NECA Compliance:
 - 1. Comply with NECA's "Standard of Installation".

1.3 SYSTEM DESCRIPTION

- A. Raceway and boxes located as indicated on Drawings, and at other locations required for splices, taps, wire pulling, equipment connections, and compliance with regulatory requirements. Raceway and boxes are shown in approximate locations unless dimensioned. Provide raceway to complete wiring system.
- B. Wet and Damp Locations: Provide rigid steel conduit. Provide cast metal junction and pull boxes. Provide flush mounting outlet box in finished areas.

- C. Concealed Dry Locations: Provide rigid steel intermediate metal conduit on electrical metallic tubing. Provide sheet-metal boxes. Provide flush mounting outlet box in finished areas. Provide hinged enclosure for large pull boxes.
- D. Exposed Dry Locations: Provide rigid steel conduit, intermediate metal conduit or electrical metallic tubing. Provide sheet-metal boxes. Provide flush mounting outlet box in finished areas. Provide hinged enclosure for large pull boxes.
- E. In Slab or Under Slab on Grade: No branch circuit raceway is allowed in any slab or under slab on grade unless specifically indicated on drawings.
- F. Types of raceways in this Section include the following:
 - 1. Electrical metallic tubing.
 - 2. Flexible metal conduit.
 - 3. Intermediate metal conduit.
 - 4. Liquid-tight flexible metal conduit.
 - 5. Rigid metal conduit.

1.4 DESIGN REQUIREMENTS

- A. Minimum Raceway Size: 3/4 inch.

1.5 SUBMITTALS

- A. Specification Review: Provide a complete item by item, line by line specification review indicating compliance with the specifications and note any deviations from the specification with reason for deviation.
- B. Product Data: Submit manufacturer's data including specifications, installation instructions and general recommendations for each type of device specified.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.
- B. Protect PVC conduit from sunlight.

1.7 COORDINATION

- A. Coordinate installation of outlet boxes for equipment connected under other Divisions.
- B. Coordinate mounting heights, orientation and locations of outlets mounted above counters, benches, and backsplashes. Refer to Architectural elevations and equipment specifications and coordinate device locations prior to electrical rough-in.

PART 2 - PRODUCTS

2.1 METAL CONDUIT

- A. Manufacturers:
 - 1. Allied
 - 2. Wheatland

3. Republic
 4. Cantex
 5. Western
 6. Prime
- B. Rigid Steel Conduit: ANSI C80.1.
- C. Intermediate Metal Conduit (IMC): Rigid steel.
- D. Fittings and Conduit Bodies: NEMA FB 1; material to match conduit
- E. Electrical Metal Tubing (EMT): All EMT fittings shall be steel not die-cast metal. All conduit stub-ups above ceiling for low voltage and data to be provided with insulating bushing.
- F. Flexible Metal Conduit (Flex): Conduit fittings shall be steel. Provide plastic anti-short bushing for all flex fittings. Comply with NEC 348.
- G. Liquidtight Flexible Metal Conduit: Shall be same as flexible metal conduit specified above except Article 350 in NEC.

2.2 ENCLOSURE

- A. Pull Boxes, Junction Boxes, Cabinets, and Wireways: Provide pull boxes, junction boxes, wireways, and cabinets wherever necessary for proper installation of various electrical systems according to the National Electrical Code and where indicated on the Drawings.
- B. Minimum Size: That size shown on the drawings, as required for the specific function, or as required by the National Electrical Code, whichever is larger.
- C. Construction:
1. Indoors in Dry Areas and Not Buried in Slab: Code gage steel - NEMA 1 construction - sides formed and welded, screw covers unless indicated hinged cover or door on drawings. Hinged doors shall be similar to panelboard doors with the same type locking device. Knockouts shall be factory made or formed O-Z Gedney Type PB or approved equal.
 2. Outdoors or Indoors in Wet Areas and Not Buried in Slab: Same as specified above for indoor except provide NEMA 3R (designated by 3R or RT) unless indicated or specified to be NEMA 4 (designated by 4 or WP) or other type rating.
 3. Indoors Buried in Slab: Watertight, galvanized cast iron in floors on or below grade, otherwise concrete tight stamped steel.
 4. Outdoors Buried in Earth: Watertight, galvanized cast iron with a six (6) inch reinforced concrete envelope, polymer concrete casting similar to Strongwell "Composolite" (www.strongwell.com; former MMG Quazite) or precast concrete type manufactured by Brooks Product, Inc brand for Oldcastle Precast, Inc. (713-991-2400). Precast box shall have appropriate structural rating for intended use. Install on a level poured concrete base to provide a solid bearing surface. Provide a bolted cast iron traffic cover with foundry-cast marking "Electrical", "Communications" or "Telephone" as applies. Top of enclosure shall be one (1) inch above finished grade in earth. Top of enclosure shall be flush with finished pavement.

2.3 WIREWAY

- A. Manufacturers: Same as Metal Conduit.
- B. Product Description: General purpose.
- C. Size: As determined by Contractor in accordance with NEC 376.
- D. Cover: Screw cover.
- E. Connector: Slip-in.
- F. Fittings: Lay-in type.
- G. Finish: Rust inhibiting primer coating with gray enamel finish.

2.4 OUTLET BOXES

- A. Manufacturers: Same as Metal Conduit.
- B. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel.
 - 1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; furnish 1/2 inch male fixture studs where required.
 - 2. Concrete Ceiling Boxes: Concrete type.
- C. Cast Boxes: NEMA FB 1, Type FD, cast fer alloy. Furnish gasketed cover by box manufacturer.
- D. Wall Plates: As specified in Section 26 27 26.

PART 3 - EXECUTION

3.1 GENERAL

- A Install electric raceways where indicated; in accordance with manufacturer's written instructions, applicable requirements of the NEC and NECA's "Standard of Installation" and complying with recognized industry practices.
- B Raceways embedded in concrete or in earth below floor slabs shall be rigid steel conduit, intermediate metal conduit or rigid schedule 40 PVC conduit. Rigid PVC conduit shall be provided with rigid metal or intermediate metal conduit elbows when the raceway system exits the concrete topping or earth.
- C Electrical metallic tubing shall not be embedded in concrete or installed in earth.
- D Aluminum conduit shall not be embedded in concrete, or installed in earth.
- E Rigid heavy wall Schedule 40 PVC conduit shall be installed in earth and concrete only.
- F Raceways in outside walls or in refrigerated areas shall be rigid steel conduit, or intermediate metal conduit.
- G Provide rigid steel conduit or intermediate metal conduit for exposed raceways from floor to eight feet above the floor in mechanical rooms and in areas designated on the plans.

- H Rigid galvanized steel conduit or galvanized intermediate metal conduit shall be used where conduit is exposed to weather.
- I Conduits in hazardous locations shall conform to the National Electrical Code. Rigid galvanized steel conduit or intermediate metal conduit shall be used in hazardous locations. PVC conduit shall not be used in hazardous areas.
- J Rigid metal, intermediate metal, electric metallic tubing or PVC conduit where allowed in other section 3.1 paragraphs shall be used for feeders and branch circuits.
- K Flexible metal conduit may be used to connect light fixtures in accordance with NEC requirements. Provide flexible metal conduit for connections to motors, transformers, generators, and other equipment subject to vibration. Length of flexible conduit shall be a minimum of one foot for conduit diameters up to 1-1/2". A minimum of 3" of flexible conduit shall be added for every 1/2" increase in conduit diameter. Flexible metal conduit installation shall be kept to a minimum in connecting other electrical equipment items.
- L Sealtight, flexible conduit shall be used where the flexible conduit may be subject to moist or humid atmosphere, corrosive atmosphere, subject to water spray and subject to dripping oil, grease or water.
- M Conduits shall be 3/4" diameter, minimum. Raceway sizes shown on the drawing are based on type THHN/THWN conductors.
- N Type Material: Except as noted otherwise all conduit shall be steel.

3.2 EXAMINATION

- A. Verify outlet locations and routing and termination locations of raceway prior to rough-in.

3.3 EXISTING WORK

- A. Remove exposed abandoned raceway, including abandoned raceway above accessible ceiling finishes. Cut raceway flush with walls and floors, and patch surfaces.
- B. Remove concealed abandoned raceway to its source.
- C. Disconnect abandoned outlets and remove devices. Remove abandoned outlets when raceway is abandoned and removed. Install blank cover for abandoned outlets not removed.
- D. Maintain access to existing boxes and other installations remaining active and requiring access. Modify installation or provide access panel.
- E. Extend existing raceway and box installations using materials and methods compatible with existing electrical installations, or as specified.
- F. Clean and repair existing raceway and boxes to remain or to be reinstalled.

3.4 INSTALLATION - RACEWAY

- A. Ground and bond raceway and boxes in accordance with Section 26 05 26.
- B. Fasten raceway and box supports to structure and finishes in accordance with Section 26

25 29.

- C. Identify raceway and boxes in accordance with Section 26 05 53.
- D. Arrange raceway and boxes to maintain headroom and present neat appearance.
- E. Raceway routing is shown in approximate locations unless dimensioned. Route to complete wiring system.
- F. Arrange raceway supports to prevent misalignment during wiring installation.
- G. Support raceway using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.
- H. Group related raceway; support using conduit rack. Construct rack using steel channel specified in Section 26 05 29.
- I. Do not support raceway with wire or perforated pipe straps. Remove wire used for temporary supports
- J. Do not attach raceway to ceiling support wires or other piping systems.
- K. Construct wireway supports from steel channel specified in Section 26 25 29.
- L. Route exposed raceway parallel and perpendicular to walls.
- M. Route raceway installed above accessible ceilings parallel and perpendicular to walls.
- N. Maximum Size Conduit in Slab Above Grade: 3/4 inch.
- O. Maintain clearance between raceway and piping for maintenance purposes.
- P. Maintain 12 inch clearance between raceway and surfaces with temperatures exceeding 104 degrees Fahrenheit.
- Q. Cut conduit square using saw or pipe cutter; de-burr cut ends.
- R. Bring conduit to shoulder of fittings; fasten securely.
- S. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for minimum 20 minutes.
- T. Install conduit hubs or sealing locknuts to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes.
- U. Provide accessible "seal-off" fittings for all raceways entering or leaving hazardous areas, entering or leaving refrigerated areas and as otherwise required by the National Electrical Code.
- V. Where conduits penetrate the roof seal, they shall be installed in curbs provided for mechanical equipment. When this is not possible, suitable pitch pockets, lead flashing, or approved fittings shall be provided. Details for special conduit installations shall be as shown on the drawings.

- W. Install no more than equivalent of three 90 degree bends between boxes. Install conduit bodies to make sharp changes in direction, as around beams. Install hydraulic one-shot bender to fabricate factory elbows for bends in metal conduit larger than two (2) inch size.
- X. Avoid moisture traps; install junction box with drain fitting at low points in conduit system.
- Y. Install fittings to accommodate expansion and deflection where raceway crosses expansion joints.
- Z. Install suitable pull string or cord in each empty raceway except sleeves and nipples.
- AA. Install suitable caps to protect installed conduit against entrance of dirt and moisture.
- BB. Surface Raceway: Install flat-head screws, clips, and straps to fasten raceway channel to surfaces; mount plumb and level. Install insulating bushings and inserts at connections to outlets and corner fittings.
- CC. Close ends and unused openings in wireway.
- DD. Provide tracer wire on all underground raceway outside building slab on grade.

3.5 RACEWAY TYPES

- A. The following raceway types are to be used in the following locations:
 - 1. Underground: Concrete encased schedule 40 PVC or concrete encased rigid galvanized steel.
 - 2. Under Slab on Grade: Schedule 40 PVC.
 - 3. Outdoor Locations, Above Grade: Rigid galvanized steel.
 - 4. Wet and Damp Locations: Rigid galvanized steel.
 - 5. Exposed or Concealed Dry Locations, Indoors: EMT, IMC, or rigid galvanized steel.

3.6 INSTALLATION - BOXES

- A. Install wall mounted boxes at elevations to accommodate mounting heights as indicated on Drawings and as approved by the Architect.
- B. Adjust box location up to ten (10) feet prior to rough-in to accommodate intended purpose.
- C. Orient boxes to accommodate wiring devices oriented as specified in Section 126 27 26.
- D. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.
- E. In Accessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaire.
- F. Do not fasten boxes to ceiling support wires or other piping systems.
- G. Support boxes independently of conduit. Provide rigid support to structure for all junction boxes. Mount junction boxes within 18" of finished ceilings to facilitate future access. Locate junction boxes to allow ready access to junction box covers without removing any

equipment.

- H. All outdoor boxes shall be UL listed for wet location service.
- I. Provide rigid support to structure for all junction boxes.
- J. Provide rigid support to structure for all conduit within 3 feet of each junction box and a maximum spacing of 10 feet.
- K. Install junction boxes above ceilings in readily accessible location with no obstructions. Locate within 18 inches of finished ceiling to facilitate easy access.
- L. For all flexible whips to light fixtures provide wire support at mid-length of whip to structure above with UL listed conduit support clip.
- M. Provide outlet boxes to meet depth requirement of Architectural walls. Refer to Architectural Spec Section 09250 and 10611 for wall partitions.

3.7 ADJUSTING

- A. Install knockout closures in unused openings in boxes.

3.8 CLEANING

- A. Clean interior of boxes to remove dust, debris, and other material.
- B. Clean exposed surfaces and restore finish.

3.9 INSTALLATION - FLOOR BOXES

- A. Use cast floor boxes for installation in slab on grade.
- B. Set floor boxes level.
- C. Install boxes and fittings to preserve fire resistant rating of slabs and other elements, using materials and methods specified in Section 26 05 29.

3.10 ADJUSTING

- A. Adjust floor box flush with finish material.

3.11 CLEANING

- A. Clean interior of boxes to remove dust, debris, and other material.

3.11 ABOVE CEILING JUNCTION BOXES

- A. Labeling: Provide label on all above ceiling junction boxes.
 - 1. Provide permanent labeling with indelible black marker, in neat, legible print indicating the panelboard name, branch circuit number(s) and voltage of conductors within the junction box. Junction boxes used for emergency power circuits to be painted red.

END OF SECTION 26 05 33

**SECTION 26 05 53
IDENTIFICATION FOR ELECTRICAL SYSTEMS**

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Nameplates.
 - 2. Underground Warning Tape.
 - 3. Lockout Devices.

1.2 QUALITY ASSURANCE

- A. Manufacturers: Firms Regularly engaged in manufacture of electrical identification, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Codes and standards: Comply with the following:
 - 1. National Electrical Code, NFPA No. 70.
 - 2. NEMA standards applicable to the product provided.
 - 3. UL standards applicable to the product provided.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include, but are not limited to the following:
 - 1. Panduit Corp.
 - 2. American Labelmark Co.
 - 3. Markal Corp.
 - 4. Calpico, Inc.
 - 5. Ideal Industries, Inc.

2.2 NAMEPLATES

- A. Product Description: Laminated three-layer plastic with engraved black letters on light contrasting background color.
- B. Emergency Power panels and Equipment: Laminated three-layer plastic with engraved white letters on **RED** background.
- C. Letter Size:
 - 1. 1/4 inch high letters for identifying individual equipment and loads.
- D. Minimum nameplate thickness: 1/8 inch.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.

3.2 INSTALLATION

- A. Install identifying devices after completion of painting.
- B. Nameplate Installation:
1. Install nameplate parallel to equipment lines.
 2. Install nameplate for each electrical distribution and control equipment enclosure with corrosive-resistant mechanical fasteners, or adhesive.
 3. Install nameplates for each control panel and major control components located outside panel with corrosive-resistant mechanical fasteners, or adhesive.
 4. Secure nameplate to equipment front using screws, rivets, or adhesive.
 5. Secure nameplate to inside surface of door on recessed panelboard in finished locations.
 6. Install nameplates for the following:
 - a. Switchboards
 - b. Panelboards
 - c. Transformers
 - d. Service Disconnects
 - 1) Enclosed Switches
 - e. Motor Control Centers
 - f. Stand-alone Motor Controllers
 - g. Generators
 - h. Contactors
- C. Underground Warning Tape Installation:
1. Install underground warning tape along length of each underground conduit, raceway, or cable six (6) to eight (8) inches below finished grade, directly above buried conduit, raceway, or cable. Where multiple lines installed in a common trench or concrete envelope, do not exceed an overall width of 16 inches; install a single line marker.
 2. Install line marker for underground wiring, both direct buried and in raceway.
- D. Printed Panelboard Directory:
1. Provide framed, typed circuit schedules with explicit description and identification of items controlled by each individual breaker for that panel.
 2. Copy in Owner's Manual.

3.3 ABOVE CEILING JUNCTION BOXES

- A. Labeling: Provide label on all above ceiling junction boxes.
1. Provide permanent labeling with indelible black marker, in neat, legible print indicating the panelboard name, branch circuit number(s) and voltage of conductors within the junction box.

3.4 ARC FLASH WARNING LABEL

- A. Install ARC flash warning label on switchboards, panel boards and motor control centers, etc. requiring examination, adjustments, servicing or maintenance while energized shall be field marked to warn persons of arc flash hazards in accordance with 2014 NEC articles 110.16 and 110.21. Marking shall be located so as to be clearly visible to qualified persons before servicing or maintenance.

END OF SECTION 26 05 53

SECTION 26 09 23
DIGITAL LIGHTING CONTROL SYSTEM

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SUMMARY

- A. Section include:
 - 1. Digital Lighting Controllers
 - 2. Relay Panels

- B. Related Sections:
 - 1. Section 26 27 26 Wiring Devices
 - 2. Section 26 50 00 Interior Lighting

1.2 REFERENCES

- A. American National Standards Institute/Institute of Electrical and Electronic Engineers (ANSI/IEEE) (www.ansi.org and www.ieee.org)
- B. International Electrotechnical Commission (IEC) (www.iec.ch)
- C. International Organization for Standardization (ISO) (www.iso.ch):
- D. National Electrical Manufacturers Association (NEMA) (www.nema.org)
- E. WD1 (R2005) - General Color Requirements for Wiring Devices.
- F. Underwriters Laboratories, Inc. (UL) (www.ul.com):
 - 1. 20 – Plug Load Controls
 - 2. 508 – Industrial Controls
 - 3. 916 – Energy Management Equipment
 - 4. 924 – Emergency Lighting

1.3 SYSTEM DESCRIPTION AND OPERATION

- A. The Lighting Control and Automation system as defined under this section covers the following equipment:
 - 1. Digital Lighting Management (DLM) local network – Free topology, plug-in wiring system (Cat 5e) for power and data to room devices.
 - 2. Digital Room Controllers – Self-configuring, digitally addressable one, two or three relay plenum-rated controllers for on/off control. Selected models include 0-10 volt or line voltage forward phase control dimming outputs and integral current monitoring capabilities.
 - 3. Digital Occupancy Sensors – Self-configuring, digitally addressable, calibrated occupancy sensors with LCD display and two-way active infrared (IR) communications.
 - 4. Digital Switches – Self-configuring, digitally addressable pushbutton on/off, dimming, and scene switches with two-way active infrared (IR) communications.
 - 5. Configuration Tools – Handheld remote for room configuration and relay panel programming provides two way infrared (IR) communications to digital devices

and allows complete configuration and reconfiguration of the device / room from up to 30 feet away.

6. Digital Lighting Management (DLM) segment network – Linear topology, BACnet MS/TP network (1.5 twisted pair, shielded) to connect multiple DLM local networks for centralized control.
7. Network Bridge – Provides BACnet MS/TP-compliant digital networked communication between rooms, panels and the Segment Manager or building automation system (BAS) and automatically creates BACnet objects representative of connected devices.
8. Programming and Configuration Software – Optional PC-native application capable of accessing DLM control parameters within a room, for the local network, via a USB adapter, or globally, for many segment networks simultaneously, via BACnet/IP communication.

Digital Lighting Management Relay Zone Controller –Panel accepts program changes from handheld configuration tool for date and time, location, holidays, event scheduling, button binding and group programming. Provides BACnet MS/TP-compliant digital networked communication between other lighting controls and/or building automation system (BAS).

1.4 SUBMITTALS

- A. Specification Review: Provide a complete item by item, line by line specification review indicating compliance with the specifications and note any deviations from the specification with reason for deviation.
- B. Shop drawings:
 1. Composite wiring diagram of each control circuit proposed to be installed.
 2. Show locations of digital devices, sensors, load controllers and switches for each area as indicated on the Construction Documents.
 3. Provide room/area details including all product used in space and sequence of operation for each room/area.
 4. Network riser diagram including floor and building level details. Include network cable specification and end-of-line termination details, if required. Illustrate points of connection to integrated systems. Coordinate integration with mechanical and/or other trades.
- C. Product Data: Submit manufacturer product data sheets, specifications, installation instructions, dimensions, size, voltage ratings and current ratings. Indicate that all equipment and devices are suitable for the proposed application.
- D. Short circuit current rating (SCCR) of equipment.
- E. U.L. Label.
- F. Electrical characteristics of equipment.
- G. Enclosure metal gauge and finish.

1.5 QUALITY ASSURANCE

- A. Manufacturer: Minimum of (10) ten years in manufacturing of lighting controls.

1.6 PROJECT CONDITIONS

- A. Do not install equipment until following conditions can be maintained in spaces to receive equipment:
 - 1. Ambient temperature: 0° to 40° C (32° to 104° F).
 - 2. Relative humidity: Maximum 90 percent, non-condensing.

1.7 WARRANTY

- A. Provide a five year limited manufacturer's warranty on all room control devices and panels.

1.8 CLOSEOUT SUBMITTALS

- A. Provide manuals as described in Section 26 05 00.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Controls:
 - 1. Watt Stopper, Inc.
 - 2. Eaton/Cooper Controls
 - 3. Hubbell Building Automation, Inc.
 - 4. Acuity Brands, Inc.
- B. Sensors/Devices
 - 1. Watt Stopper, Inc.
 - 2. Eaton/Cooper Controls
 - 3. Hubbell Building Automation, Inc.
 - 4. SensorSwitch, Inc., PLC Multipoint Inc.
- C. Basis of design: WattStopper Digital Lighting Management (DLM) System or approved equivalent listed above.
- D. Enclosure: Provide a NEMA 1 enclosure for all contactors located indoors. Provide NEMA 4X for those located outdoors and in wet areas.

2.2 DIGITAL LIGHTING CONTROLS:

- A. Furnish the Company's system which accommodates the square-footage coverage requirements for each area controlled, utilizing room controllers, digital occupancy sensors, switches, daylighting sensors and accessories which suit the lighting and electrical system parameters.

2.3 DLM LOCAL NETWORK (Room Network)

- A. The DLM local network is a free topology lighting control physical connection and communication protocol designed to control a small area of a building.
- B. Features of the DLM local network include:
 - 1. Plug n' Go™ automatic configuration and binding of occupancy sensors, switches and lighting loads to the most energy-efficient sequence of operation based upon the device attached.

2. Push n' Learn™ configuration to change the automatic configuration, including binding and load parameters without tools, using only the buttons on the digital devices in the local network.
 3. Two-way infrared communications for control by handheld remotes, and configuration by a handheld tool including adjusting load parameters, sensor configuration and binding, within a line of sight of up to 30 feet from a sensor, wall switch or IR receiver.
- C. Digital room devices connect to the local network using pre-terminated Cat 5e cables with RJ-45 connectors, which provide both data and power to room devices. Systems that utilize RJ-45 patch cords but do not provide serial communication data from individual end devices are not acceptable.
- D. If manufacturer's pre-terminated Cat5e cables are not used for the installation, the contractor is responsible for testing each cable following installation and supplying manufacturer with test results.
- E. WattStopper Product Number: LMRJ-Series

2.4 DIGITAL LOAD CONTROLLERS (ROOM CONTROLLERS)

- A. Digital controllers for lighting loads automatically bind the room loads to the connected devices in the space without commissioning or the use of any tools. Room controllers shall be provided to match the room lighting control requirements. It does not have dip switches or potentiometers, or require special configuration for standard Plug n' Go applications. The control units will include the following features:
1. Automatic room configuration to the most energy-efficient sequence of operation based upon the devices in the room.
 2. Multiple room controllers connected together in a local network will automatically arbitrate with each other, without requiring any configuration or setup, so that individual load numbers are sequentially assigned using each controller's device ID's from highest to lowest.
 3. Device Status LEDs to indicate:
 - a. Data transmission
 - b. Device has power
 - c. Status for each load
 - d. Configuration status
 4. Each load shall at a minimum be configurable to operate in the following sequences based on occupancy:
 - a. Auto-on/Auto-off (Follow on and off)
 - b. Manual-on/Auto-off (Follow off only)
 5. The polarity of each load output is reversible, via digital configuration, so that on is off and off is on.
 6. UL 2043 plenum rated
 7. Manual override and LED indication for each load
 8. Dual voltage (120/277 VAC, 60 Hz), or 347 VAC, 60 Hz (selected models only). 120/277 volt models rated for 20A total load, derating to 16A required for some dimmed loads (forward phase dimming); 347 volt models rated for 15A total load; plug load controllers carry application-specific UL 20 rating for receptacle control.
 9. Zero cross circuitry for each load
- B. On/Off Room Controllers includes:
1. One or two relay configuration
 2. Efficient 150 mA switching power supply
 3. Three RJ-45 DLM local network ports with integral strain relief and dust cover

4. WattStopper product numbers: LMRC-101, LMRC-102
- C. On/Off/Dimming enhanced Room Controllers includes:
 1. Real time current monitoring
 2. Multiple relay configurations
 - a. One, two or three relays (LMRC-21x series)
 - b. One or two relays (LMRC-22x series)
 3. Efficient 250 mA switching power supply
 4. Four RJ-45 DLM local network ports with integral strain relief and dust cover
 5. One dimming output per relay
 - a. 0-10V Dimming - Where indicated, one 0-10 volt analog output per relay for control of compatible ballasts and LED drivers. The 0-10 volt output shall automatically open upon loss of power to the Room Controller to assure full light output from the controlled lighting. (LMRC-21x series)
 - b. Each dimming output channel shall have an independently configurable minimum and maximum calibration trim level to set the dimming range to match the true dynamic range of the connected ballast or driver.
 - c. The LED level indicators on bound dimming switches will utilize this new maximum and minimum trim.
 - d. Each dimming output channel can be independently configurable minimum and maximum trim level to set the dynamic range of the output within the new 0-100% dimming range defined by the minimum and maximum calibration trim.
 - e. Calibration and trim levels must be set per output channel.
 - f. Devices that set calibration or trim levels per controller are not acceptable.
 - g. All configuration shall be digital. Devices that set calibration or trim levels per output channel via trim pots or dip-switches are not acceptable.
 6. WattStopper product numbers: LMRC-211, LRMC-212, LRMC-213

2.5 DIGITAL WALL OR CEILING MOUNTED SENSOR

- A. Wall or ceiling mounted (to suit installation) passive infrared (PIR), ultrasonic or dual technology digital (passive infrared and ultrasonic) occupancy sensor.
- B. Digital Occupancy Sensors shall provide graphic LCD display for digital calibration and electronic documentation. Features include the following:
 1. Digital calibration and pushbutton configuration for the following variables:
 - a. Sensitivity – 0-100% in 10% increments
 - b. Time delay – 1-30 minutes in 1 minute increments
 - c. Test mode – Five second time delay
 - d. Detection technology – PIR, Ultrasonic or Dual Technology activation and/or re-activation.
 - e. Walk-through mode
 2. Load parameters including Auto/Manual-ON, blink warning, and daylight enable/disable when photosensors are included in the DLM local network.
 3. Programmable control functionality including:

- a. Each sensor may be programmed to control specific loads within a local network.
 - b. Sensor shall be capable of activating one of 16 user-definable lighting scenes.
 - c. Adjustable retrigger time period for manual-on loads. Load will retrigger (turn on) automatically within a configurable period of time (default 10 seconds) after turning off.
 - d. On dual technology sensors, independently configurable trigger modes are available for both Normal (NH) and After Hours (AH) time periods. The retrigger mode can be programmed to use the following technologies:
 - e. Ultrasonic and Passive Infrared
 - f. Ultrasonic or Passive Infrared
 - g. Ultrasonic only
 - h. Passive Infrared only
 - i. Independently configurable sensitivity settings for passive infrared and ultrasonic technologies (on dual technology sensors) for both Normal (NH) and After Hour (AH) time periods.
 4. One or two RJ-45 port(s) for connection to DLM local network.
 5. Two-way infrared (IR) transceiver to allow remote programming through handheld commissioning tool and control by remote personal controls.
 6. Device Status LEDs, which may be disabled for selected applications, including:
 - a. PIR detection
 - b. Ultrasonic detection
 - c. Configuration mode
 - d. Load binding
 7. Assignment of occupancy sensor to a specific load within the room without wiring or special tools.
 8. Manual override of controlled loads.
 9. All digital parameter data programmed into an individual occupancy sensor shall be retained in non-volatile FLASH memory within the sensor itself. Memory shall have an expected life of no less than 10 years.
- C. BACnet object information shall be available for the following objects:
1. Detection state
 2. Occupancy sensor time delay
 3. Occupancy sensor sensitivity, PIR and Ultrasonic
- D. Units shall not have any dip switches or potentiometers for field settings.
- E. Multiple occupancy sensors may be installed in a room by simply connecting them to the free topology DLM local network. No additional configuration will be required.
- F. WattStopper product numbers: LMDX, LMDC

2.6 DIGITAL WALL SWITCHES

- A. Low voltage momentary pushbutton switches in 1, 2, 3, 4, 5 and 8 button configuration. Wall switches shall include the following features:
1. Two-way infrared (IR) transceiver for use with personal and configuration remote controls.
 2. Removable buttons for field replacement with engraved buttons and/or alternate color buttons. Button replacement may be completed without removing the switch from the wall.
 3. Configuration LED on each switch that blinks to indicate data transmission.
 4. Load/Scene Status LED on each switch button with the following characteristics:
 - a. Bi-level LED
 - b. Dim locator level indicates power to switch
 - c. Bright status level indicates that load or scene is active
 - d. Dimming switches shall include seven bi-level LEDs to indicate load levels using 14 steps.
 5. Programmable control functionality including:
 - a. Button priority may be configured to any BACnet priority level, from 1-16, corresponding to networked operation allowing local actions to utilize life safety priority
 - b. Scene patterns may be saved to any button other than dimming rockers. Once set, buttons may be digitally locked to prevent overwriting of the preset levels.
 6. All digital parameter data programmed into an individual wall switch shall be retained in non-volatile FLASH memory within the wall switch itself. Memory shall have an expected life of no less than 10 years.
- B. Two RJ-45 ports for connection to DLM local network.
- C. Multiple digital wall switches may be installed in a room by simply connecting them to the free topology DLM local network. No additional configuration shall be required to achieve multi-way switching.
- D. Switch attributes may be changed or selected using a wireless configuration tool:
1. Switch buttons may be bound to any load on any load controller or relay panel and are not load type dependant; each button may be bound to multiple loads.
- E. WattStopper product numbers: LMSW-101, LMSW-102, LMSW-103, LMSW-104, LMSW-105, LMSW-108, LMDM-101. Available in white, light almond, ivory, grey, red and black; compatible with wall plates with decorator opening.

2.7 HANDHELD AND COMPUTER CONFIGURATION TOOLS

- A. A wireless configuration tool facilitates optional customization of DLM local networks using two-way infrared communications, while PC software connects to each local network via a USB interface.
- B. Features and functionality of the wireless configuration tool shall include but not be limited to:
1. Two-way infrared (IR) communication with DLM IR-enabled devices within a range of approximately 30 feet.
 2. High visibility organic LED (OLED) display, pushbutton user interface and menu-driven operation.

3. Must be able to read and modify parameters for load controllers and relay panels, occupancy sensors, wall switches, daylighting sensors, network bridges, and identify DLM devices by type and serial number.
4. Save up to eight occupancy sensor setting profiles, and apply profiles to selected sensors.
5. Temporarily adjust light level of any load(s) on the local network, and incorporate those levels in scene setting. Set room mode for testing of Normal Hours (NH) and After Hours (AH) parameter settings.
6. Adjust or fine-tune daylighting settings established during auto-configuration, and input light level data to complete configuration of open loop daylighting controls.
7. Set room mode for testing of Normal Hours (NH) and After Hours (AH) parameter settings.
8. Verify status of building level network devices.

C. WattStopper Product Numbers: LMCT-100, LMCI-100/LMCS-100

2.8 DLM SEGMENT NETWORK (Room to room network)

- A. The segment network shall be a linear topology, BACnet-based MS/TP subnet to connect DLM local networks (rooms) and DLM zone controller for centralized control.
1. Each connected DLM local network shall include a single network bridge (LMBC-300), and the network bridge is the only room-based device that is connected to the segment network.
 2. Network bridges, relay panels and segment managers shall include terminal blocks, with provisions for separate “in” and “out” terminations, for segment network connections.
 3. The segment network shall utilize 1.5 twisted pair, shielded, cable supplied by the lighting control manufacturer. The maximum cable run for each segment is 4,000 feet. Conductor-to-conductor capacitance of the twisted pair shall be less than 30 pf/ft and have a characteristic impedance of 120 Ohms.
 4. Network signal integrity requires that each conductor and ground wire be correctly terminated at every connected device.
 5. Substitution of manufacturer-supplied cable must be pre-approved: Manufacturer will not certify network reliability, and reserves the right to void warranty, if non-approved cable is installed, and if terminations are not completed according to manufacturer's specific requirements.
 6. Segment networks shall be capable of connecting to BACnet-compliant BAS (provided by others) either directly, via MS/TP, or through NB-ROUTERS, via BACnet/IP or BACnet/Ethernet. Systems whose room-connected network infrastructure require gateway devices to provide BACnet data to a BAS are unacceptable.
- B. WattStopper Product Number: LM-MSTP

2.9 NETWORK BRIDGE

- A. The network bridge module connects a DLM local network to a BACnet-compliant segment network for communication between rooms, relay panels and a segment manager or BAS. Each local network shall include a network bridge component to provide a connection to the local network room devices. The network bridge shall use industry standard BACnet MS/TP network communication and an optically isolated EIA/TIA RS-485 transceiver.
1. The network bridge shall be provided as a separate module connected on the local network through an available RJ-45 port.

2. Provide Plug n' Go operation to automatically discover room devices connected to the local network and make all device parameters visible to the segment manager via the segment network. No commissioning shall be required for set up of the network bridge on the local network.

B. WattStopper product numbers: LMBC-300

2.10 LIGHTING ZONE CONTROLLER

A. HARDWARE:

Provide LMCP lighting control panels in the locations and capacities as indicated on the plans and schedules. Each panel shall be of modular construction and consist of the following components:

1. In addition to the LMCP Relay Panels, an LMZC Zone Controller panel shall be available for zero-relay applications. The panel is designed for applications where distributed load controllers are used to switch and/or dim the controlled loads. Key similarities to and differences from the LMCP panel design shall include:
 - a. The LMZC shall use the same intelligence board as the LMCP relay panel.
 - b. The LMZC shall not include relay driver boards or relays.
 - c. The LMZC shall have a removable interior section to facilitate installation, and a Tub/Cover. Cover is for surface mounting applications only.
 - d. The LMZC tub shall have two interior KOs to allow installation of LMPB-100 Power Boosters. Each installed Power Booster can provide an additional 150 mA for either of the two available DLM local networks provided by the LMZC.
 - e. All programming and networking (whether DLM Local Network and/or Segment Network) capabilities in the LMZC Zone Controller shall be similar to capabilities for LMCP relay panels, except for functions designed for panel-mounted HDR relays.
2. WattStopper Product Number Zone Controller: LMZC-301.

B. USER INTERFACE

Each lighting control panel system shall be supplied with at least (1) handheld configuration tool (LMCT-100). As a remote programming interface the configuration tool shall allow setup, configuration, and diagnostics of the panel without the need for software or connection of a computer. The user interface shall have the following panel-specific functions as a minimum:

1. Set network parameters including panel device ID, MS/TP MAC address, baud rate and max master range.
2. Relay Group creation of up to 99 groups. Group creation shall result in programming of all seven key relay parameters for member relays. The seven parameters are as follows: After-hours Override Time Delay, Normal Hours Override Time Delay, Action on Transition to Normal Hours, Action on Transition to After Hours, Sensor Action During Normal Hours, Sensor Action During After Hours, Blink-Warn Time for After Hours.
3. Program up to 254 separate scheduled events. Events shall occur on seven day intervals with each day selectable as active or inactive, and shall be configurable as to whether the event is active on holidays. Holidays are also defined through the User Interface.
4. Program up to 32 separate Dark/Light events. Events shall have a selectable source as either calculated Astro with delay, or a digital IO module with an

integral 0-5V or 0-10V analog photocell. Dark/Light events shall occur on seven day intervals with each day selectable as active or inactive, and shall be configurable as to whether the event is active on holidays.

5. Button binding of digital switches to groups shall be accessible via the handheld IR remote and accomplished from the digital switch station.
6. Programming of panel location information shall be accomplished by the handheld IR remote and include at a minimum LAT, LON, DST zone, and an approximate city/state location.
7. WattStopper Product Number: LMCT-100

2.11 PHOTO-ELECTRIC CONTROLS:

A. Description:

1. General: Photo-electric control shall switch load ON at dusk and OFF at dawn.
2. Housing: Photocell shall be enclosed in a weatherproof, corrosion resistant housing. The housing shall have a 1/2 inch I.P.S. nipple with a locking washer.
3. Element: Light sensing element shall be Cadmium-Sulfide cell hermetically sealed against moisture. Minimum time delay before change-of-state shall be 15 seconds. If the photo-electric control fails, the load shall switch ON (fail-safe ON).
4. Adjustment: The housing shall have an adjustable slide shield to vary the ambient light reaching the CdS cell. The slide shield shall not override the control; that is, the ON/OFF function shall occur even when the shield is at either extreme of the adjustment range. Adjustment shall be made by hand without tools.
5. Temperature: The photocell shall be suitable for operation in an ambient temperature range of -30 degrees Fahrenheit to + 140 degrees Fahrenheit.
6. Voltage: The photocell shall be suitable for use at voltage equal to the load voltage (120, 208, 277).
7. Capacity: Photocell shall be SPST rated for a minimum of 1800 Volt-Amps resistive or inductive load.
8. Leads: Photocell shall have minimum six (6) inch wire leads with wet location insulation. Leads shall be color coded Red/Load, Black/Line and White/Neutral.
9. Listing: Photocell shall be listed by Underwriters Laboratories.

B. Manufacturer: Intermatic, Paragon, Precision, Tork.

PART 3 – EXECUTION

3.1 PRE-INSTALLATION MEETING:

- A. A factory authorized manufacturer's representative shall provide the electrical contractor a functional overview of the lighting control system prior to installation. The contractor shall schedule the pre-installation site visit after receipt of approved submittals to review the following:
 1. Confirm the location and mounting of all digital devices, with special attention to placement of occupancy and daylighting sensors.
 2. Review the specifications for low voltage control wiring and termination.
 3. Discuss the functionality and configuration of all products, including sequences of operation, per design requirements.
 4. Discuss requirements for integration with other trades.

3.2 CONTRACTOR INSTALLATION AND SERVICES

- A. Contractor to install all devices and wiring in a professional manner. All line voltage connections to be tagged to indicate circuit and switched legs.
- B. Contractor to install all room/area devices using manufacturer's factory-tested Cat 5e cable with pre-terminated RJ-45 connectors. If pre-terminated cable is not used for room/area wiring, the contractor is responsible for testing each field-terminated cable following installation, and shall supply the lighting controls manufacturer with test results. Contractor to install any room to room network devices using manufacturer-supplied LM-MSTP network wire. Network wire substitution is not permitted and may result in loss of product warranty per DLM SEGMENT NETWORK section of specification. Low voltage wiring topology must comply with manufacturer's specifications. Contractor shall route network wiring as shown in submittal drawings as closely as possible, and shall document final wiring location, routing and topology on as built drawings.
- C. Install the work of this Section in accordance with manufacturer's printed instructions unless otherwise indicated. Before start up, contractor shall test all devices to ensure proper communication.

3.3 FACTORY SERVICES

- A. Upon completion of the installation, the manufacturer's factory authorized representative shall start up and verify a complete fully functional system.
- B. The electrical contractor shall provide both the manufacturer and the electrical engineer with three weeks written notice of the system start up and adjustment date.
- C. Upon completion of the system start up, the factory-authorized technician shall provide the proper training to the owner's personnel on the adjustment and maintenance of the system.

3.4 EXAMINATION

- A. Site Verification: Verify that wiring conditions, which have been previously installed under other sections or at a previous time, are acceptable for product installation in accordance with manufacturer's instructions.
- B. Inspection: Inspect all material included in this contract prior to installation. Manufacturer shall be notified of unacceptable material prior to installation.

3.5 INSTALLATION

- A. The Electrical Contractor, as part of the work of this section, shall coordinate, receive, mount, connect, and place into operation all equipment. The Electrical Contractor shall furnish all conduit, wire, connectors, hardware, and other incidental items necessary for properly functioning lighting control as described herein and shown on the plans (including but not limited to System Field Devices, 0-10V dimming ballasts, fixed output ballasts, 0-10V LED drivers and communication wire). The Electrical Contractor shall maintain performance criteria stated by manufacturer without defects, damage, or failure.

- B. Power: The contractor shall test that all branch load circuits are operational before connecting loads to sensor system load terminals, and then de-energize all circuits before installation.
- C. Related Product Installation: Refer to other sections listed in Related Sections for related products' installation.

3.6 PHOTO-ELECTRIC CONTROL MOUNTING:

- A. Provide photo-electric control on roof of building. When more than one building is constructed on site, install photo control on each roof. Aim true North and locate in places where ambient night lighting will not cause interference. Wire down to respective contactors in each building.

3.7 SENSOR INSTALLATION

- A. Adjust sensitivity to cover area installed
- B. Set time delay on occupancy sensors that are connect to the lighting control system to the minimum. Time delays shall be controlled via Central Control Software.
- C. Sensor shall be powered through Input Module. No external power packs shall be used for powering sensors.
- D. Install occupancy sensors on vibration free stable surface.
- E. Install interior light sensor in ceiling facing the floor.

3.8 WIRING INSTALLATION

- A. Wiring Method: Comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size shall be 3/4 inch.
- B. Wiring within Enclosures: Comply with NEC & CEC. Separate power-limited and non power-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.

3.9 SOFTWARE INSTALLATION

- A. Install and program software with initial settings of adjustable values. Make backup copies of software and user-supplied values. Provide current site licenses for software.

3.10 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Perform the following field tests and inspections with the assistance of a factory-authorized service representative:

1. Operational Test: After installing wall stations and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation
 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Lighting control devices will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

END OF SECTION 26 09 23

SECTION 26 24 16
ELECTRICAL PANELBOARDS

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

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.
- B This Section is a Division 26 "Basic Materials and Methods" section, and is a part of each Division 26 section making reference to panelboards specified herein.

1.2 DESCRIPTION OF WORK

- A Extent of panelboard and enclosure work, including cabinets and cutout boxes is indicated on the drawings and by schedules.
- B Types of panelboards and enclosures in this Section include the following:
 - 1. Distribution Panels
 - 2. Lighting and Appliance Panels
- C Refer to other Division 26 sections for cable/wire, connectors and electric raceway work required in conjunction with panelboards and enclosures; not work of this Section.

1.3 QUALITY ASSURANCE

- A Manufacturers: Firms regularly engaged in the manufacture of panelboards and enclosures, of types, size and ratings required, whose products have been in satisfactory use in similar service for not less than five (5) years.
- B Installer: A firm of at least three (3) years of successful installation experience on projects with electrical installation work similar to that required for this project.

1.4 REFERENCES

- A Special Use Markings: Provide panelboards, constructed for special use, with UL markings indicating that special type usage. Panels identified or shown on the drawings for use as main service entrance equipment shall be labeled at the factory with "SERVICE ENTRANCE" type UL label.
- B UL Compliance: Comply with applicable UL safety standards pertaining to panelboards, accessories, and enclosures. Provide units which have been UL listed and labeled. UL standards are as follows:
 - 1. Panelboards - UL67
 - 2. Cabinets and Boxes - UL50

- C NEC Compliance: Comply with the NEC as applicable to the installation of panelboards, cabinets, and cutout boxes.
- D NEMA Compliance: Comply with NEMA Stds. Pub. No. 250 "Enclosures for Electrical Equipment (1000 volt maximum)", Pub. No. 1 "Panelboards" and Pub. No. PB1.1, "Instruction for Safe Installation, Operation, and Maintenance of Panelboards Rates 600 Volts and Less".
- E NECA Compliance: Comply with NECA's "Standard of Installation".

1.5 SUBMITTALS

- A Specification Review: Provide a complete item by item, line by line specification review indicating compliance with the specifications and note any deviations from the specification with reason for deviation.
- B Product Data: Submit manufacturer's data including specifications, installation instructions and general recommendations for each panelboard required. Include data substantiating that units comply with specified requirements.
- C Shop Drawings: Submit dimensioned drawings of panelboards and enclosures showing accurately scaled layouts of enclosures and required individual panelboard devices, including but not limited to circuit breakers, fusible switches, fuses, ground fault circuit interrupters, and accessories.

1.6 SHORT CIRCUIT CURRENT RATINGS

- A General: All switchboards and panelboards shall be fully rated and marked with a maximum short circuit current rating unless otherwise noted. The equipment manufacturer shall have verified this rating with high-amperage testing. All short circuit current ratings are expressed as amperes RMS symmetrical at the applied voltage unless otherwise noted. All equipment shall withstand the specified level of fault current. All overcurrent devices shall interrupt the specified level of fault current.
- B Series Ratings: Series rated panels are not permitted without the approval of the Owner and Engineer. Contractor shall provide coordination study and test results as part of the submittal for series rated panels. All series ratings shall be UL listed and derived from actual testing. A copy of the listing shall be included in the equipment submittal.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS: Subject to compliance with requirements provide products of one of the following:

- a. Cutler Hammer
- b. General Electric Corp.
- c. Square D Company
- d. Siemens

2.2 GENERAL

- A Except as otherwise indicated, provide panelboards, enclosures and ancillary components, of types, sizes, and ratings indicated, which comply with manufacturer's standard materials, and which are designed and constructed in accordance with published product information. Provide solderless lugs, or connectors, in the correct number and size for conductors on mains, on the load side of each branch, circuit, and on ground and neutral bars. Provide tin plated copper busses. Provide an insulated neutral bus (equal in size to the phase bussing) and a bonded equipment ground bus mounted at the opposite end of the structure from the mains, and having numbered screw or lug terminals for connection of wires. Equip panels with the number of unit devices as required for a complete installation. Where more than one type of component meets the indicated requirements, selection is installer's option. Where types, sizes or ratings are not indicated, comply with NEC, UL and established industry standards for applications indicated.
- B Provide ground fault circuit interrupting type circuit breakers for all devices noted with a "GFI" subscript on the panelboard schedules for this project.
- C Provide UL listed HACR type circuit breakers for all devices which serve heating, ventilating, or air conditioning equipment.
- D Panelboards shall be provided with covers for surface or flush mounting as shown on the drawings, or as required for actual project conditions.
- E Panelboards shall be constructed for top or bottom feeder service, as required by actual project conditions.
- F All panels shall be marked with PPE level per NEC where fault current calculations have been done.

2.3 LIGHTING AND APPLIANCE PANELS

- A Lighting and appliance panelboards shall be Square D type NQOD, class 1630 (or equal) for 277/480 volt or 120/208 volt applications. All branch circuit breakers are to be quick-make, quick-break, trip indicating and common trip on all multi-pole breakers, and shall be bolt-on type. Trip indication shall be clearly shown by breaker handle located between the "ON" and the "OFF" positions. Panelboards shall have distributed phase copper bussing throughout.
- B Product Description: NEMA PB1, circuit breaker type, lighting and appliance branch circuit panelboard.
- C Panelboard Bus: Copper current carrying components, ratings as indicated on Drawings. Furnish copper ground bus in each panelboard;
- D For non-linear load applications subject to harmonics furnish 173 percent rated, plated copper, solid neutral.
- E Minimum Integrated Short Circuit Rating: 10,000 amperes rms symmetrical for 208-240/120 volt panelboards; 14,000 amperes rms symmetrical for 480 volt panelboards.
- F Molded Case Circuit Breakers: NEMA AB 1, bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles, listed as Type SWD for lighting circuits, Type

- HACR for air conditioning equipment circuits, Class A ground fault interrupter circuit breakers as indicated on Drawings. Do not use tandem circuit breakers.
- G Enclosure: NEMA PB 1, Type 1 or Type 3R.
 - H Cabinet Front: Safety dead front type with concealed trim clamps, concealed hinge, metal directory frame, and flush lock keyed alike. Finish in manufacturer's standard gray enamel.
 - I Provide ground-fault circuit breaker for each heat trace branch circuit.
 - J Panelboards indicated to have thru-feed lugs shall be furnished with thru-feed lugs in all sections of panelboard.
 - K Provide fully rated main circuit breaker type panelboards, where the short circuit rating of the complete panelboard assembly is determined by the lowest rated branch device. Provide panelboard interrupting ratings as noted on the drawings. The Contractor may, at his option, (if acceptable to the local Code Authority) provide main circuit breaker type panelboards where the short circuit rating of the complete panelboard is determined by the use of UL approved combinations of main and branch circuit breaker devices, and the rating of the complete panelboard assembly is as shown on the drawings.
 - L Provide fully rated main lug only type panelboards where the short circuit rating of the complete panelboard assembly is determined by the lowest rated branch device. Provide panelboard interrupting ratings as noted on the drawings. The Contractor may, at his option, (if acceptable to the local Code Authority) provide main lug only type panelboards where the short circuit rating of the complete panelboard assembly is determined by the use of UL approved combinations of upstream devices and branch circuit breaker devices, and the rating of the complete panelboard assembly is as shown on the drawings.
 - M Panelboard boxes shall have 6-inch minimum gutters. Fronts are to be complete with door and cylinder lock, with all locks keyed alike. Fronts shall have adjustable trim clamps, directory frames, and shall be equipped with a typewritten directory that identifies each circuit breaker by number and the equipment that the breaker serves. One additional blank directory card for each panel shall be furnished to the Owner.
 - N Panelboards shall be Underwriters' Laboratory listed and shall bear the UL label. The size of the panelboard main disconnect device or main lugs, the rating and number of branch circuits, and the type of mounting shall be as shown on the drawings.
 - O All factory installed devices shall be re-torqued prior to energizing.

PART 3 - EXECUTION

3.1 INSTALLATION

- A General: Install panelboards and enclosures where indicated, in accordance with the manufacturers' written instructions, applicable requirements of the NEC and NECA's "Standard of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

- B Coordinate the installation of panelboards and enclosures with cable and raceway installation work.
- C Provide all required electrical connections within the enclosure.
- D Fill out typewritten panelboard circuit directory cards upon completion of the installation work.

END OF SECTION 26 24 26

**SECTION 26 27 26
WIRING DEVICES**

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes wall switches; wall dimmers; receptacles; device plates and box covers. All devices shall be installed in outlet boxes of required size and volume.

1.2 DESCRIPTION OF WORK

- A. The extent of wiring device work is indicated by drawings and schedules. Wiring devices are defined as single discrete units of electrical distribution systems which are intended to carry, but not utilize electrical energy.
- C. Types of electrical wiring devices in this Section include the following:
 - 1. Receptacles
 - 2. Occupancy Sensors
 - 3. Switches
 - 4. Wall Plates

1.3 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in manufacture of wiring devices of types, sizes, and ratings required, whose products have been in satisfactory use in similar service for not less than 10 years.
- B. Installer: Qualified with at least 5 years of successful installation experience on projects with electrical installation work similar to that required for this project.

1.4 REFERENCES

- A. NEC Compliance: Comply with NEC as applicable to construction and installation of electrical wiring devices.
- B. UL Compliance and Labeling: Provide electrical wiring devices which have been UL listed and labeled.
- C. NEMA Compliance: Comply with NEMA standards for general and specific purpose wiring devices. Standards WD-1 and WD-6.
- D. NECA Compliance: Comply with NECA's "Standard of Installation."

1.5 SUBMITTALS

- A. Specification Review: Provide a complete item by item, line by line specification review indicating compliance with the specifications and note any deviations from the specification with reason for deviation.

- B. Submit manufactures product data for all wiring devices intended to be used on project, indicate intended color and cover plate. Final color selections to be made by Architect.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All devices shall be suitable for use intended, and have voltage and current ratings adequate for loads being served.

2.2 Manufacturers: Subject to compliance with requirements, provide products of one of the following:

- A. Pass and Seymour Corporation
- B. Cooper
- C. Hubbell, Inc.
- D. Leviton, Inc.
- E. Crouse Hinds
- F. Wiremold
- G. Lutron

2.3 WALL SWITCHES

- A. Single Pole Switch, Toggle Style:
 - 1. Leviton 1221 Series, 20A, 120/277V.
- B. Double Pole Switch, Toggle Style:
 - 1. Leviton 1222 or 3032 Series, 20A or 30A, 120/277V.
- C. Three-way Switch, Toggle Style:
 - 1. Leviton 1223 Series, 20A, 120/277V.
- D. Four-way Switch, Toggle Style:
 - 1. Leviton 1224 Series, 20A, 120/277V.
- E. Indicator Switch, Toggle Style:
 - 1. Leviton 1201 Series, 20A, 120/277V. Switch illuminated when load is on.
- F. Locator Switch, Toggle Style:
 - 1. Leviton 1221 Series, 20A, 120/277V. Switch illuminated when load is off.
- G. Digital Time Switch:
 - 1. Wattstopper TS-400 digital time switch with optional visual warning to flash lights at 5 minutes and 1 minute prior to time-out.
- H. Key lock switches:
 - 1. Provide key lock switches for corridor lighting and other locations indicated on electrical drawings.

2. 20 Amp rated.
3. 120/277 Volt ac rated.
4. Key-lock mechanism can only be turned ON or OFF with key.
5. Single pole: Leviton 1221-2KL or approved equal.
6. 3-Way: Leviton 1223-2kl or approved equal.
7. 4-Way: Leviton 1224-2kl or approved equal.
8. Provide 302 stainless steel wall plate for each switch.
9. Provide 2 keys on ring for each switch.
10. Include a brass tag on every key switch ring. Engrave tag; Example: "Hall East Lights".
11. Key all switches alike to match the owners standard key. Coordinate with School District for key match.

I. Color: As selected by Architect.

2.4 MOTOR RATED SWITCHES

- A. Provide where a switch is indicated as a local disconnect for all mechanical and plumbing equipment.
- B. Leviton MS Series.

2.5 RECEPTACLES

- A. Single Convenience Receptacle:
 1. Leviton 5361 Series, 20A/125V.
- B. Duplex Convenience Receptacle:
 1. Leviton 5262 Series or 5362 Series, 20A/125V.
- C. GFCI Receptacle:
 1. Leviton 7899 Series, 20A/125V.
 2. Provide GFCI receptacles for all receptacles on 120v circuits installed in kitchens, restrooms and outdoors (including rooftops).
- D. Provide 20 amp receptacles for single-receptacle branch circuits.
- E. For locations where a quadruplex or fourplex is required, provide 2-duplex receptacles under common cover plate.
- F. Color:
 1. For general purpose receptacles color shall be as selected by Architect.
 2. For receptacles on emergency power and/or life safety power color shall be RED.
 3. For isolated ground receptacles color shall be ORANGE with GREEN triangle.
 4. For receptacles on UPS power color shall be BLACK or color as determined by Owner.

2.6 OCCUPANCY SENSORS

- A. **General Requirements:**
 1. All occupancy sensors shall be line voltage hardwired type; battery type shall not be permitted. Low voltage sensors with power packs shall be allowed in area with an accessible and where indicated on the drawings.

2. Sensors shall use dual technology, passive infrared and passive acoustic sensing or passive infrared and ultrasonic sensing for detecting room occupancy.
3. Sensitivity shall be user adjustable or self-adjusting type.
4. The delay timer shall be adjusted within a range of 6 to 30 minutes by the contractor in the field. The sensor shall have a test mode for performance testing.
5. The test LED shall indicate motion.
6. Line voltage sensors are acceptable, especially in exposed ceiling areas where all wiring shall be installed in conduit, including low voltage cabling if power packs are used. Provide power pack as required for low voltage sensors.
7. See drawings for actual types of sensors.
8. Occupancy sensors and power packs shall have five year warranties.

B Wall Mounted (Wall Switch Type):

1. The unit shall fit in/on a standard single gang switch box.
2. Rated capacity: 600 watts minimum at 120 volts, 60 Hz; 1000 watts minimum at 277 volts, 60 Hz.
3. The sensor shall have two switches where dual-level lighting is required. The switch shall have manual override for positive OFF and automatic ON.
4. The area of coverage shall be approximately 180 degrees by 35-40 feet.

C Auxiliary Contacts for HVAC Interlock:

1. Provide auxiliary dry contacts for HVAC BAS interlock when required. Refer to the HVAC drawings for requirements. When required, provide auxiliary contacts regardless if the occupancy sensors are line or low voltage.
2. The BAS wiring to the auxiliary contacts shall be by the Division 23 contractor.

2.7 WALL PLATES

- A. Type 302 Stainless Steel with matching mounting screws.

PART 3 - EXECUTION

3.1 EXISTING WORK

- A. Disconnect abandoned circuits and remove raceway, wire, and cable. Remove abandoned boxes when connecting wire and cable is abandoned and removed. Install blank cover for remaining abandoned boxes.
- B. Maintain access to existing boxes and wiring connections remaining active and requiring access.
- C. Extend existing circuits using materials and methods compatible with existing electrical installations, or as specified.

3.2 INSTALLATION

- A. Install wiring devices as indicated in compliance with manufacturer's written instructions, applicable requirements of the NEC and NECA's "Standard of Installation," and in accordance with recognized industry practices to fulfill project requirements.

- B. Coordinate with other work including painting, electrical boxes and wiring work, as necessary to interface installation of wiring devices and other work.
- C. Testing: Test wiring devices for electrical continuity and proper polarity of connections. Test wiring devices to demonstrate compliance with requirements.
- D. All outlets shall be located as shown on the drawings, except that where practicable; outlets shall be located in center of panels or trim or otherwise symmetrically located to conform with the structural layout. Outlets incorrectly installed shall be corrected. Damaged items or damaged finishes shall be repaired or replaced at no expense to the Owner.
- E. Outlets shall be set plumb or horizontal and shall extend to the finished surface of the walls, ceiling or floor, as the case may be, without projecting beyond the same.
- F. Outlets shall be installed with ground at top and in accordance with manufacturer's installation instructions.
- G. Receptacles, switches, etc., shown on wood trim, cases or other fixtures shall be installed symmetrically; and, where necessary, shall be set with the long dimensions of the plate horizontal, or ganged in tandem.
- H. Where dimmer switches are shown adjacent to standard switches, both shall be installed in separate back boxes with adequate space between so that neither cover plate requires cutting.
- I. Where devices are shown near wall openings, coordinate location if corner guards are to be installed so that cover plates do not require cutting.
- J. Where devices are shown mounted adjacent to one another on the drawings, provide multi-gang faceplates to cover all devices.
- K. Route raceway and cable to meet Project conditions.
- L. Set wall mounted boxes at elevations to accommodate mounting heights indicated.
- M. Adjust box location up to ten (10) feet prior to rough-in when required to accommodate intended purpose.
- N. Do not install flush mounting box back-to-back in walls; install boxes with minimum 24 inches separation.
- O. Wet Locations: Wiring devices and their enclosures installed outdoors and in wet locations shall be approved for that purpose. Install "in-use" non-attended hinged cover for all receptacles installed outdoors.
- P. Minimum Raceway Size: 3/4 inch.
- Q. Occupancy sensors shall be installed at locations indicated on the manufacturer's submittal layout drawings. Sensors shall be located to prevent false "ON" tripping of the lights.
- R. Occupancy Sensor Time Delay Test: Set the time delay for 15 minutes. Walk into the room to activate the sensor then leave room. Sensor must turn lights off at approximately

15 minutes. Walk into the room again to reactivate the lights. Lights should activate within 1 second.

3.3 MOUNTING HEIGHTS

- A. As indicated on Drawings or if not indicated in accordance with the Architects instructions. All other telephone, Data, TV, etc. outlets shall be same as receptacle.

3.4 GANGED SWITCHES

- A. Install permanent barrier between all 277 Volt light switches ganged into one outlet box.
- B. Where multiple switches are grouped on one location, install switches under a one piece, multi-gang cover plate.
- C. Other telephone, data, TV, etc. outlets shall be same as receptacle.

3.5 GFCI

- A. Provide ground-fault circuit-interrupter type receptacles for all 15 and 20 amp receptacles shown on drawings in restrooms, kitchens and outdoors.
- B. All receptacles installed and within 6 feet of the outside edge of sinks shall be GFCI type.
- C. All receptacles installed in outdoor locations, garages, rooftops, and in other damp or wet locations shall be GFCI type with a weather-resistant (WR) rating.
- D. All outdoor receptacles shall be provided with a non-attended "in-use" cover. Cover shall ensure that device and plug are not exposed to the weather conditions when in use.

END OF SECTION 26 27 26

**SECTION 26 50 00
INTERIOR LIGHTING**

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes interior luminaires, lamps, ballasts, and accessories. Provide all luminaires complete with all new lamps, completely wired, controlled, and securely attached to supports.

1.2 REFERENCE STANDARDS

1. RoHS - Restriction of Hazardous Substances. Council of the European Union (EC) Directive 2002/95/EC on the restriction of the use of certain hazardous substances in electrical and electronic equipment.
2. LM-79-08 (or latest) - IES Approved Method for the Electrical and Photometric Measurements of Solid-State Lighting Products.
3. LM-80-08 (or latest) - IES Approved Method for Measuring Lumen Maintenance of LED Light Sources.
4. TM-21-11 (or latest) - IES Technical Memorandum on Projecting Long Term Lumen Maintenance of LED Light Sources.
5. NEMA SSL 1-2010 (or latest) - Electronic Drivers for LED Devices, Arrays, or Systems.

1.3 DEFINITIONS

1. Driver - the power supply used to power LED luminaires, modules, or arrays.
2. L70, L₇₀, or L_{70%} - The reported life of an LED component or system to reach 70% lumen maintenance, or 70% of the LED's original light output. This test is being developed by the IES and is currently described by TM-21-11.
3. LED's - Broadly defined as complete luminaire with light emitting diode (LED) packages, modules, light bars or arrays, complete with driver.
4. LED luminaire failure - Negligible light output from more than 10 percent of the LED's constitutes luminaire failure.

1.4 SUBMITTALS

- A. Specification Review: Provide a complete item by item, line by line specification review indicating compliance with the specifications and note any deviations from the specification with reason for deviation.
- B. Product Data: Submit dimensions, ratings, and performance data.
- C. Photometric data for each luminaire, lamp and ballast. Include indications of all options and accessories as well as finish color.
- D. In addition to above for LED fixtures submit the following:
- Delivered lumens
 - Input watts
 - Efficacy
 - Color rendering index.

- E. Specification Review: Provide a complete item by item, line by line specification review indicating compliance with the specifications and note any deviations from the specification with reason for deviation.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements:
1. Provide luminaires listed by U.L.
 2. Luminaires installed in outdoor areas unprotected from weather to be U.L. Listed for wet locations.
 3. Insulated ceilings: Luminaires installed into insulated ceilings shall be U.L. Listed Type IC.
- B. Certification: Certify that fixtures submittal have trim compatible with ceilings being installed.
- C. Concrete for outdoor lighting poles foundations shall be provided per Section 03 30 00 - Concrete.

1.6 EXTRA MATERIALS

- A. Provide extra materials for Owners use. All parts shall packaged in suitable carton.
- B. Provide ten (10) percent spare lamps of each lamp type. Deliver to Owner in original packaging.

PART 2 - PRODUCTS

2.1 LUMINAIRES

- A. Product Description: Complete luminaire assemblies, with features, options, and accessories as scheduled.
- B. All luminaires shall be new and of specification grade.
- C. Manufacturer nomenclature in fixture schedule or otherwise described on the Drawings is given only to show the general fixture series. Contractor shall provide fixture with all required accessories and mounting frame type.
- D. Provide wire guard at fixtures in mechanical, electrical, and high abuse areas.

2.2 LED LUMINAIRES

- A. LED Luminaires shall meet all DesignLights Consortium® (DesignLights.org) Product Qualification Criteria. This does not require that the luminaire be listed on the DesignLights Consortium's® Qualified Products List, but they must meet the Product Qualification Criteria. The technical requirements that the luminaire shall meet for each Application Category are:
- Minimum Light Output.
 - Zonal Lumen Requirements.

- Minimum Luminaire Efficacy.
- Minimum CRI.
- L70 Lumen Maintenance.
- Minimum Luminaire Warranty of 5 years (not pro-rated) to include LED driver and all LED components.

Additional requirements:

- B. Color Temperature of 3000K-4100K for interior luminaires as listed in the Luminaire Schedule on the plans. The color temperature of exterior LED luminaires should not exceed 4100K (nominal).
- C. Color Consistency: LED manufacturer shall use a maximum 3-step MacAdam Ellipse binning process to achieve consistent luminaire-to-luminaire color for interior luminaires. Exterior luminaires shall use a maximum 4-step MacAdam Ellipse binning process.
- D. Glare Control: Exterior luminaires shall meet DesignLights Consortium's® criteria for Zonal Lumen Distribution requirements or Backlight-Uplight-Glare (BUG) standards for exterior luminaires.
- E. Luminaire shall be mercury-free, lead-free, and RoHS compliant.
- F. Luminaire shall comply with FCC 47 CFR part 15 non-consumer RFI/EMI standards.
- G. Light output of the LED system shall be measured using the absolute photometry method following IES LM-79 and IES LM-80 requirements and guidelines.
- H. Luminaire shall maintain 70% lumen output (L70) for a minimum of 50,000 hours.
- I. Driver shall have a rated life of 50,000 hours, minimum.
- J. Lumen output shall not depreciate more than 20% after 10,000 hours of use.
- K. Driver and LEDs shall be furnished from a single manufacturer to ensure compatibility.
- L. Luminaire Color Rendering Index (CRI) shall be a minimum of 80 for interior luminaires, and a minimum of 70 for exterior luminaires.
- M. LED luminaire shall be thermally designed as to not exceed the maximum junction temperature of the LED for the ambient temperature of the location the luminaire is to be installed. Rated case temperature shall be suitable for operation in the ambient temperatures typically found for the intended installation. Exterior luminaires to operate in ambient temperatures of -20°F to 122°F (-29°C to 50°C).
- N. LED driver shall have a minimum power factor (pf) of 0.9 and a maximum crest factor (cf) of 1.5 at full input power and across specified voltage range.
- O. Luminaire shall operate normally for input voltage fluctuations of plus or minus 10 percent.
- P. Luminaire shall have a maximum Total Harmonic Distortion (THD) of 20% at full input power and across specified voltage range.
- Q. Wiring connections to LED drivers shall utilize polarized quick-disconnects for field maintenance.
- R. All connections to luminaires shall be reverse polarity protected and provide high voltage protection in the event connections are reversed or shorted during the installation process.

- S. Fuse Protections: All luminaires shall have built-in fuse protection. All power supply outputs shall be either fuse protected or be Polymeric Positive Temperature Coefficient (PTC)-protected as per Class 2 UL listing.
- T. All luminaires shall be provided with knockouts for conduit connections.
- U. The LED luminaire shall carry a limited 5-year warranty minimum for LED light engine(s)/board array, and driver(s).

2.3 LED LUMINAIRES USED FOR EMERGENCY EGRESS LIGHTING:

- A. The failure of one LED shall not affect the operation of the remaining LEDs.

2.4 LED LUMINIARE DRIVERS:

- A. LED dimming shall be equal in range and quality to a commercial grade incandescent dimmer. Quality of dimming to be defined by dimming range, freedom from perceived flicker or visible stroboscopic flicker, smooth and continuous change in level (no visible steps in transitions), natural square law response to control input, and stable when input voltage conditions fluctuate over what is typically experience in a commercial environment. Demonstration of this compliance to dimming performance will be necessary for substitutions or prior approval.
- B. Ten-year expected life while operating at maximum case temperature and 90 percent non-condensing relative humidity.
- C. Driver must limit inrush current.
 - 1. Base specification: Meet or exceed NEMA 410 driver inrush standard of 430 Amps per 10 Amps load with a maximum of 370 Amps² – seconds.
 - 2. Preferred Specification: Meet or exceed 30mA²s at 277VAC for up to 50 watts of load and 75A at 240us at 277VAC for 100 watts of load.
- D. Withstand up to a 1,000 volt surge without impairment of performance as defined by ANSI C62.41 Category A.
- E. No visible change in light output with a variation of plus/minus 10 percent line voltage input.
- F. Total Harmonic Distortion less than 20% percent and meet ANSI C82.11 maximum allowable THD requirements at full output. THD shall at no point in the dimming curve allow imbalance current to exceed full output THD.
- G. Driver must support automatic adaptation, allowing for future luminaire upgrades and enhancements and deliver improved performance:
 - 1. Adjustment of forward LED voltage, supporting 3V through 55V.
 - 2. Adjustment of LED current from 200mA to 1.05A at the 100 percent control input point in increments of 1mA
 - 3. Adjustment for operating hours to maintain constant lumens (within 5 percent) over the 50,000 hour design life of the system, and deliver up to 20 percent energy savings early in the life cycle.

- H. Driver must be able to operate for a (+/- 10%) supply voltage of 120V through 277VAC at 60Hz.
- I. Driver should be UL Recognized under the component program and shall be modular for simple field replacement. Drivers that are not UL Recognized or not suited for field replacement will not be considered.
- J. Driver shall include ability to provide no light output when the analog control signal drops below 0.5 V , or the DALI/DMX digital signal calls for light to be extinguished and shall consume 0.5 watts or less in this standby. Control deadband between 0.5V and 0.65V shall be included to allow for voltage variation of incoming signal without causing noticeable variation in fixture to fixture output.

2.5 LIGHT QUALITY

- A. Over the entire range of available drive currents, driver shall provide step-free, continuous dimming to black from 100 percent to 0.1 percent and 0% relative light output, or 100 – 1% light output and step to 0% where indicated. Driver shall respond similarly when raising from 0% to 100%
 - 1. Driver must be capable of 20 bit dimming resolution for white light LED drivers or 15 bit resolution for RGBW LED drivers.
- B. Driver must be capable of configuring a linear or logarithmic dimming curve, allowing fine grained resolution at low light levels
- C. Drivers to track evenly across multiple fixtures at all light levels, and shall have an input signal to output light level that allows smooth adjustment over the entire dimming range.
- D. Driver and luminaire electronics shall deliver illumination that is free from objectionable flicker as measured by flicker index (ANSI/IES RP-16-10). At all points within the dimming range from 100-0.1 percent luminaire shall have:
 - 1. LED dimming driver shall provide continuous step-free, flicker free dimming similar to incandescent source.
 - 2. Base specification: Flicker index shall less that 5% at all frequencies below 1000 Hz.
 - 3. Preferred specification: Flicker index shall be equal to incandescent, less that 1% at all frequencies below 1000 Hz.

2.6 CONTROL INPUT

- A. 4-Wire (0-10V DC Voltage Controlled) Dimming Drivers
 - 1. Must meet IEC 60929 Annex E for General White Lighting LED drivers
 - 2. Connect to devices compatible with 0 to 10V Analog Control Protocol, Class 2, capable of sinking 0.6 ma per driver at a low end of 0.3V. Limit the number of drivers on each 0-10V control output based on voltage drop and control capacity.
 - 3. Must meet ESTA E1.3 for RGBW LED drivers
- B. Digital Dimming Drivers
 - 1. Must meet IEC 62386

2.7 INSTALLATION

- A. To be installed per manufacturers prescribed methods.

- B. Driver may be remote mounted up to 300 ft. (100 m) depending on power level and wire gauge.

2.8 EMERGENCY BATTERY PACKS

- A. Provide Emergi-Lite FPSIU series, or approved equal, battery pack for fluorescent fixtures designated to have emergency battery back-up.
- B. Fixture shall include lighted push button test switch installed in visible, accessible location adjacent to fixture.
- C. Provide unswitched alternating current power source per manufacturer's instructions.
- D. Provide connection to local switch where indicated on drawings, connect such that fixture can be controlled on/off from local switch without discharge of battery.
- E. For fixtures designated to have emergency battery pack and be on a contactor controlled circuit, provide unswitched alternating current source ahead of contactor and wiring as required to allow automatic on/off control from the contactor without discharge of battery and local on/off switching where indicated.
- F. Battery pack shall provide min. 1400 lumen output for 90 minutes per 2'x4' light fixture.

2.9 EXIT SIGNS

- A. Exit signs shall meet visibility requirements and be listed per UL 924 " Emergency Lighting and Power Equipment". Also shall meet Federal, State and Local Codes.
- B. Chevron Directional Indicator: Provide Chevron per NFPA 101 Section 5-10.4.1.2.
- C. Product Description:
 - 1. LED Exit Sign:
 - a. Provide exit sign with Light Emitting Diodes (LED) illuminance source. Cover LED with diffuser.
 - b. Output of fixture shall not exceed 5 amps.
- D. Housing: Diecast aluminum with stencil face and matte white paint finish.
- E. Input Voltage: 120/277 volt, dual input voltage.
- F. EPA Energy Star Label.
- G. Wire Guards: Install wire guard on all exit signs installed in gyms, lockers rooms, and athletic wing.

PART 3 - EXECUTION

3.1 EXISTING WORK

1. Disconnect and remove abandoned luminaires, lamps, poles and accessories.
2. Extend existing luminaire installation using materials and methods compatible with existing installation, or as specified.
3. Clean, repair and re-lamp all existing luminaires to remain or to be reinstalled.

3.2 INSTALLATION

- A. Install lighting fixtures at locations and heights as indicated, in accordance with fixture manufacturer's written instructions, applicable requirements of the NEC, NECA's "Standard of Installation", NEMA standards, and with recognized industry practices to ensure that lighting fixtures fulfill requirements.
- B. Coordinate with other electrical work as appropriate to properly interface installation of lighting fixtures with other work.
- C. Adjust and Clean: Clean lighting fixtures of dirt and debris upon completion of the installation. Protect installed fixtures from damage during the remainder of the construction period.
- D. Field Quality Control: Upon completion of the installation of lighting fixtures, and after building circuits have been energized, apply electrical energy to demonstrate capability and compliance with the requirements. Where possible, correct malfunctioning units at the site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting.
- E. General: All luminaires shall have proper supports.
- F. Install suspended luminaires using pendants supported from swivel hangers.
- G. Locate recessed ceiling luminaires as indicated on Drawings.
- H. Install surface mounted ceiling luminaires plumb and adjust to align with building lines and with each other. Secure to prevent movement.
- I. Chain Hung: Unless otherwise indicated all fluorescent fixtures in Mechanical, Electrical and Elevator Equipment Rooms shall be chain hung. See drawings for mounting heights. Verify exact mounting height with Architect before installing fixtures. Provide pendant hangers when equipment room has fire-resistive ceiling.
- J. Suspended Ceilings:
 1. All lighting fixtures installed in grid type suspended ceiling systems, shall be positively attached to the ceiling system with clips that are UL listed for the application. In addition, a minimum of four (4) ceiling support system rods or wires shall be provided for each light fixture and shall be installed not more than six (6) inches from fixture corners. Provide two (2) No. 12 gage hangers from each fixture housing at opposite corners to the building structure above (wires may be installed slack). Light fixtures shall be supported directly from the structure above by UL listed and approved hangers. Light fixtures that are smaller than the ceiling grid shall be installed at locations indicated on the reflected ceiling plans, or shall be installed in the center of the ceiling panel and shall be supported independently by at least two metal channels that span and are secured to the ceiling system and supported from the building structure.

2. Suspended lighting fixtures shall be supported directly from the building structure without using suspended ceilings as support systems. Support systems shall be UL listed and approved for the specific installation. Where pendants or rods exceed 48 inches in length, brace support systems to limit swinging.
 3. Where the lighting design indicates multi-level lighting where 3 lamps fixtures are shown in a room, the outer 2 lamps will be switched from one switch and the center lamp will be switched from the other switch. Where 4 lamp fixtures are shown in a room, the outer 2 lamps will be switched from one switch and the center 2 lamps will be switched from the other switch. A similar multi-level lighting arrangement will be provided where 4-3 way switches are shown. Two ballasts must be used when dual level switching is shown.
 4. Ceiling tiles shall not bear the weight of luminaires. Surface mount luminaires, recessed downlights, light track, exit signs, etc. shall be supported by proper frames or other attachment to building structure above ceiling.
 5. Luminaires shall be centered in ceiling tile.
 6. Luminaire shall have flange or trim ring for closure of ceiling cutout or opening.
 7. Fire-rated Ceiling Assembly: For Luminaires to be flush-mounted into a fire-rated ceiling or surface mounted to a fire-rated ceiling, install with independent, secure support. Raceway, cable assemblies, boxes and fittings located above a fire-rated floor/ceiling or roof ceiling assembly shall not be secured to, or supported by, the ceiling assembly including the ceiling support wires. Provide an independent means of secure support. Independent support wires shall be distinguishable by color, tagging, or other effective means from those that are part of the fire-rated design.
- K. Verify weights and recommended mounting methods of all luminaires with manufacturers. Furnish and install supports. All luminaires shall be supported independently of the outlet box.

3.3 LOCATIONS

- A. Luminaires shown on the Electrical Drawings represent general arrangements only. Refer to Architectural Drawings and to Architect on jobsite for more exact locations. Coordinate location with all other trades before installation. Coordinate all light fixtures in Mechanical Rooms with the final installed piping and ductwork layouts. Adjust fixture mounting height and location if required so that light output is not obstructed by piping and ductwork.

3.4 FIRE INTEGRITY OF CEILING PENETRATIONS

- A. Where ceiling is part of a fire-rated assembly, maintain integrity of that assembly with methods given in Section Electrical Hangers and Supports. Obtain ceiling system UL Fire Resistance Directory Design Number from Architectural Drawings.

3.5 AIMING AND ADJUSTMENT

- A. General: All adjustable lighting units shall be aimed, focused, and locked by the Contractor under the supervision of the Architect/Owner. All aiming and adjusting shall be carried out after the entire installation is complete.

3.6 LAMPS

- A. Clean all lamps after installation.

3.7 CLEANING

- A. Lens: Clean lenses of all luminaires after space is finished and prior to project acceptance.
- B. Louvers: Remove plastic bag from parabolic louver luminaires after space is finished and prior to project acceptance. Do not remove bags until luminaires have been cleared by the air-balance subcontractor.

3.8 RFI

- A. Provide flexible braided metal electrical bonding strap from grounded housing to door frame of all fluorescent parabolic fixtures in designated rooms. Bonding strap shall be braided conductor designed for field installation to either long door side.

END OF SECTION 26 50 00