PROJECT MANUAL

RHODE ISLAND COLLEGE

Murray Center HVAC Updates

600 Mt Pleasant Ave
Providence, RI 02908

RGB #6963
March 2026

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Architecture · Engineering · Interior Design
RGB

00 01 01 – TITLE PAGE

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00 01 15 – LIST OF DRAWINGS

GENERAL

G000	COVER SHEET

ARCHITECTURAL

C 100	SITE PLAN

STRUCTURAL

S100	ENLARGED PLAN OF MECHANICAL ENCLOSURE PAD

FIRE PROTECTION

FA001	FIRE ALARM COVER SHEET
FA100	FIRE ALARM PLANS

MECHANICAL

M001.00	MECHANICAL SYMBOLS, LEGEND & NOTES
M002.00	MECHANICAL EQUITMENT SCHEDULE
DM101.00	DEMOLLITION PLAN MECHANICAL DUCTWORK/PIPING
M101.00	MECHANICAL DUCTWORK
M201.00	MECHANICAL PIPING
M301.00	ELEVATION VIEW
M401.00	MECHANICAL CONTROLS
M501.00	MECHANICAL DETAILS
M1.2	MECHANICAL 2ND FLOOR PLAN DUCT SYSTEM (EXISTING PLAN)

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M5.0 MECHANICAL: EQUIPMENT SCHEDULES

ELECTRICAL

E001	ELECTRICAL SYMBOLS AND NOTES
E200	ELECTRICAL PLANS
E300	ELECTRICAL RISER

END OF SECTION

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00 40 00 – STATE PROCURMENT DOCUMENTS

Procurement documents are provided under separate cover.

END OF SECTION

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00 43 00 – BID BOND

See AIA Document A310-2010, example attached as the following page.

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DRAFT AIA® Document A310™ – 2010

Bid Bond

CONTRACTOR:
(Name, legal status and address)

« »« »
« »

SURETY:
(Name, legal status and principal place of business)

« »« »
« »

OWNER:
(Name, legal status and address)

« »« »
« »

BOND AMOUNT: $ « »

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

« »
« »
« »

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

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

When this Bond has been furnished to comply with a statutory or other legal requirement in the location of the Project, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. When so furnished, the intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

ADDITIONS AND DELETIONS: The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes added information as well as revisions to the standard form text is available from the author and should be reviewed.

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

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

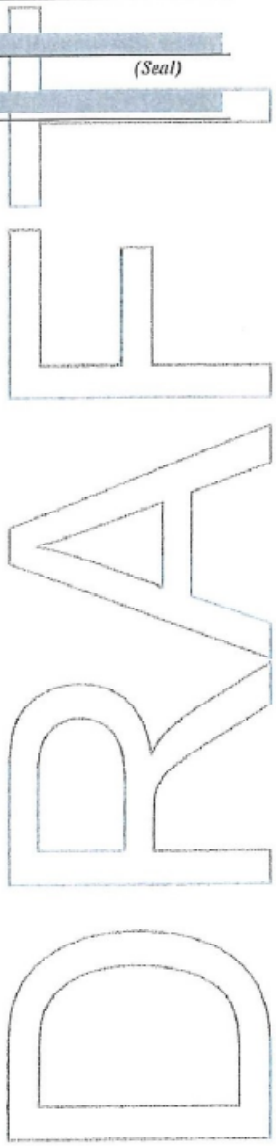
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User Notes: (1665413965)

1

Signed and sealed this « » day of « », « »

	« »
	(Contractor as Principal) *(Seal)*
	« »
(Witness)	*(Title)*
	« »
	(Surety) *(Seal)*
	« »
(Witness)	*(Title)*



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2

END OF SECTION

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00 50 00 – CONTRACTING FORMS

PART 1 - GENERAL

1.1 COPYRIGHT

A. Contractor is responsible for obtaining a valid license to use all copyrighted documents specified or included in the Project Manual.

1.2 AGREEMENT AND CONDITIONS OF THE CONTRACT

A. See Section 00 5200 for the Agreement form to be executed.

B. See Section 00 7200 for the General Conditions.

1.3 FORMS

A. Use the following forms for the specified purposes unless otherwise indicated elsewhere in the Contract Documents.

B. Bond Forms:

1. Performance Bond and Payment Bond Forms: AIA A312

C. Release of Lien:

1. Release of Liens Form: AIA G706A
2. RIC Waiver of Liens Form 01 20 00

D. Insurance certificate, supplementary attachment:

1. ACORD Certificate of Insurance Form: AIA G715

1.4 REFERENCE STANDARDS

A. AIA G706A – Release of Liens: 1994.

B. AIA A312 - Performance Bond: 2010 and Payment Bond: 2010.

C. AIA G715 – ACORD Certificate of Insurance: 1991.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

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00 51 00 – NOTICE OF AWARD

RI State Purchasing shall issue the Notice of Tentative Award.

END OF SECTION

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00 52 00 – AGREEMENT FORM PART

1 - GENERAL

1.1 AGREEMENT FORM

A. The Agreement Form to be utilized on this project is AIA Document A101-2017 as amended by the state https://ridop.ri.gov/vendor-resources/public-works-aia-custom-state-rhode-islanddocuments.

B. Agreement made as of the date of issue of the Purchase Order for this Work.

C. This Agreement is entered into as of the date of the applicable Purchase Order and is assumed as executed once the Purchase Order is issued.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 EXECUTION OF THE AGREEMENT

A. Following the issuance of the Notice of Tentative Award, the user Agency, Design Team and Contractor shall convene a Pre-Award Conference. Meeting minutes from the Pre-Award Conference and acceptance of the minutes by the Contractor shall be incorporated into the Contract.

B. The User Agency will transmit the A101-2017 to the Contractor for signature. The Contractor will sign and return the contract to the User Agency, who then transmits it to the RI State Purchasing Office for final signatures.

END OF SECTION

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00 55 00 – NOTICE TO PROCEED

RI State Purchasing shall issue the Purchase Order. The User Agency shall issue the Notice to Proceed, per AIA A101-2017 as amended by the state §3.1.

END OF SECTION

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00 61 00 – BOND FORMS

The RI State Purchasing Notice of Tentative Award indicates the required bonding forms for this project.

END OF SECTION

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00 62 00 – CERTIFICATES AND OTHER FORMS

PART 1 - GENERAL

1.1 ARCHITECT PROVIDED CERTIFICATES AND PROJECT FORMS **(NOT USED)**

1.1 USER AGENCY PROVIDED FORMS **(NOT USED)**

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

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00 65 00 – CLOSEOUT FORMS

PART 1 - GENERAL

1.1 CLOSEOUT FORMS

A. The following forms are required as part of the closeout documentation:

1. Transmittal on Contractor's letter head for each package of documents transmitted.
2. Upon Substantial Completion, the User Agency shall provide copies of the AIA Documents indicated in Section 01 74 19.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

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00 72 00 – GENERAL CONDITIONS PART

1 - GENERAL

1.1 GENERAL CONDITIONS

A. The General Conditions to be utilized on this project are AIA Document A201-2007 as amended by the state. https://ridop.ri.gov/vendor-resources/public-works-aia-custom-state-rhode-island-documents

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 EXECUTION OF THE GENERAL CONDITIONS

A. The User Agency will transmit the A201-2007 as amended by the state to the Contractor. The contractor shall initial and return to the User Agency, who then transmits it to the RI State Purchasing Office.

B. Any conflicts with the general provisions included in the project manual, and the A201-2007 as amended by the state, the provisions in form A201-2007 as amended by the state will take precedence.

END OF SECTION

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00 73 43 – PREVAILING WAGE RATES

The State of Rhode Island Department of Labor, Division of Professional Regulation General Decision Modification document is an integral part of the Bid Documents for use in fulfilling prevailing wage rate requirements. A copy is available linked to the web site of the State of Rhode Island Department of Administration, Division of Purchases. Contractors working on RI Prevailing Wage projects must adjust employee hourly rates every July 1 in accordance with updated Davis Bacon rates. These rates may be obtained at the following website:

https://sam.gov/content/wage-determinations

The Division of Purchases Web Site Address is: http://www.purchasing.ri.gov/RIVIP/Info.asp

The link for the US Government prevailing wage tables is:
http://www.purchasing.ri.gov/bidinfo/geninfo/geninfo.aspx

Applicable Rhode Island labor laws may be found at: http://www.dlt.ri.gov/pw/

END OF SECTION

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00 91 13 – ADDENDA AND MODIFICATIONS

PART 1 - GENERAL

A. As of the time of publication of this Project Manual, 3 Addenda had been issued.

B. Addenda issued during the Bid Period, will augment this Document and become a part of the Project Manual.

C. Such Addenda and Modifications when issued, with reference to the Project Manual, the General Conditions, Supplemental General Conditions, Drawings or Specifications, shall be inserted following this page and become integral parts of the Contract Documents.

END OF SECTION

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RHODE ISLAND COLLEGE
MURRAY CENTER, HVAC UPDATES
PROVIDENCE, RHODE ISLAND

ADDENDUM NO. 1

May 8, 2026

The attention of Bidders submitting proposals for the above-mentioned project in at Rhode Island College in Providence, RI, is called to the following addendum to the Contract Documents. The following additions, clarifications, and/or deletions are hereby to be included in their entirety with the scope of the Contract Documents, and shall, in turn, form a part of the proposals submitted for Bid.

CHANGES/CLARIFICATIONS TO THE STATE OF RHODE ISLAND RFQ – REQUEST FOR QUOTE OF PUBLIC WORKS

Addendum 1.1 **DELETED** from Section F: ALTERNATES: "Add Alternate 1" in its entirety, and "Deduct Alternate #2" in its entirety.

CHANGES/CLARIFICATIONS TO THE PROJECT MANUAL & SPECIFICATIONS

Addendum 1.2 **ADD** specification Section 013000 "RIC Administrative Requirements" to the project manual.

Addendum 1.3 **ADD** specification Section 013100 "Project Management & Coordination" to the project manual.

Addendum 1.4 **ADD** specification Section 013200 "Construction Progress Documentation" to the project manual.

Addendum 1.5 **ADD** specification Section 013300 "RIC Submittal Procedures" to the project manual.

Addendum 1.6 **ADD** specification Section 013523 "RIC Hot Work Procedures" to the project manual.

Addendum 1.7 **ADD** specification Section 013524 "RIC Managing Fire Protection Systems" to the project manual.

Addendum 1.8 **ADD** specification Section 015000 "RIC Temporary Facilities & Controls" to the project manual.

Addendum 1.9 **REPLACE** specification Section 232113 "Hydronic Piping" in its entirety with the attached new Section 232113 "Hydronic Piping"

Addendum 1.10 **REPLACE** specification Section 232116 "Hydronic Piping Specialties" in its entirety with the attached new Section 232116 "Hydronic Piping Specialties"

Addendum 1.11 **REPLACE** specification Section 237323 "Factory Built-up Air Handling Units" in its entirety with the attached new Section 237323 "Factory Built-up Air Handling Units"

QUESTIONS & ANSWERS

1. This project has liquidated damages. At time of award will the owner work with the contractor to establish an agreeable schedule based on long lead items, and the contractor will not be penalized by liquidated damages for any long lead items that we cannot control delivery on?

   Please see the new critical path schedule proposed by Rhode Island College. Liquidated damages will remain in effect as specified.

   - **5/19/26 Bids due**
   - **6/16/26 Contract start (target)**
   - **ASAP Long lead Submittals begin**
   - **ASAP Long Lead items order released**
   - **12/15/27 (or earlier) HVAC equipment on-site.**
   - **12/15/27 Interior Gym work starts (to be finalized with AD)**
   - **1/8/27 Interior Gym work complete (4 weeks)**
   - **1/15/27 Final completion (hard deadline)**

   The GC shall coordinate the other required work (electrical, exterior, snow guards, etc.) along this critical path with the majority of non-gym area work to be completed prior to 12/15/26.

2. Has the lead time of the equipment been verified with the manufacturer to meet the project schedule?

   No. The schedule has been adjusted. Please see the answer to question #1.

3. Has the fire review been completed, and if so, will the cost be paid by the owner or the GC?

   Drawings were submitted on 4/3/26. The review is in progress. The General Contractor shall pay all permit fees.

4. Does the project have RIBCC approval

   The project has been submitted and approval is

pending. 5. Please confirm alternates on bid are correct?

   The alternates on the bid are incorrect and are hereby removed as part of Addendum 1, item 1.1.

6. Please confirm there will be a staging area available for contractor parking, storage containers, dumpster.

   A staging area will be provided in the Physical Plant parking lot to the rear (west) of the Murray Center.

7. Please provide existing FA system manufacturer?

   The existing fire alarm panel is Gamewell FCI Model E3 series by Honeywell.

8. Please confirm we are painting all new duct work and HVAC equipment?

   All new and existing ductwork in the gym shall be painted, color to match existing.

9. Please confirm gym floor can support lift for work to be completed in ceiling of gym?

   The General Contractor shall submit the lift(s) intended for use to the College for review and approval by the floor manufacturer. Additionally, the GC will need to protect the wood floor as to not damage during work. This protection method shall be submitted for review as well. The GC will be responsible to repair any damage done to the wood floor due to construction

10. Spec section 012000 mentions a testing & inspection allowance, but we do not see one on the bid form. Please confirm.

    Testing & Inspections of the concrete will be carried by the College under a separate contract. No additional testing is anticipated.

11. What contractor currently holds the roof warranty?

    The current roof warranty is serviced by Capeway Roofing Systems.

12. Spec sections 013000 – 015000 seem to be missing from the manual, please provide?

    Specification Sections 013000 – 015000 have been added to the Project Manual by this addendum as listed above.

13. Please confirm once contractor is mobilized, they will have complete access to the entire gym for the duration of the work during normal workings hours? The contractor will not have to turn over the work area certain days during construction?

    The Contractor will have complete access to the Gym for four (4) weeks.

14. Please confirm we are not to include off hours work in our bid?

    The General Contract shall provide the mean & methods to meet the revised schedule in the answer to question #1.

END OF DOCUMENT

RFQ26006544 - RIC HVAC IMPROVEMENTS MURRAY CENTER GYM

ADDENDUM NO. 2

May 15, 2026

The attention of Bidders submitting proposals for the above-mentioned project in at Rhode Island College in Providence, RI, is called to the following addendum to the Contract Documents. The following additions, clarifications, and/or deletions are hereby to be included in their entirety with the scope of the Contract Documents, and shall, in turn, form a part of the proposals submitted for Bid.

The number of this Addendum, Addendum No. 2, must be entered in the space provided on the Bid Form.

REVISION TO QUESTIONS AND ANSWERS:

1. This project has liquidated damages. At time of award will the owner work with the contractor to establish an agreeable schedule based on long lead items, and the contractor will not be penalized by liquidated damages for any long lead items that we cannot control delivery on?

   Please see the new critical path schedule proposed by Rhode Island College. Liquidated damages will remain in effect as specified.

   - **5/26/26 Bids due**
   - **6/23/26 Contract start (target)**
   - **6/29/26 Long lead Submittals begin (or ASAP)**
   - **7/6/26 (week of) Long Lead items order released (ASAP)**
   - **10/23/26 (or earlier) HVAC equipment on-site.**
   - **4/19/2027 Interior Gym work starts (to be finalized with AD)**
   - **5/28/27 Interior Gym work complete (6 weeks)**
   - **6/7/27 Final completion (hard deadline)**

   This schedule is for bidding purposes. <u>The only fixed dates are for the availability of the gym</u>. The GC shall be responsible for the final schedule and coordinate the other required work (electrical, exterior, snow guards, etc.) along this critical path.

   <u>It is the intent of this contract to have all work that does not occur inside the gym be complete prior to start of winter.</u>

END OF DOCUMENT

RHODE ISLAND COLLEGE
MURRAY CENTER, HVAC UPDATES
PROVIDENCE, RHODE ISLAND

ADDENDUM NO. 3

May 28, 2026

The attention of Bidders submitting proposals for the above-mentioned project in at Rhode Island College in Providence, RI, is called to the following addendum to the Contract Documents. The following additions, clarifications, and/or deletions are hereby to be included in their entirety with the scope of the Contract Documents, and shall, in turn, form a part of the proposals submitted for Bid.

The number of this Addendum, Addendum No. 3, must be entered in the space provided on the Bid Form.

REVISION TO SCOPE OF WORK:

3.1 The scope of work added in Addendum #3 shall include demolition and removal of the existing units (#2-1 and #2-2 that feed the class room areas); rigging and installation of two new Trane Performance Climate Changer air-handling units (used as basis of design see attached cut sheets of units); reconnection to the existing ductwork, chilled water, hot water, condensate, electrical power, and controls; conversion from the existing arrangement to a 4-pipe coil configuration with external 6-way valves in lieu of face-and-bypass dampers; associated electrical modifications for power reconnection, disconnects, controls power, and coordination with the new fan/VFD arrangement; startup, controls integration, and final testing and balancing / air-system rebalancing to restore the intended air distribution to the adjacent areas served by these units. The selected replacement units are both provided with 15 HP supply fans. Air handlers HVAC Unit #2-1 and Unit #2-2 are in the Gym as indicated in the attached drawing M1.2 (6/14/93) and drawing M5.0 (6/14/93). The work shall include all sheet metal work to be painted to match existing duct work in the gym; as required for complete, operable, and warrantable installation.

END OF DOCUMENT

SECTION 01 00 50 - GENERAL REQUIREMENTS AT EXISTING FACILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The General Conditions, Supplementary Conditions and applicable portions of Division 1 of the Specification are a part of this Section, which shall consist of all labor, materials, equipment, tools, construction equipment and machinery, water, heat, utilities, transportation and other facilities and services necessary for the proper execution and completion of the work, whether temporary or permanent and whether or not incorporated or to be incorporated in the work; and as related to the project or projects defined in the Bidding Requirements.

B. The specification format used herein is in accordance with MASTERFORMAT, CSI (2004 Format) and in no way intends to restrict this Contractor from expediting his work as he sees fit, nor is there any intention of segregating the units of work as related to specific trades involving jurisdictional problems.

1.2 CONTRACTOR'S DUTIES

A. The Contractor is responsible for all personnel involved in the work, including those of his direct employ, his sub-contractors and suppliers of materials and equipment and/or labor. The Technical Specifications have been divided for convenience only to cover the scope of work, and where reference to a particular contractor is noted, it is for convenience only. The Owner and Architect only recognize one Contractor as party to this Contract.

B. As it is impractical to enumerate every piece of equipment, device and/or accessory required for proper operation of the indicated systems specified within their respective Sections or Divisions of the Project Manual; it is intended that all materials, systems, and/or equipment, required to insure proper operation of the equipment, device, and/or accessory, be provided as a part of the Work of this Project so the specified work or system functions, and/or performs as required by the specification. To infer the intent is otherwise, is to render the specified work or system less than required.

C. Except as specifically noted, provide and pay for:

1. Labor, materials and equipment.
2. Tools, construction equipment and machinery.
3. Other facilities and services necessary for proper execution and completion of the Work.

D. Pay sales, consumer, use and similar taxes for the Work or portions thereof.

E. Secure and pay for, as necessary for proper execution and completion of the Work, and as applicable at time of receipt of Bids:

1. Permits.
2. Government fees.
3. Licenses.

F. Give required notices.

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G. Comply with codes, ordinances, rules, regulations, orders and other legal requirements of public authorities which bear on the performance of the Work.

H. Promptly submit written notice to the Architect of observed variance of Contract Documents from legal requirements.

I. Lay out all work and be responsible for all lines, elevations, measurements of the building, utilities and site work executed under the Contract. Verify the figures shown before laying out the Work and be responsible for any error resulting from failure to do so. Employ a competent registered engineer or registered land surveyor, approved by the Architect, for establishing all lines, levels and dimensions, and place at the disposal of the Architect, as required for checking purposes.

J. Enforce strict discipline and good order among employees. Do not employ persons not skilled in assigned task.

K. Notify all trades, sub-contractors and suppliers of all designated alternatives and be responsible for their coordination.

L. At your option, certain indicated materials and/or procedures are specified herein to be used in lieu of other indicated materials and/or procedures, at no change in Contract Price. Such options should be analyzed and coordinated during the bidding period, so that the selection of any may immediately be brought to the Architect's attention, once the Contract is awarded (within thirty days thereafter).

1.3 SCOPE OF THE WORK: Includes but is not limited to:

A. EXTERIOR:

1. **Furnishing and installing a new concrete pad, (2) 80-ton air cooled condensers, and 10’ height aluminum encloser with gates.**

B. INTERIOR:

1. Removing the existing Gym duct work and HVAC units (HV2-1, 2-2). Adding structural reinforcing to existing joists to accommodate the new insulated duct work and AHU as required. Paint existing and new duct work in gym.

1.4 SPECIAL CONDITIONS

A. The Contractor must schedule the Work, in the various rooms with the Owner, a minimum of seven days in advance.

B. The Owner will make available to the Contractor requested spaces, to be determined during the course of the Work. Upon substantial completion of the work in these areas and a minimal punch list, the Owner will make additional spaces available to the Contractor. Punch list completion must be scheduled to permit notification of tenants.

C. Miscellaneous work in other areas of the building must be scheduled seven (7) days in advance and approved by the Owner.

D. The Contractor is responsible to physically isolate all work areas, to protect residents, while maintaining safe egress.

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E. The Contractor shall maintain a professional relationship with all tenants, employees and other occupants. All incidents with the residents must be promptly reported to the Owner or the Owner's Representative. The Owner will resolve all issues with all employees and other occupants.

F. Use of premises:
1. No storage of materials in the building. (Locate trailer in area designated by the Owner, and repair all damaged areas upon completion of the work.)
2. Provide office trailer and toilet facilities for work force. Do not use building facilities.
3. No smoking on the site or within the buildings.
4. Daily clean-up required.
5. Use of on-site utilities, electric and water permitted. Do not overtax existing systems.
6. Major movement of materials must be scheduled so as to minimize inconvenience of the tenants. Coordinate with the Owner.
7. Notify the Owner of utility interruptions a minimum of thirty-six (36) hours in advance.

1.5 HEALTH AND SAFETY PRECAUTIONS

A. HAZARDOUS BUILDING MATERIALS:

1. Prior to commencing any removal or demolition operations, coordinate with the Owner/Operator to ensure that an asbestos survey has been conducted, in accordance with National Emission Standard for Hazardous Air Pollutants (NESHAP), 40 CFR, Part M, Section 61.145, of the Clean Air Act.
2. Notify the EPA prior to demolition/renovation operations in which more than 260 L.F. or 160 S.F. of regulated asbestos-containing material (RACM) is to be stripped or removed from facility components.
3. If during the course of the Work hazardous materials are encountered, or suspicion exists that such may be prevalent, including, but not limited to asbestos and/or lead paint, immediately and prior to any removal, contact the governing agency for testing and removal procedures.

B. OSHA:

1. These construction documents, and the joint and several phases of construction hereby contemplated, are to be governed, at all times, by the applicable portions of the Federal Laws, including but not limited to, the latest amendments of the following:

   a. Williams-Steiger Occupational Safety and Health Act of 1970, Public Law 91-956;
   b. Part 1910 - Occupational Safety and Health Standards, Title 29, Code of Federal Regulations, as amended to date;

   c. Part 1926 - Safety and Health Regulations for Construction, Title 29, Code of Federal Regulations, as amended to date.

2. This Project, the Contractor and his sub-contractors shall, at all times, be governed by applicable Chapters of Title 29, Code of Federal Regulations, Part 1926 - Safety and Health Regulations for Construction, as amended to date.

   a. Note: Furnish the Owner and Architect copies of all accident reports.

C. Dig Safe:

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1. All excavations near underground public utility facilities shall be performed in accordance with Connecticut State Law.

D. Emergencies:

1. Should tornado, hurricane, gale or heavy wind warnings be issued, take precautions to minimize the danger to persons, to the work, and to the adjacent property. Damage caused to any part of the work shall be rectified or replaced to the complete satisfaction of the Architect and at no expense to the Owner. Injury to personnel or damage to adjacent property because of the work shall be the complete responsibility of the Contractor, and he accepts exclusive responsibility for same.

E. Loading:

1. Do not load any part of the work involved in this Contract, during construction, with a load greater than it is calculated to carry with safety. Should any accidents or damage occur through any violation of this requirement, the Contractor shall be held responsible under his Contract and Bond. When, in the opinion of the Architect, portions of the structure appear to be overloaded, it shall be the Contractor's responsibility to prove otherwise, or the Contractor shall follow the instructions of the Architect in connection with reduction of the loads.

1.6 PROJECT RECORD DOCUMENTS

A. Maintain at job site, one copy of:

1. Contract Drawings.
2. Specifications.
3. Addenda.
4. Reviewed Shop Drawings.
5. Record Drawings.
6. Change Orders.
7. Other modifications to Contract.
8. Field Test Reports.
9. Approved materials, samples and colors.

B. Store documents in approved field construction office, apart from documents used for construction.

1. Provide files and racks for storage of documents.
2. File documents in accordance with Project Filing Format of MASTERFORMAT.
3. Maintain documents in clean, dry, legible condition.
4. Do not use record documents for construction purposes.
5. Make documents available at all times for inspection by Architect and Owner.

C. Recording changes:

1. Provide red pen or pencil for all marking.
2. Keep record documents current.
3. Do not permanently conceal any work until required information has been recorded.
4. Contract Drawings: Legibly mark to record actual construction and the following:

a. Record various elements of foundations in relation to lowest floor elevation.

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b. Reference horizontal and vertical location of underground utilities and appurtenances to permanent surface improvements.
c. Reference location of internal utilities and appurtenances concealed in construction to visible and accessible features of structure.
d. Record field changes of dimensions and details.
e. Record changes made by Change Order or Field Order.
f. Record details not on original Contract Drawings.

5. Specifications and Addenda: Legibly mark up each Section to record the following:

a. Manufacturer, trade name, catalog number, and supplier of each product and item of equipment actually installed.
b. Changes made by Change Order and Field Order.
c. Other matters and materials not previously specified.

6. Shop Drawings: Maintain as record documents; legibly annotate drawings to record changes after review.

1.7 TRANSPORTATION AND HANDLING

A. Transport all materials and equipment on legally approved conveyances as required or recommended by the respective manufacturer or supplier.

B. Receive and handle all materials and equipment, at the project site, by conveyances or methods as recommended by the respective manufacturer or supplier.

C. Coordinate delivery of equipment and materials when two or more trades, contractors or suppliers are involved.

D. Remove from the site any material or item of equipment damaged during the transportation or handling process, and immediately replace at no additional cost to the Owner.

1.8 STORAGE AND PROTECTION

A. Store all materials and equipment as recommended by the respective manufacturer or supplier, including the following minimum requirements.

B. Upon receipt of such materials and equipment, check, distribute, store and safeguard in a clean, dry, ventilated location.

C. Elevate off the ground, items which can be stored in exterior locations, and completely cover with approved tarpaulins. Protect against the elements at all times.

D. Maintain all storage areas in a clean and orderly condition at all times.

E. Immediately replace any material or item of equipment damaged, due to inadequate storage protection, at no additional cost to the Owner.

1.9 CUTTING AND PATCHING

A. Execute cutting, including excavating, fitting or patching work required to:

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B. Make several parts fit properly.

C. Uncover work to provide for installation of ill-timed work.

D. Remove and replace defective work.

E. Remove and replace work not conforming to the Contract Documents.

F. Remove samples of installed work, as specified, for testing.

G. Install specified work in existing construction.

1. In addition to the Contract requirements, upon written instructions from Architect:

    a. Uncover work to provide for Architect's observation of covered work, as required by General Conditions.
    b. Remove samples of installed materials for testing; as required by the General Conditions.

2. Do not endanger any work by cutting or altering work, or any part of it.
3. Do not cut or alter work of another Contractor without written permission of the Architect.
4. Prior to cutting which affects structural safety of Project, or work of another Contractor, submit written notice to Architect requesting consent to proceed with cutting.
5. Prior to cutting and patching, done on instruction of the Architect, submit cost estimate.
6. Should conditions of work, or schedule, indicate change of materials or methods, submit written recommendations to the Architect including:

    a. Conditions indicating change.
    b. Recommendations for alternative materials or methods.
    c. Submittals required for Substitutions.

H. Submit written notice, to the Architect, designating time work will be uncovered, to provide for observation.

I. Payment for costs caused by ill-timed or defective work, or work not conforming to the Contract Documents, including costs for additional services of Architect will be borne by the Contractor.

J. Contractor Inspection:

1. Inspect existing conditions of work, including elements subject to movement or damage during:

    a. Cutting and patching.
    b. Excavating and backfilling.

2. After uncovering work, inspect conditions affecting installation of new products.

K. Preparation: (prior to cutting)

1. Provide shoring, bracing and support as required to maintain structural integrity of the Project.
2. Provide protection for other portions of the Project.
3. Provide protection from the elements.

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L. Performance: Perform all work of fitting, adjustment, cutting, patching, finishing, and restoration to perfectly match the quality as specified throughout these specifications.

1.10 CONNECTING TO AND USE OF EXISTING

A. Demolish and remove from site all existing construction work as indicated. Do such work in a neat and orderly manner so as not to endanger the lives of the working force nor cause damage to adjacent surfaces indicated to remain.

B. Remove portions of existing work as indicated or required, and perfectly patch, match and tie into the new work.

C. Repair existing walls, floors, ceilings, partitions, doors, frames, etc., where required for tieing into, including existing systems such as electrical or mechanical, etc.

D. If existing conditions, indicated to remain, include defective work, deteriorated or rotted materials, immediately notify the Architect. Do not conceal such materials.

E. Relocate and remove certain existing items, facilities and equipment, as indicated. Items designated to be removed, and not be re-used, shall remain the property of the Owner and placed on the site where directed by the Owner.

F. Quality of Work/Responsibility to Match Existing:

1. Perfectly match the existing building finishes for all new work, unless otherwise specified or shown. Such matching includes quality, style, character, finish and color. Likewise, repair or replace, in exact likeness to the existing, any existing surfaces, materials, fixtures, or items damaged by the process of completing the new work.

1.11 CONTRACTOR USE OF PREMISES

A. Confine operations at site to areas permitted by:

1. Law.
2. Ordinances.
3. Permits.
4. Contract Documents.

B. Do not unreasonably encumber the site with materials and equipment.

C. Do not load structure with weight that will endanger structure.

D. Assume full responsibility for protection and safekeeping of products stored on the premises.

E. Move any stored products which interfere with operations of Owner or other Contractor.

F. Obtain and pay for use of additional storage or work areas needed for operations.

G. Limit use of site for work and storage within confines of the Project Limit Line.

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1.12 PARTIAL OWNER OCCUPANCY

A. Schedule early completion of designated areas for Owner's usage prior to Substantial Completion of the entire Project.

B. Contractor provide:

1. Access for Owner personnel.
2. Operation of mechanical and electrical systems.

C. Prior to occupancy, execute Certificate of Substantial Completion for designated areas.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01 00 50

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01 10 00 – SUMMARY

PART 1 - GENERAL

1.1 PROJECT

A. The Project consists of the construction of the following types of work:
   1. New addition of air conditioning to the gym area. Which includes new concrete pad, aluminum enclosure and (2) air cooled condensers to the rear West of the exterior. Interior work to include (2) air handler units and new insulated duct work in the gym, paint to match existing.

1.2 CONTRACT DESCRIPTION

A. Contract Type: A single prime contract based on a Stipulated Price as described in Document 00 50 00 – Contracting Forms.

1.3 DESCRIPTION OF WORK

A. Scope of demolition and removal work is shown on drawings plus as specified in Section 020600

B. Scope of alterations work is shown on drawings and/or as specified herein.

C. Site modifications as shown on drawings and/or as specified herein.

1.4 SCHEDULE

A. The date of commencement of the Work shall be the latter of: (i) the issuance of the Purchase Order by the Owner; and (ii) the date set forth in a notice to proceed issued by the User Agency.

B. Ordering of products, Building Permit, coordination and preparatory work shall commence immediately upon receipt of Purchase Order.

C. Construction at the site can commence immediately upon receipt of PO and building permit and shall be agreed upon with the User Agency.

D. The substantial completion date is August 1st . This is the date to which liquidated damages may apply and may only be adjusted as provided for in the Contract Documents. Contractor shall be responsible for completing the submittals required for issue of a Purchase Order in a timely manner. No extension will be granted for purchasing delays. Contractor shall account for any premium time required to meet the substantial completion date of August 1st,2026 in their base bid.

E. Final Completion is September 1st,2026. This date represents the completion of all outstanding punch list items and complete demobilization of the site.

F. Cooperate with User Agency to minimize conflict and to facilitate the facility's operations.

1.5 ITEMS TO BE SALVAGED

No items removed and not identified for reinstallation shall be salvaged

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1.6 SUBCONTRACTOR CERTIFICATION REQUIREMENTS

A. Installation certification from the roof manufacturer for the roofing subcontractor for both the asphalt shingle roofing and membrane roofing. Refer to roofing specification section for clarification specifics.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

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01 14 00 – COORDINATION OF WORK WITH USER AGENCY

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Contractor Use of Site and Premises.

B. Utility and Building Services Outages and Shutdowns.

C. Construction Requirements in Occupied Buildings.

D. Construction Activities in Occupied Spaces.

E. Time Restrictions and Working Hours.

F. Schedule Coordination.

1.2 CONTRACTOR USE OF SITE AND PREMISES

A. User Agency intends to continuously occupy the facility. Work areas will be made available as mutually agreed to during project scheduling.

B. Construction Operations: Limited to areas noted on Drawings. Coordinate with Site Utilization Requirements. Include in the Base Bid all costs of this coordination, including all premium time wages that may be required to meet these requirements and project schedule. Cost of all work done during second or third shifts or on weekends and holidays shall be included in the bid price. Contractor is responsible for protection and restoration of existing conditions including, but not limited to hardscape, landscape and lawns.

C. Arrange use of site and premises to allow:

1. Adjacent projects to progress as planned for the User Agency.
2. Use of street and adjacent properties by the Public.
3. Continued operation of the facility.

D. For activities requiring closure of parking lots, roadways and/or walkways, seven (7) days' notice is required. Refer to Section 01 50 00 Temporary Facilities and Controls for further information.

E. Provide access to and from site as required by law and by User Agency:

1. Maintain appropriate egress for workforce and users of the facility.
2. Do not obstruct roadways, sidewalks, or other public ways without permit. Provide necessary signage and barriers to direct pedestrians around work areas.
3. Barriers and signage must be provided by the contractor to the satisfaction of the User Agency to separate the work area from occupied areas. Efforts must be taken to limit dust, noise and odors from escaping the work area. Proper separation and protection of interior spaces shall be established and maintained during the project, to the satisfaction of the User Agency.
4. Contractor is responsible for cleaning construction dust and/or debris from public areas and daily or at the request of the User Agency. Work areas within the building shall be kept tidy at all times.

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5. Contractor shall provide and maintain walk-off mats at all entrances to the work site from occupied areas.

1.3 UTILITY AND BUILDING SERVICES OUTAGES AND SHUTDOWN:

A. Prevent accidental disruption of utility services to other facilities. Contractor is responsible for restoration and damages resulting from unplanned disruptions to utilities.

B. For life safety systems interruptions or shutdowns, including but not limited to fire sprinklers and fire alarm system, seven (7) days' written notice to User Agency and authorities having jurisdiction shall be provided. Contractor to utilize Fire Sprinkler and Alarm System Impairment Notification Forms found in Section 00 73 02. Contractor is responsible for providing Fire Alarm Technician or support personal to provide the necessary bypassing or fire watch as required for fire sprinkler or other life safety shutdowns.

C. Electrical, plumbing, network and other utility shutdowns shall be scheduled off hours. Contractor shall provide written request for utility shutdown at least 72 hours in advance.

D. When construction activities impact ventilation, heating or air conditioning to occupied building spaces, the contractor shall provide the necessary equipment to maintain proper ventilation rates and a temperature of 68° heating and 72° cooling. Prior to the decommissioning of equipment, the contractor shall submit a plan for temporary HVAC services, including unit location, utility connection, ductwork tie in and other logistical considerations.

1.4 CONSTRUCTION REQUIREMENTS FOR OCCUPIED BUILDINGS:

A. User Agency intends to continuously occupy the facility. Work areas will be made available as mutually agreed to during project scheduling.

B. The building and surrounding areas will be occupied during construction. The Contractor shall be solely responsible for initiating, maintaining and supervising safety, security and protection programs and shall comply with all applicable laws, ordinances, rules and regulations concerning safety of people and the protection of property.

C. Barriers and signage must be provided by the contractor to the satisfaction of the User Agency to separate the work area from occupied areas. Appropriate signage, approved by the User Agency, shall be placed at all potential entrances to the Project Site and maintained throughout the project.

D. Efforts must be taken to limit dust, noise and odors from escaping the work area. Proper separation and protection of interior spaces shall be established and maintained during the project, to the satisfaction of the User Agency. Contractor shall provide and maintain walk-off mats and plastic barriers at work site entries.

E. Contractor shall provide appropriate masking of building supply air intakes to protect indoor air quality and limit transfer of odors. Contractor to coordinate with User Agency regarding shut down of appropriate units as work continues.

F. Contractor to provide air scrubbing and/or negative air machines to prevent odors from escaping the Project Site.

G. During the progress of the Work, the Contractor shall so conduct his work that as little inconvenience as possible is caused to the occupants. At the close of the work each day, the Contractor shall pick up and stow all equipment and miscellaneous material leaving the site in a neat and safe condition.

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H. The Contractor shall repair or replace, at his own expense, with new any item, surface, or object that is damaged by the Contractor or damaged because of the Contractor's actions during the course of the Work and during any guarantee period.

I. Site and building conditions shall be restored to their condition as they were at the start of the Work. Before commencing work, the Contractor shall report any existing damage to the Architect in writing to assure that the Contractor will not be liable for preexisting damage.

J. Contractor is responsible for cleaning construction dust and/or debris from public areas and daily or at the request of the User Agency. Work areas within the building shall be kept tidy at all times.

K. Refer to Section 01 50 00 – TEMPORARY FACILITIES AND CONTROLS for more information.

1.5 CONSTRUCTION ACTIVITIES IN OCCUPIED SPACES

A. The Project Site is defined as the immediate rooms under construction at a given time. Any work in vertically or horizontally adjacent classrooms, hallways, MEP/IT/FP spaces and grounds outside the footprint indicated on the Site Utilization Plan shall be considered as being outside the Project Site. Areas outside the project site are identified as Occupied Spaces.

B. The safety of building occupants and construction workers is paramount. All construction activities within Occupied Spaces shall be marked with cones and caution tape. Computer generated signage shall be provided indicating the path of travel around construction zones, and shall also be posted at stairwell doors indicating where internal construction activities may take place.

C. Activities which require work in Occupied Spaces shall be specifically and clearly indicated on the Two-Week Look-Ahead and confirmed with the User Agency at least two (2) business days in advance.

D. Sufficient time to clean up work zones shall be allocated at the end of the shift. All construction activities within the building shall be thoroughly vacuumed, wet mopped and cleaned to the satisfaction of the User Agency at the end of each shift.

E. Use of exterior occupied spaces will be permitted during off-hours as permissible provided such use is coordinated with the User Agency at least 72 hours in advance.

F. All construction materials, tools and debris must be removed from occupied building spaces once construction activities have ended for the day. Occupied spaces must be returned to original conditions to the greatest extent possible by 8am weekdays. If it is not feasible to do as such, notify the User Agency immediately. With approval, the area shall be cordoned off with cones and caution tape and computer generated signage shall be posted to the satisfaction of the User Agency.

1.6 TIME RESTRICTIONS AND WORKING HOURS

A. Include in the Base Bid all costs of this coordination, including all premium time wages that may be required to meet these requirements and project schedule. Cost of all work done during second or third shifts or on weekends and holidays shall be included in the bid price.

B. Disruptive Activities & Work Restrictions The College uses the following categories to indicate work activities allowable during certain time periods:

1. No Work: on site work is prohibited to take place during this time. Workers are prohibited from the site without prior notification to the User Agency. In order to ensure the safety of

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occupants and preserve the educational experience, work **MAY NOT** take place during the time periods specified in Paragraph C, below.

2. Quiet Work: vibration producing work may not occur. Work that generates noise or odors that would escape the project site and cause disruption to occupant in adjacent Occupied Spaces is prohibited. Disallowed activities include but are not limited to: demolition of block and concrete, use of jackhammers, saw cutting, hammer drilling, connecting to building structure, mechanical fastening and other work activities which provides loud noises or vibrations that are constant in nature. Use of heavy solvents, odious paints and other irritants which cannot be contained through mechanical or physical barriers prohibited. Work in Occupied Spaces prohibited unless specific, written authorization is requested and granted.

    a. It is the sole discretion of the User Agency to determine if activities are considered disallowed during quiet work periods. The designation of disallowed activities is contingent on location within the job site and the activities of the occupants.

    b. The contractor my request a “disturbance test” which may allow for some disallowed activities to take place during quiet work times. Contractor may request with 24 hour notice to run a limited test to determine if a specific activity in a set location can be performed during quiet work periods. The User Agency will observe the impact on the occupied areas and determine if the activity take place. Waivers resulting from disturbance tests will be valid for a set period of time, based on construction activities and occupant usage.

3. No Restrictions: normal construction activities may take place. No restrictions on noise or vibrations. Utility shutdowns may occur following proper notifications.

    a. This project’s unrestricted hours are 10pm-8am Sunday-Friday and weekends between 5pm Friday and 8am Monday.

    b. There are not classes on the following days and therefore have no work restrictions:

    No work restrictions on Monday – Friday from 7:00 am – 4:00 pm. Contractor to coordinate with Owners project manager for any specific calendar school events, that the contractor will need to work around. The contractor shall account for any premium time required to meet the substantial completion date of August 1st,2025 in their base bid

C. Working Hours

1. Contractor is expected to plan and execute the work on schedule within the parameters indicated above. Regular working hours for contractors are between 7:00 a.m. and 4:00 p.m., Monday through Friday. Work that is to take place outside of these timeframes are to be reflected on the Two Week Look-Ahead.

2. Contractor is permitted to work holidays, nights and weekends if it is communicated two (2) business days in advance.

3. In the event of adverse weather, the College is open unless a State of Emergency is called by the Governor. The College is not responsible for lost time due to weather. Contractor to communicate with Project Manager regarding the college’s status.

4. Special Work Hours are called for the following activities:

    a. No Work Hours: Contractor to coordinate with Owner’s project manager for any specific calendar school events, performances/etc. that the contractor will need to work around for facility access.

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b. Quiet Work: Contractor to coordinate with Owner's project manager for any specific calendar school events, performances/etc. that the contractor will need to work around.

c. Hours of No Restrictions: No work restrictions from 7:00 am – 4:00 pm. Contractor to coordinate with Owner's project manager for any specific calendar school events, performances/etc. that the contractor will need to work around

d. Hoisting: Contractor to provide any anticipated hoisting activities in their schedule. Contractor must coordinate with Rhode Island College and Owner's project manager to allow for flexibility and scheduling for contractor, Rhode Island College, and Owner's project manager.

e. Material deliveries: Contractor to provide any anticipated material deliveries in their schedule. Con tractor must coordinate with Rhode Island College and Owner's project manager to allow for flexibility and scheduling for contractor, Rhode Island College, and Owner's project manager.

1.7 SCHEDULE COORDINATION

A. The contractor shall provide, in writing, via email, by noon on Thursdays the two week project look ahead which lists in detail the planned activities, locations of disturbance, scheduled subcontractors and working hours for the forthcoming Sunday-Saturday. The same shall be provided for the second week, but as a working draft. The document shall list out any utility shutdowns or other activities which require review and approval of the User Agency. Failure to provide the Look Ahead may result in a reduction of payment of general requirements line item in the following pay requisition.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

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01 17 90 – UTILITY PLANNING AND INTERRUPTIONS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. This section details the minimum coordination requirements for system connections and service interruptions that may be required for new construction and renovation projects.

B. Requirements.

C. Outage Types.

D. Outage Planning.

E. Outage Requirements.

F. Scheduling.

G. Outage Coordination

1.2 REQUIREMENTS

A. If a project or contract work requires the shutdown or de-energizing of any campus utility or building system, Contractor shall notify, in writing, the User Agency's Project Manager at least ten (10) calendar days in advance of the planned outage. User Agency's Project Manager shall be responsible for contacting Facilities Operations and scheduling a meeting to review the shutdown. (Refer to Scheduling section).

B. In general, Contractors are not allowed to operate valves open or closed, or energize and de-energize switches without prior coordination and approval from the User Agency. Exceptions to this policy are for new construction or within buildings that are closed for total renovation, where the utilities affected are within the construction zone and have been verified ahead of time not to have an adverse effect on other building or campus operations.

C. Chilled water, high temperature hot water and steam shutdowns can be scheduled only during off-peak seasons with limited exceptions such as an emergency repair.

D. Contractors shall coordinate to have the building fire alarm system disabled prior to performing any work, such as cutting or welding that may cause inadvertent operation of the fire alarm system, ("Hot Work") and arrange for it to be enabled at the completion of the work.

E. "Hot work" permits are required prior to any cutting and welding operations within buildings; follow all policy safety precautions.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 OUTAGE TYPES

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A. There are three general types of outages, depending upon the impact that the work will have on existing building infrastructure and campus utilities. The level of planning and detail coordination required varies for each, as noted below.

1. Independent Outages:

a. Independent outages typically have no impact on existing campus utilities, operating communications infrastructure, building occupants or building systems. Examples include work within new building construction or "gut" building renovations, or installation of new campus utilities not yet in service.

b. For independent outages, the Contractor shall contact the User Agency's Project Manager to coordinate the outage scheduling, as well as outage notification, to other College departments and building Users affected by this work. Facilities Operations support is not required for this type of outage.

2. Minor Outages:

a. Minor outages typically have a limited impact on existing campus utilities, including operating communications infrastructure within the project site or running through the site; building occupants or building systems. Examples include fire alarm zone lock-outs for welding or other "Hot work" permits, to suit the installation of new fire alarm devices, or for branch line water shut-offs to suit connections of new plumbing fixtures.

b. For Minor outages, limited College coordination is required; the Contractor shall contact the User Agency's Project Manager to coordinate the outage scheduling with Facilities Operations and the College's trade staff. Details of the outage work will be developed as a general scope of work.

c. Project Manager will also coordinate the outage notification to other College departments and building Users affected by this work. Minimum outage notification times are required and an outage coordination meeting prior to the outage is required to review outage scope and details (See Scheduling section).

3. Major Outages:

a. Major outages typically have a significant impact on existing campus utilities, communication systems and infrastructure, building occupants or building systems. Examples include shut down of building electrical power systems, central heating and cooling systems, shutdown of BAS and fire alarm systems, or shutdown of campus water, heating and chilled water systems.

b. For Major outages, significant coordination is required for both the Contractor and the User Agency. Determination of major outages will be made in the Project Planning phase. Details of the outage work, and general outage scheduling will be developed during the design phase as an outage checklist (OCL).

c. During the construction phase, Contractor shall coordinate outage scheduling with the User Agency's Project Manager who will contact Facilities Operations to coordinate the required to support the outage work, as well as develop work orders for Trades support.

d. User Agency's Project Manager will also coordinate the outage notification to other College departments and building Users affected by this work. Minimum outage notification times are required and an outage coordination meeting prior to the outage is required to review outage scope and details (See Scheduling section).

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3.2 OUTAGE PLANNING

A. The Contractor will utilize the Utility & Critical System Outage Checklist deliverables provided in the Design phase and incorporate all required outages into their project construction schedule as milestone activities.

B. The Contractor shall utilize and update the draft Utility & Critical System Outage Checklist(s) (OCLs) (as developed by the Design Agent) based on their proposed project schedule and plan for construction.

C. The updated Utility & Critical System Outage checklist shall be used for required outage coordination review meetings to review and confirm the outage impacts and resources required to support the outage from the College, the project team or others. Updated outage checklists shall clearly identify:

1. Project impacts (what buildings, utility systems and/or system loads are impacted by the work).
2. Any updates determined in the course of Contractor's physical walkdown and verification of what systems and equipment are affected by the proposed shutdown.
3. Outage schedule (time/date of when work will be performed and outage durations), including contingency communications for work that will extend beyond schedule;
4. Required prep work to be completed or to be in place prior to support the actual outage work (install portable generator(s), pipe flushing procedures, filling and venting procedures, etc.).
5. Brief description of the actual outage work and essential tasks being performed during the outage (Switches or valves being opened/closed, piping connections, etc.);
6. Note key coordination issues that need to be included as a part of the outage (need for portable generators to maintain power, street closure(s), police details, etc.).
7. For hydronic systems, include how system draining, flushing, refilling and venting will be accomplished.
8. For building electrical system outages, include copies of the panelboard schedules for all affected electrical equipment (panelboards, switchboards, motor control centers, etc.).
9. Review and identify any potential outage impacts that may affect ongoing critical Research and Academic activities: i.e.: campus water and/or electrical services; building ventilation and exhaust systems, BAS controls, etc.
10. Listing of key contacts and phone numbers for the Contractor, Facilities Operations, Information Technology Services (ITS) DPS staff, and affected building staff.

D. As a prerequisite of outage planning and preparations, it is the responsibility of the Contractor to perform their own visual inspection and walk down to verify what utilities and systems will be physically affected by the shutdown. This effort shall be made after review of available Record documentation, and consultations with the Design Agent, User Agency's Project Manager and Facilities Operations, as well as other affected College departments, such as Environmental Health & Safety, Informational Technology, etc. The intent of the physical inspection and walkdown is to:

1. Verify known systems and system loads that will be affected by the outage.

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2. Identify any other undocumented systems and loads that may be affected by the proposed outage.
3. Verify locations of existing system isolation switches, valves, bypasses, and temporary services.

3.3 OUTAGE REQUIREMENTS

A. Facilities Operations shall be notified for all interruptions that affect building fire alarm and detection systems, fire suppression systems (fire sprinklers, kitchen hood suppression systems, dry systems, clean agent or Halon suppression systems), fire pumps and water distribution lines that connect to fire suppression systems.

B. For Research facilities, Facilities Operations shall be notified of all interruptions affecting: fume hoods, HVAC supply and exhaust systems, Potable and non-Potable water systems, electrical, heating and cooling systems and Process cooling systems.

C. The College's Information Technology Services (ITS) office requires notification for all communications systems and infrastructure outages and interruptions that affect telephone or network services.

D. Proper Lockout/Tagout procedures shall be followed by both the Contractor and College's staff.

3.4 SCHEDULING

A. Outage dates shall be coordinated with the College's Academic calendar and identified blackout (no outage work) periods. Outages will occur off hours unless otherwise approved by the User Agency.

B. Independent Outages: Per the User Agency's discretion.

C. Minor Outages: normal workday hours; 72-hour minimum advance notice. Weekend/off-hours; 96-hour minimum advance notice. Actual outage scheduling is subject to User Agency's staff availability.

D. Major Outages: As determined by draft Utility & Critical System Outage checklist: minimum (2) week notice after approval; (4) weeks is preferred for major shutdowns.

E. The User Agency's Project Manager will assist the Constructor in the scheduling, as well as the notification of, related building Users and other College departments affected by this work.

F. Steam Shutdowns must be coordinated through the Project Manager. Facilities Management will perform all steam shutdowns. The contractor must provide a minimum of ten (10) calendar days' notice to the Project Manager for a pre-scheduled shutdown. The pre-scheduling must take place as far in advance as practicable, and no later than 30 days in advance.

3.5 OUTAGE COORDINATION

A. The Project Manager shall coordinate the shutdown details required for the project with the Facilities and Operations staff, the project team, Campus Police, and the Building Users (as required by the particular system interruption).

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B. A coordination meeting shall be held with representatives of the Contractor, affected building Users, and other concerned parties to review the planned outage sequences and timing. Facilities Operations staff will generally advise of what campus operations and building Users will be affected by the proposed outage or shutdown; the Project Manager is in turn responsible to contact all the affected groups to determine the proper time for the shutdown and any special requirements to be provided during the shutdown.

C. A Utility and Critical System Outage Checklist (OCL) is required to be filled out for each major outage by the Design Agent and Contractor, with support from the Project Manager. The checklist includes relevant pre-outage work required prior to the outage, sequence(s) of work to be performed during the outage, expected outage times and durations, and key contact (cell phone) information for the Contractor, Facilities Operations staff, other affected College Department staff and affected Users. The completed checklist requires sign-off from the Facilities Operations Director.

D. The Project Manager will submit the signed outage checklist to Facilities Operations, who will then assign to the appropriate staff to perform and monitor the shutdown. The Project Manager will also formally notify all affected parties of the planned outage date(s) by e-mail and physical posting of the impacted buildings.

END OF SECTION

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01 20 00 – PRICE AND PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 SECTIHES ON INCLUDES

A. Sales tax exemption.

B. Allowances.

C. Testing and inspection allowance.

D. Unit prices.

E. Alternates.

F. Schedule of values.

G. Applications for payment.

H. Change procedures.

I. Defect assessment.

J. Warranty inspection retainage.

K. Waiver of Lien Form

L. MBE Compliance Form

1.2 TAX EXEMPTION

A. The State of Rhode Island is exempt from payment of any federal or state excise, transportation, or sales tax. Refer to A201-2007 General Conditions §3.6.2.

1. Place exemption certificate number on invoice for materials incorporated in the Work of the Project.

2. Furnish copies of invoices to Owner.

3. Upon completion of Work, file a notarized statement with Owner that all purchases made under exemption certificate were entitled to be exempt.

4. Pay legally assessed penalties for improper use of exemption certificate number.

1.3 ALLOWANCES

A. Refer to A201-2007 §3.8 for Allowance provisions. General Contractor overhead and profit, bonding and other fees should be calculated into the Contract Sum and may not be assessed on Allowance Usage.

B. Design Agent Responsibility:

1. Consult with Contractor for consideration and selection of products, suppliers, and Installers.

2. Select products in consultation with User Agency and transmit decision to Contractor.

3. Prepare Change Order to account for the use of allowance.

C. Contractor Responsibility:

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1. Assist Design Agent or its Consultants in selection of products, suppliers and installers.
2. Obtain proposals from suppliers and installers, and offer recommendations.
3. On notification on selection by Design Agent, execute purchase agreement with designated supplier and installer.
4. Arrange for and process shop drawings, product data, and samples. Arrange for delivery.
5. Modify the Schedule of Values to provide line items for each approved use of an allowance.
6. Promptly inspect products upon delivery for completeness, damage, and defects. Submit claims for transportation damage.

D. Schedule of Allowances: Allowances
1. Please refer to the Bid Form for the list of Allowances.

1.4 TESTING AND INSPECTION ALLOWANCE

A. All costs of regularly scheduled testing are included in the Base Bid. See Bid Form for allowance to cover costs of additional testing to be provided when directed by the User Agency.

B. See Section 01 40 00 and its attachment for testing requirements.

1.5 UNIT PRICES

A. See Section 01 22 00.

1.6 ALTERNATES

A. Alternates quoted on Bid Forms will be reviewed and accepted or rejected at the User Agency's option. Accepted Alternates will be identified in the Purchase Order.

B. Coordinate related work and modify surrounding work as required.

C. Schedule of Alternates: See Section 01 23 00.

1.7 SCHEDULE OF VALUES

A. Refer to A201-2007 General Conditions §9.2 for Schedule of Values provisions. Contractors are encouraged to submit the Schedule of Values as soon as practical after contract commencement, but within the duration indicated in the General Conditions.

B. Schedule of Values (SOV) shall only be accepted on an original AIA Form G702 - Application and Certificate for Payment and AIA G703 - Continuation Sheet.

C. Format:
1. Utilize the Table of Contents of this Project Manual. Identify each line item with number and title of the major specification Section.
2. At a minimum, provide line items under the heading General Conditions for: Site Mobilization, Bonds, Insurance, Permits, Construction Schedules, Temporary Facilities, Project Management & Supervision, General Cleaning, and Dumpsters & Trash Removal. The Design Agent and User Agency reserves the right to request further breakout beyond those requested here.
3. At a minimum, provide line items under the heading Closeout for: Final Cleaning, Monetized Punchlist (zero value at start of contract), Administrative Closeout, Owner's Manual,

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Project Record Documents and Warranty Retainage (.5%). The Design Agent and User Agency reserves the right to request further breakout beyond those requested here.

4. Per A101-2017 §5.5, out of state firms shall also include a “Foreign Company” line item valued at 3% of the Contract Sum.
5. Provide separate line items for Labor and Materials where the value is greater than $10,000.
6. Provide separate line items where multiple vendors or subcontractors are providing services.
7. No single line item shall exceed twenty percent (20%) of the total contract.
8. Identify each Allowance as a line item.
9. Identify each Alternate as a line item.

D. Submit for review and approval to the Design Agent and User Agency the Schedule of Values prior to the first Application for Payment. Indicate in the email the intended date for each progress payment, typically the last day of the month. The first Application for Payment will not be accepted until the SOV is approved.

E. Revisions:
1. Once approved, the SOV shall only be revised to accommodate changes to the Contract Value.
2. Revise SOV to list changes to the contract value for which a revised Purchase Order has been issued. Provide a heading for the Change Order Number and list Change Order Proposals comprising said Change Order as individual lines on the SOV.
3. As Allowances are used, under the heading for the appropriate allowance, list Change Order Proposals charged to the Allowance as individual lines on the SOV. For unit cost Allowances, identify quantities taken from Contract Documents multiplied by the unit cost to achieve the total for the item.

1.8 APPLICATIONS FOR PAYMENT

A. See General Conditions §9.3 for Applications for Payment provisions. Contractors shall submit for payment on a monthly basis.

B. Prepare a draft version “pencil copy” of each application.
1. The Pencil Copy shall be distributed via email ten (10) calendar days prior to the established date for progress payment for review by Design Agent and User Agency’s representative.
2. Accompanying the Pencil Copy, Contractor shall provide a summary list of all subcontractors who performed work on the site for the month.
3. Design Agent and User Agency’s representative shall review the Pencil Copy and request adjustments as appropriate.
4. Contractor shall make agreed revisions and prepare final for payment

C. Submitting for Payment
1. Prepare one (1) original of the approved AIA Form G702 - Application and Certificate for Payment and AIA G703 - Continuation Sheet, accompanied by three (3) copies.
2. Individually sign and notarize and emboss with notary's official seal, the original and each of the three (3) copies. Deliver to Design Agent for further processing and distribution.

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3. Applications not including original copyrighted AIA G702, and G703 Forms, will be rejected, and returned for re-submittal.
4. Applications not properly signed and notarized will be rejected, and returned for re- submittal.

D. An Application for Payment is not considered acceptable per the Prompt Payment Policy until the signed, notarized and certified AIA G702 and G703 Forms with ALL required enclosures are received. Applications submitted without the following items described in this section and its attachments will be returned for resubmittal. These items shall be sent via email to the User Agency's Representative. Failure to provide items listed below with the Application for Payment submission will result in a delay in processing and may result in a reduction in the amount of said Application for Payment.

1. Transmittal letter as specified for Submittals in Section 01 33 00.
2. Updated construction schedule, prepared per Section 01 33 00.
3. Statement signed by the Contractor's firm principal certifying that there are no unidentified outstanding claims for delay.
4. Beginning with the second Application for Payment, Certified Monthly Payroll Records for all workers on site for the previous month.
    a. Forms for the submission of Certified Payroll Records may be found from the Rhode Island Prevailing Wage Website in either PDF or Excel formats. These forms must be used on monthly submittals.
5. Beginning with the second Application for Payment, Contractor's right to payment must be substantiated by documenting, on a copy of the RIC Waiver of Lien Form included in this Project Manual, that payment monies due, less retainage not exceeding five (5) percent, have been paid in full to subcontractor and suppliers for work, materials, or rental of equipment billed for under specific line item numbers in the immediately preceding application.
6. Affidavits attesting to off-site stored products with insurance certificates as requested.
7. Digital Photographs as specified in Section 01 33 00. Provide as a link.
8. Updated Submittal Log.
9. Identify Apprenticeship hours required under RIGL 37-13-3.1 for all contracts over $1million in value.
10. A Minority Utilization Report for minority subcontractors must be included. Use the form provided.
11. Additional Substantiating Data: When the User Agency or Design Agent requires additional substantiating information from the review of the "pencil copy," submit data justifying dollar amounts in question.

1.9 CHANGE PROCEDURES

A. Refer to AIA A201-2007 as amended by the state, General Conditions §7.

B. Submittals: Submit name of the individual authorized to receive change documents and be responsible for informing others in Contractor's employ or Subcontractors of changes to the Work.

C. Types of Change Proposals

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1. Stipulated Sum Change Order: Based on Proposal Request and Contractor's Change Proposal as approved by Design Agent. All quotations shall include detailed material costs and labor hour and rate breakouts.
2. Unit Price Change Order: For contract unit prices and quantities, the Change Order will be executed on a fixed unit price basis. For unit costs or quantities of units of work which are not pre-determined, execute the Work under a Construction Change Directive. Changes in the Contract Sum or Contract Time will be computed as specified for a Time and Material Change Order.
3. Time and Material Change Order: Submit an itemized account and supporting data after completion of the change, including timeslips signed by User Agency's representative, within the time limits indicated in the Conditions of the Contract. The Design Agent will determine the change allowable in the Contract Sum and Contract Time as provided in the Contract Documents. Only User Agency-representative-signed timeslips will be considered.

D. The Design Agent may issue a Proposal Request which includes a detailed description of a proposed change with supplementary or revised Drawings and specifications, a change in Contract Time for executing the change with a stipulation of any overtime work required, and the period of time during which the requested price will be considered valid. Contractor will prepare and submit the Change Proposal within fifteen (15) calendar days.

E. The Contractor may propose changes by submitting a Change Proposal request to the Design Agent and User Agency, describing the proposed change and its full effect on the Work. Include a statement describing the reason for the change, and the effect on the Contract Sum and Contract Time with full documentation, and a statement describing the effect on Work by separate or other Contractors. Document any requested substitutions in accordance with Section 01 60 00.

F. For all Change Proposals, maintain detailed records of work done on a Time and Material basis. Submit timeslips daily for verification and sign-off by User Agency's representative on-site. Provide full information required for an evaluation of the proposed changes, and to substantiate costs for the changes in the Work.

G. Document each quotation for a change in cost or time with sufficient data to allow an evaluation of the quotation. Provide detailed breakdown of costs and estimates for labor and materials including a detailed breakdown for subcontractor's or vendor's Work. Include copies of written quotations from subcontractors or vendors.

H. Construction Change Directive: refer to General Conditions §7.3. Design Agent may issue a directive, on AIA Form G714 as amended by the state.

I. For Minor Changes, §7.4: The Design Agent will advise of minor changes in the Work not involving an adjustment to Contract Sum or Contract Time by issuing supplemental instructions on AIA Form G710 as amended by the state.

J. Change Order Forms: AIA G701 as amended by the state Change Order.

K. Execution of Change Orders: The Design Agent will issue Change Orders for signatures of the parties as provided in the Conditions of the Contract. Electronic signatures are acceptable. Design Agent shall also issue a Letter of Justification to accompany the Change Order.

1. The approved Change Order amount shall include all compensation to the Contractor, including but not limited to Overhead and Profit, General Conditions, Material, Labor, Equipment and other costs. Following the execution of the Change Order, no additional compensation for the work covered in the Change Order shall be considered.

L. Correlation Of Contractor Submittals:

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1. Promptly revise the Schedule of Values and the Application for Payment forms to record each authorized Change Order as a separate line item and adjust the Contract Sum. Promptly revise progress schedules to reflect any change in the Contract Time, revise sub- schedules to adjust times for any other items of work affected by the change, and resubmit.
2. Promptly enter changes in the Project Record Documents.
3. Update Schedule of Values and Subcontractor List as required.

1.10 DEFECT ASSESSMENT

A. Refer to General Conditions §12.2. Replace the Work, or portions of the Work, not conforming to specified requirements.

B. If, in the opinion of the Design Agent, it is not practical to remove and replace the Work, the Design Agent will direct an appropriate remedy or adjust payment.

C. The defective Work may remain, but the unit sum will be adjusted to a new sum at the discretion of the Design Agent.

D. The defective Work will be partially repaired to the instructions of the Design Agent, and the unit sum will be adjusted to a new sum at the discretion of the Design Agent.

1.11 WARRANTY INSPECTION RETAINAGE

A. One-half of one percent of the cost of the Work will be retained from Final Payment for duration of twelve (12) months from date of Substantial Completion. This shall be included in the Schedule of Values. If, after ten months, all systems including mechanical and electrical, are determined by the User Agency to be properly functioning, the Warranty Inspection Retainage will be released.

B. If, after twelve (12) months, there are found to be modifications, adjustments, or corrections necessary to be made to address any system or product malfunction, in order to fulfill specified performance or requirements of such systems or products, release of the warranty inspection retainage will be delayed until such malfunctions are rectified.

C. If, after twelve (12) months from the date of Substantial Completion, all systems have not been fully addressed, the User Agency may utilize the Warranty Inspection Retainage to hire others to execute necessary modifications, adjustments, or corrections.

1.12 WAIVER OF LIEN FORM

A. RIC Document Waiver of Lien Form is included, following this page, as an integral part of the Contract documents. A copy with completed information must be submitted with the second and each succeeding Application for Payment.

1.13 MBE COMPLIANCE

A. The MBE Compliance Form is included after this section. Contractors shall work with the RI Office of Diversity, Equity & Opportunity to ensure that all participation and reporting requirements are met.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

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END OF SECTION

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SECTION 01 21 00 - ALLOWANCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The General Provisions and applicable portions of Division 1 of the specification are a part of this Section, which shall consist of all labor, equipment and materials necessary to complete all allowance work indicated on the drawings and herein specified.

1.2 OTHER CASH ALLOWANCES

A. Should allowances be included in other Sections of these specifications, follow the procedures of this Section, but include the cost of same under the respective Sections.

1.3 CASH ALLOWANCES DEFINITION

A. Amount of each allowance includes:

1. Net cost of product and/or service.
2. Delivery and unloading at site.
3. All soft costs, such as engineering, design, drafting, etc.

B. Include in the Base Bid amount, and not part of the amounts of the allowances, the costs for.

1. Handling at the site, including uncrating and storage.
2. Protection from elements and from damage.
3. Labor, installation and finishing.
4. Other expenses, including incidental/appurtenant materials and labor required to complete the installation.
5. Overhead and profit.

1.4 CASH ALLOWANCES

A. Purchase materials and/or services under each allowance as directed by the Architect.

B. Include the following amounts in Bid, for inclusion in the Base Bid:

Allowance #1 Carry $20,000.00 to cover additional unforeseen conditions encountered on site for excavation beyond initial BID scope area.

Allowance #2 Carry $10,000.00 to cover planting and landscaping.

Total Allowance dollars to be carried in the Contractor’s lump sum base bid price: **$ 30,000**

1.5 PROCEDURES

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C. Selection of Materials:

1. Assist Architect and Owner in determining qualified suppliers.
2. Obtain proposals from suppliers when requested by Architect and Owner.
3. Make appropriate recommendations for consideration by Architect and Owner.
4. Notify Architect and Owner of any effect anticipated by selection of product or supplier under consideration on:

    a. Construction Schedule.
    b. Contract Sum.
    c. Facility operations.
    d. Impact on Owner furnished items.

5. On notification of selection, enter into purchase agreement with designated supplier.

D. Delivery:

1. Arrange for delivery and unloading.
2. Promptly inspect products for damage or defects.
3. Submit claims for transportation damages.

E. Installation:

1. Comply with the requirements of the referenced specification section.

F. Adjustment of Costs:

1. Should the actual purchase cost be more or less than specified amount of allowance, Contract Sum will be adjusted by Change Order equal to amount of difference, provided accounting of expenditures is current, and accurate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 02 10

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01 22 00 – UNIT PRICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for unit prices.

B. Related Requirements:

1. Section 01 20 00 "Price & Payment Procedures" for procedures for submitting and handling Change Orders.

1.3 DEFINITIONS

A. Unit price is an amount incorporated in the Agreement, applicable during the duration of the Work as a price per unit of measurement for materials, equipment, or services, or a portion of the Work, added to or deducted from the Contract Sum by appropriate modification, if the scope of Work or estimated quantities of Work required by the Contract Documents are increased or decreased.

B. Excavation quantities shall be measured on a volume basis as computed from original in-place position. Fill quantities shall be measured on a volume basis as computed from in-place position.

C. No removed material shall be calculated against more than one category of allowance.

1.4 PROCEDURES

A. Unit prices include all necessary material, plus cost for delivery, installation, insurance, overhead, and profit.

B. Measurement and Payment: See individual Specification Sections for work that requires establishment of unit prices. Methods of measurement and payment for unit prices are specified in those Sections.

C. User Agency reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, at User Agency's expense, by an independent surveyor acceptable to Contractor.

1.5 SCHEDULE OF UNIT PRICES

A. Please refer to the Bid Form for the list of Unit Costs. Specification Sections referenced in the schedule contain requirements for materials described under each unit price.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

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A. SCHEDULE OF UNIT PRICES

1. **Suitable Structure Fill Material $/CY**

   a. Description: Structure Fill Material, in-place from off-site, placed by power equipment
   b. Unit of Measurement: cu. yd. (Cubic Yard)

2. **Loam & Topsoil $/CY**

   a. Description: Fine grading and seeding for general lawns in accordance with Division 32, Section “Turfs and Grasses.”
   b. Unit of Measurement: cu. yd. (Cubic Yard)

3. **Gravel $/CY**

   a. Description: Compacted gravel under slab, in-place excluding fine grading.
   b. Unit of Measurement: cu. yd. (Cubic Yard)

4. **Air entrained, Concrete Pads & Paving $/CY**

   a. Concrete in-place, reinforcement 4000 psi, air entrained.
   b. Unit of Measurement: cu. yd. (Cubic Yard)

END OF SECTION 01 22 00

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SECTION 01 23 00 - ALTERNATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for alternates.

1.3 DEFINITIONS

A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount if Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.

1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
2. The cost for the alternate is the net addition to the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.

1.4 PROCEDURES

A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.

1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.

B. Notification: Immediately following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated revisions to alternates.

C. Execute accepted alternates under the same conditions as other work of the Contract.

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

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PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

A. Alternate No. 1: Replace unit 1 and 2 that feed the classroom wing in the gym

1. Alternate: demolition and removal of the existing units (#2-1 and #2-2 that feed the classroom areas); rigging and installation of two new Trane Performance Climate Changer air-handling units as used as bases of design. As indicated in the mechanical drawings.

END OF SECTION 01 23 00

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SECTION 01 25 00 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for substitutions.

B. Related Requirements:
   1. Division 01 Section "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.
   2. Divisions 02 through 10 Sections for specific requirements and limitations for substitutions.

1.3 DEFINITIONS

A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.

   1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
   2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.

1.4 ACTION SUBMITTALS

A. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

   1. Substitution Request Form: Use CSI Form 13.1A
   2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:

      a. Statement indicating why specified product or fabrication or installation cannot be provided, if applicable.
      b. Coordination information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution.
      c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes such as performance, weight, size,

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durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.

d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
e. Samples, where applicable or requested.
f. Certificates and qualification data, where applicable or requested.
g. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
h. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
j. Detailed comparison of Contractor's construction schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
k. Cost information, including a proposal of change, if any, in the Contract Sum.
l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents except as indicated in substitution request, is compatible with related materials, and is appropriate for applications indicated.
m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor through Construction Manager of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.

a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.5 QUALITY ASSURANCE

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

1.6 PROCEDURES

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

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PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.

1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:

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

B. Substitutions for Convenience: Not permitted.

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 25 00

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SECTION 01 26 00 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for handling and processing Contract modifications.

B. Related Requirements:

1. Division 01 Section "Substitution Procedures" for administrative procedures for handling requests for substitutions made after the Contract award.

1.3 MINOR CHANGES IN THE WORK

A. Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710, Architect's Supplemental Instructions.

1.4 PROPOSAL REQUESTS

A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.

1. Work Change Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
2. Within [time specified in Proposal Request] [or] [15 days, when not otherwise specified,] after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.

a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
c. Include costs of labor and supervision directly attributable to the change.
d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
e. Quotation Form: Use CSI Form 13.6D, "Proposal Worksheet Summary," and Form 13.6C, "Proposal Worksheet Detail."

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B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect.

1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include costs of labor and supervision directly attributable to the change.
5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
6. Comply with requirements in Division 01 Section "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
7. Proposal Request Form: Use CSI Form 13.6A, "Change Order Request (Proposal)," with attachments CSI Form 13.6D, "Proposal Worksheet Summary," and Form 13.6C, "Proposal Worksheet Detail”

1.5 ADMINISTRATIVE CHANGE ORDERS

A. Allowance Adjustment: See Division 01 Section "Allowances" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect actual costs of allowances.

B. Unit-Price Adjustment: See Division 01 Section "Unit Prices" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect measured scope of unit-price work.

1.6 CHANGE ORDER PROCEDURES

A. On Owner's approval of a Work Changes Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor on AIA Document G701.

1.7 CONSTRUCTION CHANGE DIRECTIVE

A. Construction Change Directive: Architect may issue a [Construction] Change Directive on [AIA Document G714] [EJCDC Document C-940] [form included in Project Manual]. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.

1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.

B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.

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1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 26 00

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SECTION 01 29 00 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.

B. Related Requirements:

1. Division 01 Section "Allowances" for procedural requirements governing the handling and processing of allowances.
2. Division 01 Section "Unit Prices" for administrative requirements governing the use of unit prices.
3. Division 01 Section "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
4. Division 01 Section "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.

1.3 DEFINITIONS

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

1.4 SCHEDULE OF VALUES

A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.

1. Coordinate line items in the schedule of values with other required administrative forms and schedules, including the following:

a. Application for Payment forms with continuation sheets.
b. Submittal schedule.
c. Items required to be indicated as separate activities in Contractor's construction schedule.

2. Submit the schedule of values to Architect at earliest possible date, but no later than ten days before the date scheduled for submittal of initial Applications for Payment.

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B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.

1. Identification: Include the following Project identification on the schedule of values:

a. Project name and location.
b. Name of Architect.
c. Architect's project number.
d. Contractor's name and address.
e. Date of submittal.

2. Arrange schedule of values consistent with format of AIA Document G703.

3. Arrange the schedule of values in tabular form with separate columns to indicate the following for each item listed:

a. Related Specification Section or Division.
b. Description of the Work.
c. Name of subcontractor.
d. Name of manufacturer or fabricator.
e. Name of supplier.
f. Change Orders (numbers) that affect value.
g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.

1) Labor.
2) Materials.
3) Equipment.

4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with Project Manual table of contents. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.

a. Include separate line items under Contractor and principal subcontracts for LEED documentation and other Project closeout requirements in an amount totaling five percent of the Contract Sum and subcontract amount.

5. Round amounts to nearest whole dollar; total shall equal the Contract Sum.

6. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.

a. Differentiate between items stored on-site and items stored off-site. If required, include evidence of insurance.

7. Provide separate line items in the schedule of values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.

8. Allowances: Provide a separate line item in the schedule of values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.

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9. Purchase Contracts: Provide a separate line item in the schedule of values for each purchase contract. Show line-item value of purchase contract. Indicate owner payments or deposits, if any, and balance to be paid by Contractor.

10. Each item in the schedule of values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.

    a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the schedule of values or distributed as general overhead expense, at Contractor's option.

11. Schedule Updating: Update and resubmit the schedule of values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.5 APPLICATIONS FOR PAYMENT

A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.

1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.

B. Payment Application Times: The period covered by each Application for Payment is one month, ending on the last day of the month.

1. Submit draft copy of Application for Payment seven days prior to due date for review by Architect.

C. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.

D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.

1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.

E. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.

1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment, for stored materials.

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2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
3. Provide summary documentation for stored materials indicating the following:

    a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
    b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
    c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.

F. As-Built documentation: As-Built documentation is required as a condition for application of payment processing and approval. Documentation is to be provided for Owner and/or Architect to review at the time of the draft review of the monthly application, but no later than five days prior to submission of the application for payment. Failure to maintain the as-built documentation may result in delay of the processing of the Application for Payment until such time as the as-built documentation is provided for review.

G. Transmittal: Submit four signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments.

1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.

H. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's liens from subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application.

1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
2. When an application shows completion of an item, submit conditional final or full waivers.
3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
5. Waiver Forms: Submit executed waivers of lien on forms, acceptable to Owner.

I. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:

1. List of subcontractors.
2. Schedule of values.
3. Contractor's construction schedule (preliminary if not final).
4. Products list (preliminary if not final).
5. Schedule of unit prices.
6. Submittal schedule (preliminary if not final).
7. List of Contractor's staff assignments.
8. List of Contractor's principal consultants.
9. Copies of building permits.
10. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.

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11. Initial progress report.
12. Report of preconstruction conference.
13. Certificates of insurance and insurance policies.
14. Performance and payment bonds.
15. Data needed to acquire Owner's insurance.

J. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.

1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.

K. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:

1. Evidence of completion of Project closeout requirements.
2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
3. Updated final statement, accounting for final changes to the Contract Sum.
4. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
5. AIA Document G706A, "Contractor's Affidavit of Release of Liens."
6. AIA Document G707, "Consent of Surety to Final Payment."
7. Evidence that claims have been settled.
8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
9. Final liquidated damages settlement statement.
10. Build code required contractor certification.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 29 00

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01 30 00 – ADMINISTRATIVE REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Pre-Award Meeting.

B. Site Administration.

C. Coordination and Project Conditions.

D. Preconstruction Meeting.

E. Site Utilization Plan.

F. Preconstruction Video.

G. Site Mobilization Meeting.

H. Progress Meetings.

I. Digital Photographs of Progress.

J. Pre-installation Meetings.

1.2 PRE-AWARD MEETING

A. Following the issuance of the Notice of Tentative Award from the RI State Purchasing Office, the Design Team, User Agency and Contractor shall convene as soon as possible for a Pre-Award Meeting.

B. The Architect shall prepare meeting minutes and provide to the User Agency in Microsoft Word format within two (2) business days of the meeting. The User Agency shall review and make edits as required and transmit to the Contractor for review and acceptance. Upon the receipt of an email indicating the Contractor's acceptance of the minutes, the User Agency shall prepare the AIA Contract and General Conditions.

C. Agenda

1. Introductions.
2. Roles, responsibilities and lines of communications.
3. Site utilization expectations.
4. Anticipated schedule.
5. Thorough Scope Review, using form generated by the User Agency and Design Agent. Form shall become part of the Contract Documents.
6. Discussion of inspections, testing, verification and commissioning.
7. Review of pre-award and post-contract documents, deliverables and requirements.

1.3 SITE ADMINISTRATION

A. Maintain a daily attendance log to include the names of all project employees and guests to the site. Each guest signing the log should indicate a brief description of the reason for the visit, the guest's employer or organization. The log sheet, or sheets, must clearly indicate the Project Name, and the name of the general Contractor. Each line in the log should allow for

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the name of that employee, the employee's job title (use terminology used by prevailing wage job title), and the name of that employee's employer. This log shall be kept on a uniform form prescribed by the Director of Labor and Training. Such log shall be available for inspection on the site at all times by the Purchaser, Owner, User Agency, and/or the Director of the Department of Labor and Training and his or her designee. Provide copies when requested.

B. Daily Attendance Form

1. Maintain Daily Attendance Form acceptable to the Department of Labor and Training for all projects with a contract value over $1 Million. Submit as requested.

1.4 COORDINATION AND PROJECT CONDITIONS

A. Coordinate the scheduling, submittals, and the Work of the various Sections of the Project Manual to ensure an efficient and orderly sequence of the installation of interdependent construction elements.

B. Verify that the utility requirements and characteristics of the operating equipment are compatible with the building utilities. Coordinate the Work of the various Sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.

C. Coordinate the space requirements, supports and installation of the mechanical and electrical Work, which are indicated diagrammatically on the Drawings. Follow the routing shown for the pipes, ducts, and conduit, as closely as practicable; place runs parallel with the lines of the building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

D. Coordinate the completion and cleanup of the Work of the separate Sections in preparation for Substantial Completion and for portions of the Work designated for the User Agency's partial occupancy.

E. After the User Agency's occupancy of the premises, coordinate access to the site for correction of defective Work and the Work not in accordance with the Contract Documents to minimize disruption of the User Agency's activities.

1.5 PRECONSTRUCTION MEETING

A. The Design Agent will schedule a meeting after a Purchase Order is issued to the Contractor.

B. Attendance Required: User Agency's Representative, Design Agent, and Contractor.

C. Agenda:

1. Distribution of the Contract Documents.

2. Review of submission of contractually required deliverables: Superintendent Qualifications, procurement timeline and list of Subcontractors, list of products, submittal log with timelines, schedule of values, project schedule, site safety procedures and mobilization schedule.

3. Designation of the personnel representing the parties in the Contract and the Design Agent.

4. The procedures and processing of requests for information, site access, field decisions, submittals, substitutions, applications for payments, proposal requests, Change Orders, and Contract closeout procedures.

5. Scheduling.

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D. The Design Agent shall record the minutes and distribute copies within two (2) days of the meeting to the participants, with copies to the Contractor, User Agency, other participants, and those consultants affected by the decisions made.

1.6 SITE UTILIZATION PLAN

A. Refer to Drawings for approximate area for site staging.

B. Refer to Section 01 50 00 Temporary Facilities and Controls for specific requirements.

C. A Site Utilization Plan shall be submitted by the Contractor within ten (10) business days of issuance of the Purchase Order for approval by the User Agency.

1.7 PRECONSTRUCTION VIDEO

A. Conduct a pre-construction survey of the project side and areas immediately adjacent to the site. Submit two (2) copies of the video on thumb drive to the User Agency.

1.8 SITE MOBILIZATION MEETING

A. The Design Agent will schedule a meeting at the Project site prior to the Contractor's occupancy and may occur at the same time as the Preconstruction meeting noted above.

B. Attendance Required: The User Agency, Design Agent, Contractor, the Contractor's Superintendent, and major Subcontractors.

C. Agenda:

1. Use of the premises by the User Agency and the Contractor.
2. The User Agency’s requirements and partial occupancy.
3. Construction facilities and controls provided by the User Agency.
4. Temporary utilities provided by the User Agency.
5. Security and housekeeping procedures.
6. Schedules.
7. Application for payment procedures.
8. Procedures for testing.
9. Procedures for maintaining the record documents.
10. Requirements for the start-up of equipment.
11. Inspection and acceptance of the equipment put into service during the construction period.

D. Contractor shall record the minutes and distribute the copies within two days after the meeting to the participants, with copies to the Design Agent, User Agency, other participants, and those consultants affected by the decisions made.

1.9 PROGRESS MEETINGS

A. Schedule and administer the meetings throughout the progress of the Work at weekly intervals while work is in process.

B. Make arrangements for the meetings, prepare the agenda with copies for the participants, and preside at the meetings.

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C. Attendance Required: The job superintendent, major subcontractors and suppliers, the User Agency, Design Agent, and Consultants as appropriate to agenda topics for each meeting.

D. Agenda:

1. Review the minutes of previous meetings.
2. Review of the Work progress.
3. Field observations, problems, and decisions.
4. Identification of the problems which impede the planned progress.
5. Review of the submittals schedule and status of the submittals.
6. Review of delivery schedules.
7. Maintenance of the progress schedule.
8. Corrective measures to regain the projected schedules.
9. Planned progress during the succeeding work period.
10. Coordination of the projected progress.
11. Maintenance of the quality and work standards.
12. Effect of the proposed changes on the progress schedule and coordination.
13. Other business relating to the Work.

E. Contractor shall record the minutes and distribute the copies within two days after the meeting to the participants, with copies to the Design Agent, Consultants, User Agency, participants, and others affected by the decisions made.

1.10 DIGITAL PHOTOGRAPHS OF WORK PROGRESS

A. Submit minimum 12 digital photographs of construction progress each month. Include both jpg. and reduced-size pdf versions for email use. Refer to Price and Payment Procedures 01 20 00

B. Include an additional minimum of 12 photographs documenting underground utilities when installed in relationship to visible site features.

C. Include photographs of important in-wall or ceiling utilities before close-in at appropriate stages of construction.

D. See Section 01 78 00 for close-out copy requirements of these files.

1.11 PREINSTALLATION MEETINGS

A. When required in the individual specification Sections or listed below, convene a pre-installation meeting at the site prior to commencing the Work of the Section. Pre-installation Meetings:

1. The following items of work will require pre-installation meetings:
    a. Temporary HVAC systems
    b. Network and Telecommunication wiring and systems.
    c. Network and Telecommunication data rack connections.
    d. Fire Alarm and Sprinkler demolition and installation.
    e. Door Access and Security Systems

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f. Roofing sequencing and installation

g. Insert any other variations.

B. Require attendance of the parties directly affecting, or affected by, the Work of the specific Section.

C. Notify the Design Agent four days in advance of the meeting date.

D. Prepare an agenda and preside at the meeting:

1. Review the conditions of installation, preparation and installation procedures.

2. Review coordination with the related work.

E. Record the minutes and distribute the copies within two days after the meeting to the participants, with copies to the Design Agent, User Agency, participants, and those Consultants affected by the decisions made.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

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SECTION 01 31 00 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:

1. General coordination procedures.
2. Coordination drawings.
3. Requests for Information (RFIs).
4. Project Web site.
5. Project meetings.

B. Each contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific contractor.

C. Related Requirements:

1. Division 01 Section "Multiple Contract Summary" for a description of the division of work among separate contracts and responsibility for coordination activities not in this Section.
2. Division 01 Section "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
3. Division 01 Section "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
4. Division 01 Section "Closeout Procedures" for coordinating closeout of the Contract.

1.3 DEFINITIONS

A. RFI (Request for information) Request from Owner, Architect, or Contractor seeking information required by or clarifications of the Contract Documents.

1.4 INFORMATIONAL SUBMITTALS

A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Use a industry standard form that include the following information in tabular form:

1. Name, address, and telephone number of entity performing subcontract or supplying products.
2. Number and title of related Specification Section(s) covered by subcontract.

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3. Drawing number and detail references, as appropriate, covered by subcontract.

B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home, office, and cellular telephone numbers and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.

1. Post copies of list in project meeting room, in temporary field office, on Project Web site, and by each temporary telephone. Keep list current at all times.

1.5 GENERAL COORDINATION PROCEDURES

A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.

B. Coordination: Each contractor shall coordinate its construction operations with those of other contractors and entities to ensure efficient and orderly installation of each part of the Work. Each contractor shall coordinate its operations with operations, included in different Sections that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components with other contractors to ensure maximum performance and accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.

C. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.

1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.

D. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors when appropriate and/or required, to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:

1. Preparation of Contractor's construction schedule.
2. Preparation of the schedule of values.
3. Installation and removal of temporary facilities and controls.

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4. Delivery and processing of submittals.
5. Progress meetings.
6. Preinstallation conferences.
7. Project closeout activities.
8. Startup and adjustment of systems.

E. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.

1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

1.6 COORDINATION DRAWINGS

A. Coordination Drawings, General: Prepare coordination drawings, at a scale not less than 1/4" = 1'-0", according to requirements in individual Sections, and additionally where installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.

1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:

a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
b. Coordinate the addition of trade-specific information to the coordination drawings by multiple contractors in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
f. Indicate required installation sequences.
g. Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

B. Coordination Drawing Organization: Organize coordination drawings as follows:

1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within ceiling plenum to

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accommodate layout of light fixtures indicated on Drawings. Indicate areas of conflict between light fixtures and other components.

3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
6. Mechanical and Plumbing Work: Show the following:

    a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
    b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
    c. Fire-rated enclosures around ductwork.

7. Electrical Work: Show the following:

    a. Runs of vertical and horizontal conduit 1-1/4 inches (32 mm) in diameter and larger.
    b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
    c. Panel board, switch board, switchgear, transformer, busway, generator, and motor control center locations.
    d. Location of pull boxes and junction boxes, dimensioned from column center lines.

8. Fire-Protection System: Show the following:

    a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.

9. U.L. fire-rated walls shall be indicated.
10. Review: Architect will review coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make changes as directed and resubmit.
11. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements in Division 01 Section "Submittal Procedures."

C. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:

1. File Preparation Format: Same digital data software program, version, and operating system as original Drawings.
2. File Preparation Format: DWG, Version ACAD 2009, operating in Microsoft Windows operating system.
3. File Submittal Format: Submit or post coordination drawing files using format same as file preparation format and Portable Data File (PDF) format.

D. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.

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1. Architect will return RFIs submitted to Architect by other entities controlled by Contractor with no response.
2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.

E. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:

1. Project name.
2. Project number.
3. Date.
4. Name of Contractor.
5. Name of Architect (and Construction Manager when identified).
6. RFI number, numbered sequentially.
7. RFI subject.
8. Specification Section number and title and related paragraphs, as appropriate.
9. Drawing number and detail references, as appropriate.
10. Field dimensions and conditions, as appropriate.
11. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
12. Contractor's signature.
13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.

    a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.

F. RFI Forms: Contractors standard AIA form or AIA Document G716, Software-generated form with substantially the same content as indicated above, acceptable to Architect.

1. Attachments shall be electronic files in Adobe Acrobat PDF format.

G. Architect's Action: Architect and Construction Manager will review each RFI, determine action required, and respond. Allow seven working days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.

1. The following Contractor-generated RFIs will be returned without action:

    a. Requests for approval of submittals.
    b. Requests for approval of substitutions.
    c. Requests for approval of Contractor's means and methods.
    d. Requests for coordination information already indicated in the Contract Documents.
    e. Requests for adjustments in the Contract Time or the Contract Sum.
    f. Requests for interpretation of Architect's actions on submittals.
    g. Incomplete RFIs or inaccurately prepared RFIs.

2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt of additional information.
3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Division 01 Section "Contract Modification Procedures."

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a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 7 days of receipt of the RFI response.

H. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Use forms and/or Software log that is part of a Project Web based site with not less than the following:

1. Project name.
2. Name and address of Contractor.
3. Name and address of Architect (and Construction Manager when required).
4. RFI number including RFIs that were returned without action or withdrawn.
5. RFI description.
6. Date the RFI was submitted.
7. Date Architect's (and Construction Manager's) response was received.

I. On receipt of Architect's (and Construction Manager's) action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect (and Construction Manager) within five (5) days if Contractor disagrees with response.

1. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
2. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

1.7 PROJECT MEETINGS

A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.

1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner**,** Construction Manager, and Architect, within three (3) days of the meeting.

B. Preconstruction Conference: Schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than ten (10) days after execution of the Agreement.

1. Conduct the conference to review responsibilities and personnel assignments.
2. Attendees: Authorized representatives of Owner, Owner's Commissioning Authority, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
3. Agenda: Discuss items of significance that could affect progress, including the following:

a. Tentative construction schedule.
b. Phasing.
c. Critical work sequencing and long-lead items.
d. Designation of key personnel and their duties.

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e. Lines of communications.
f. Procedures for processing field decisions and Change Orders.
g. Procedures for RFIs.
h. Procedures for testing and inspecting.
i. Procedures for processing Applications for Payment.
j. Distribution of the Contract Documents.
k. Submittal procedures.
l. Preparation of record documents.
m. Use of the premises and/or and existing building.
n. Work restrictions.
o. Working hours.
p. Owner's occupancy requirements.
q. Responsibility for temporary facilities and controls.
r. Procedures for moisture and mold control.
s. Procedures for disruptions and shutdowns.
t. Construction waste management and recycling.
u. Parking availability.
v. Office, work, and storage areas.
w. Equipment deliveries and priorities.
x. First aid.
y. Security.
z. Progress cleaning.

4. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.

C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.

1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect , and Owner's Commissioning Authority of scheduled meeting dates.
2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:

a. Contract Documents.
b. Options.
c. Related RFIs.
d. Related Change Orders.
e. Purchases.
f. Deliveries.
g. Submittals.
h. Review of mockups.
i. Possible conflicts.
j. Compatibility requirements.
k. Time schedules.
l. Weather limitations.
m. Manufacturer's written instructions.
n. Warranty requirements.
o. Compatibility of materials.
p. Acceptability of substrates.
q. Temporary facilities and controls.
r. Space and access limitations.
s. Regulations of authorities having jurisdiction.

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t. Testing and inspecting requirements.
u. Installation procedures.
v. Coordination with other work.
w. Required performance results.
x. Protection of adjacent work.
y. Protection of construction and personnel.

3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

D. Project Closeout Conference: Schedule and conduct a project closeout conference, at a time convenient to Owner and Architect, but no later than 90 days prior to the scheduled date of Substantial Completion.

1. Conduct the conference to review requirements and responsibilities related to Project closeout.
2. Attendees: Authorized representatives of Owner, Owner's Commissioning Authority, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:

a. Preparation of record documents.
b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
c. Submittal of written warranties.
d. Requirements for preparing operations and maintenance data.
e. Requirements for delivery of material samples, attic stock, and spare parts.
f. Requirements for demonstration and training.
g. Preparation of Contractor's punch list.
h. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
i. Submittal procedures.
j. Coordination of separate contracts.
k. Owner's partial occupancy requirements.
l. Installation of Owner's furniture, fixtures, and equipment.
m. Responsibility for removing temporary facilities and controls.

4. Minutes: Entity conducting meeting will record and distribute meeting minutes.

E. Progress Meetings: Conduct progress meetings at weekly and/or regular intervals.

1. Coordinate dates of meetings with preparation of payment requests.
2. Attendees: In addition to representatives of Owner**,** Owner's Commissioning Authority, Construction Manager, and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants

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at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.

3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

   a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

      1) Review schedule for next period.

   b. Review present and future needs of each entity present, including the following:

      1) Interface requirements.
      2) Sequence of operations.
      3) Resolution of BIM component conflicts.
      4) Status of submittals.
      5) Deliveries.
      6) Off-site fabrication.
      7) Access.
      8) Site utilization.
      9) Temporary facilities and controls.
      10) Progress cleaning.
      11) Quality and work standards.
      12) Status of correction of deficient items.
      13) Field observations.
      14) Status of RFIs.
      15) Status of proposal requests.
      16) Pending changes.
      17) Status of Change Orders.
      18) Pending claims and disputes.
      19) Documentation of information for payment requests.

4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.

   a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

F. Coordination Meetings: Conduct Project coordination meetings at weekly and/or regular intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.

1. Attendees: In addition to representatives of Owner**,** Owner's Commissioning Authority, Construction Manager, and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meetings shall be familiar with Project and authorized to conclude matters relating to the Work.

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2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

    a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to combined Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
    b. Schedule Updating: Revise combined Contractor's construction schedule after each coordination meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
    c. Review present and future needs of each contractor present, including the following:

        1) Interface requirements.
        2) Sequence of operations.
        3) Resolution of component conflicts.
        4) Status of submittals.
        5) Deliveries.
        6) Off-site fabrication.
        7) Access.
        8) Site utilization.
        9) Temporary facilities and controls.
        10) Work hours.
        11) Hazards and risks.
        12) Progress cleaning.
        13) Quality and work standards.
        14) Change Orders.

3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 31 00

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SECTION 01 32 00 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:

1. Startup construction schedule.
2. Contractor's construction schedule.
3. Construction schedule updating reports.
4. Daily construction reports.
5. Material location reports.
6. Site condition reports.
7. Special reports.

B. Related Requirements:

1. Division 01 Section "Multiple Contract Summary" for preparing a combined Contractor's construction schedule.
2. Division 01 Section "Submittal Procedures" for submitting schedules and reports.
3. Division 01 Section "Quality Requirements" for submitting a schedule of tests and inspections.

1.3 DEFINITIONS

A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.

1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
2. Predecessor Activity: An activity that precedes another activity in the network.
3. Successor Activity: An activity that follows another activity in the network.

B. Cost Loading: The allocation of the schedule of values for the completion of an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum unless otherwise approved by Architect.

C. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.

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D. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.

E. Event: The starting or ending point of an activity.

F. Float: The measure of leeway in starting and completing an activity.

1. Float time [belongs to Owner] [is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date].
2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

G. Resource Loading: The allocation of manpower and equipment necessary for the completion of an activity as scheduled.

1.4 INFORMATIONAL SUBMITTALS

A. Format for Submittals: Submit required submittals in the following format:

1. Working electronic copy of schedule file, where indicated.
2. PDF electronic file.

B. Startup construction schedule.

1. Approval of cost-loaded, startup construction schedule will not constitute approval of schedule of values for cost-loaded activities.

C. Startup Network Diagram: Of size required to display entire network for entire construction period. Show logic ties for activities.

D. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.

1. Submit a working electronic copy of schedule, using software indicated, and labeled to comply with requirements for submittals. Include type of schedule (initial or updated) and date on label.

E. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports shall contain activity number, activity description, cost and resource loading, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.

1. Activity Report: List of all activities sorted by activity number and then early start date, or actual start date if known.
2. Logic Report: List of preceding and succeeding activities for all activities, sorted in ascending order by activity number and then early start date, or actual start date if known.
3. Total Float Report: List of all activities sorted in ascending order of total float.

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4. Earnings Report: Compilation of Contractor's total earnings from [**commencement of the Work**] [**the Notice to Proceed**] until most recent Application for Payment.

F. Construction Schedule Updating Reports: Submit with Applications for Payment.

G. Daily Construction Reports: Submit at weekly intervals.

H. Material Location Reports: Submit at weekly intervals.

I. Site Condition Reports: Submit at time of discovery of differing conditions.

J. Special Reports: Submit at time of unusual event.

K. Qualification Data: For scheduling consultant.

1.5 QUALITY ASSURANCE

A. Scheduling Consultant Qualifications: An experienced specialist in CPM scheduling and reporting, with capability of producing CPM reports and diagrams within 24 hours of Architect's request.

B. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to the preliminary construction schedule and Contractor's construction schedule, including, but not limited to, the following:

1. Review software limitations and content and format for reports.
2. Verify availability of qualified personnel needed to develop and update schedule.
3. Discuss constraints, including **phasing, work stages, area separations**.
4. Review delivery dates for Owner-furnished products.
5. Review schedule for work of Owner's separate contracts.
6. Review submittal requirements and procedures.
7. Review time required for review of submittals and resubmittals.
8. Review requirements for tests and inspections by independent testing and inspecting agencies.
9. Review time required for Project closeout and Owner startup procedures[**, including commissioning activities**].
10. Review and finalize list of construction activities to be included in schedule.
11. Review procedures for updating schedule.

1.6 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 Contractor's construction schedule with the schedule of values,[**list of subcontracts,**] submittal schedule, progress reports, payment requests, and other required schedules and reports.

1. Secure time commitments for performing critical elements of the Work from entities involved.

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2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 - PRODUCTS

2.1 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

A. Time Frame: Extend schedule from date established for the Notice to Proceed to date of final completion.

1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.

B. Activities: Treat each story or separate area as a separate numbered activity for each main element of the Work. Comply with the following:

1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.
2. Procurement Activities: Include procurement process activities for the following long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.

a. **Condenser Units / Controls**

3. Submittal Review Time: Include review and resubmittal times indicated in Division 01 Section "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's construction schedule with submittal schedule.
4. Startup and Testing Time: Include no fewer than [**15**] days for startup and testing.
5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
6. Punch List and Final Completion: Include not more than 45 days for completion of punch list items and final completion.

C. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.

1. Phasing: Arrange list of activities on schedule by phase.
2. Work under More Than One Contract: Include a separate activity for each contract.
3. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
4. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Division 01 Section "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
5. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Division 01 Section "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
6. Work Restrictions: Show the effect of the following items on the schedule:

a. Coordination with existing construction.

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b. Limitations of continued occupancies.
c. Uninterruptible services.
d. Partial occupancy before Substantial Completion.
e. Use of premises restrictions.
f. Provisions for future construction.
g. Seasonal variations.
h. Environmental control.

7. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:

a. Subcontract awards.
b. Submittals.
c. Purchases.
d. Mockups.
e. Fabrication.
f. Sample testing.
g. Deliveries.
h. Installation.
i. Tests and inspections.
j. Adjusting.
k. Curing.
l. Building flush-out.
m. Startup and placement into final use and operation.

8. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:

a. Structural completion.
b. Completion of mechanical installation.
c. Completion of electrical installation.
d. Substantial Completion.

D. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, temporary enclosure, space conditioning, Substantial Completion, and final completion[**.**][**, and the following interim milestones:**]

1. Temporary enclosure and space conditioning.
2. Completed rough in of systems

E. Cost Correlation: Superimpose a cost correlation timeline, indicating planned and actual costs. On the line, show planned and actual dollar volume of the Work performed as of planned and actual dates used for preparation of payment requests.

1. See Division 01 Section "Payment Procedures" for cost reporting and payment procedures.

F. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:

1. Unresolved issues.
2. Unanswered Requests for Information (RFI).
3. Rejected or unreturned submittals.

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4. Notations on returned submittals.
5. Pending modifications affecting the Work and Contract Time.

G. Recovery Schedule: When periodic update indicates the Work is [**14**] <**Insert number**> or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, and equipment required to achieve compliance, and date by which recovery will be accomplished.

H. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.

1. Use [**Microsoft Project,**] [**Primavera,**] [**Meridian Prolog,**] **[Pro-Core] [Scheduling component of Project Web site software specified in Division 01 Section "Project Management and Coordination,"**]

2.2 STARTUP CONSTRUCTION SCHEDULE

A. Bar-Chart Schedule: Submit startup, horizontal, bar-chart-type construction schedule within (7) seven days of date established for commencement of the Work.

B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Outline significant construction activities for first 90 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

2.3 CONTRACTOR'S CONSTRUCTION SCHEDULE (GANTT CHART)

A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal, Gantt-chart-type, Contractor's construction schedule within 30 days of date established for the Notice to Proceed. Base schedule on the startup construction schedule and additional information received since the start of Project.

B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.

1. For construction activities that require three months or longer to complete, indicate an estimated completion percentage in 10 percent increments within time bar.

2.4 CONTRACTOR'S CONSTRUCTION SCHEDULE (CPM SCHEDULE)

A. General: Prepare network diagrams using AON (activity-on-node) format.

B. Startup Network Diagram: Submit diagram within 14 days of date established for the Notice of Award. Outline significant construction activities for the first 90 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

C. CPM Schedule: Prepare Contractor's construction schedule using a cost- and resource-loaded, time-scaled CPM network analysis diagram for the Work.

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1. Develop network diagram in sufficient time to submit CPM schedule so it can be accepted for use no later than 60 days after date established for the Notice to Proceed.

    a. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates, regardless of Architect's approval of the schedule.

2. Conduct educational workshops to train and inform key Project personnel, including subcontractors' personnel, in proper methods of providing data and using CPM schedule information.
3. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
4. Use "one workday" as the unit of time for individual activities. Indicate nonworking days and holidays incorporated into the schedule in order to coordinate with the Contract Time.

D. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the startup network diagram, prepare a skeleton network to identify probable critical paths.

1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:

    a. Preparation and processing of submittals.
    b. Mobilization and demobilization.
    c. Purchase of materials.
    d. Delivery.
    e. Fabrication.
    f. Utility interruptions.
    g. Installation.
    h. Work by Owner that may affect or be affected by Contractor's activities.
    i. Testing and commissioning.
    j. Punch list and final completion.
    k. Activities occurring following final completion.

2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.
3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.

    a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.

5. Cost- and Resource-Loading of CPM Schedule: Assign cost to construction activities on the CPM schedule. Do not assign costs to submittal activities. Obtain Architect's approval prior to assigning costs to fabrication and delivery activities. Assign costs under main subcontracts for testing and commissioning activities, operation and maintenance manuals, punch list activities, Project record documents, [**LEED documentation,**]and demonstration and training (if applicable), in the amount of 5 percent of the Contract Sum.

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a. Each activity cost shall reflect an appropriate value subject to approval by Architect.
b. Total cost assigned to activities shall equal the total Contract Sum.

E. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using a network fragment to demonstrate the effect of the proposed change on the overall project schedule.

F. Initial Issue of Schedule: Prepare initial network diagram from a sorted activity list indicating straight "early start-total float." Identify critical activities. Prepare tabulated reports showing the following:

1. Contractor or subcontractor and the Work or activity.
2. Description of activity.
3. Main events of activity.
4. Immediate preceding and succeeding activities.
5. Early and late start dates.
6. Early and late finish dates.
7. Activity duration in workdays.
8. Total float or slack time.
9. Average size of workforce.
10. Dollar value of activity (coordinated with the schedule of values).

G. 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.

H. Value Summaries: Prepare two cumulative value lists, sorted by finish dates.

1. In first list, tabulate activity number, early finish date, dollar value, and cumulative dollar value.
2. In second list, tabulate activity number, late finish date, dollar value, and cumulative dollar value.
3. In subsequent issues of both lists, substitute actual finish dates for activities completed as of list date.
4. Prepare list for ease of comparison with payment requests; coordinate timing with progress meetings.

a. In both value summary lists, tabulate "actual percent complete" and "cumulative value completed" with total at bottom.
b. Submit value summary printouts [**one week**] <**Insert time**> before each regularly scheduled progress meeting.

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2.5 REPORTS

A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:

1. List of subcontractors at Project site.
2. List of separate contractors at Project site.
3. Approximate count of personnel at Project site.
4. Equipment at Project site.
5. Material deliveries.
6. High and low temperatures and general weather conditions, including presence of rain or snow.
7. Accidents.
8. Meetings and significant decisions.
9. Unusual events (see special reports).
10. Stoppages, delays, shortages, and losses.
11. Meter readings and similar recordings.
12. Emergency procedures.
13. Orders and requests of authorities having jurisdiction.
14. Change Orders received and implemented.
15. Construction Change Directives received and implemented.
16. Services connected and disconnected.
17. Equipment or system tests and startups.
18. Partial completions and occupancies.
19. Substantial Completions authorized.

B. Material Location Reports: At monthly intervals, prepare and submit a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site. Indicate the following categories for stored materials:

1. Material stored prior to previous report and remaining in storage.
2. Material stored prior to previous report and since removed from storage and installed.
3. Material stored following previous report and remaining in storage.

C. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

2.6 SPECIAL REPORTS

A. General: Submit special reports directly to Owner within one day(s) of an occurrence. Distribute copies of report to parties affected by the occurrence.

B. Reporting Unusual Events: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

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2.7 RECORD DOCUMENTS

A. Prior to the start of construction, the Architect shall deliver to the Contractor, a complete set of “Issued for Construction” drawings, and a complete project manual, including addenda, for the purpose of maintaining record documents.

B. Also, maintain a copy of all modifications and change orders.

C. Maintain the documents in a safe, dry location during the entire construction process. The Contractor, together with his sub-contractors, shall indicate clearly and accurately, any and all changes necessitated by field conditions. In addition, accurately maintain dimensions locating all pipes, ducts, etc. built into or under concrete slabs or masonry walls, including elevations, inverts, etc.

D. With each monthly requisition, send certification, signed by the Contractor’s Superintendant and Owner’s Field Representative, that the documents are being maintained accurately and currently. At the completion of the Project, return the documents to the Architect, along with certification that the documents are complete in that they represent the true constructed conditions.

E. Electronic Submission of Record Drawings in AutoCAD is mandatory in addition to hard copies.

2.8 ELECTRONIC FILES

A. The Robinson Green Beretta Corporation shall make electronic drawing files available to the successful Contractor, at a charge of $250.00 for the purpose of preparing submittals, record drawings, etc in accordance with the following policy:

1. Drawings shall not be e-mailed, but burned to a CD/DVD.
2. Requester must sign an Electronic File Transmittal Form.
3. Copies of documents that may be relied upon by the Contractor are limited to the printed copies (also known as hard copies) that are signed or sealed by the Architect. Files in electronic media format or test, data, graphic or other types that are furnished by the Architect to the Contractor are only for the convenience of the Contractor. Any conclusion or information obtained or derived from such electronic files will be at the user’s sole risk. When transferring documents in electronic media format, the Architect make no representations as to long-term compatibility, usability, or readability of documents resulting from the use of software application packages, operating systems or computer hardware differing from those in use by the Architect at the beginning of this project.

END OF SECTION 01 32 00

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01 33 00 – SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Submittal procedures.

B. Site superintendent.

C. Construction progress schedules.

D. Subcontractor list.

E. Proposed products list.

F. Product data.

G. Shop drawings.

H. Samples.

I. Test reports.

J. Design Data.

K. Certificates.

L. Manufacturer's instructions.

1.2 SUBMITTAL PROCEDURES

A. Per General Conditions §3.10.2, a Submittal Schedule (Log) shall be submitted. To ensure timely execution of the work, Contractor is encouraged to submit the Submittal Schedule for review within seven (7) calendar days of issuance of the Purchase Order. The Submittal Log shall list all required submittals, organized by division and section, with a proposed date for each item to be submitted. This shall coordinate with the construction schedule.

1. As the project progresses, update the Submittal Log with the date submittal was sent, days since submittal was sent, status of submittal, date submittal was received in return, and any date associated with resubmittals.

2. Update the Submittal Log with each submission and response.

3. Issue copy of the updated Submittal Log electronically with each Application for Payment or upon request by the User Agency.

B. Preparation and transmission of submittals:

1. Identify all variations from the Contract Documents and any Product or system limitations which may be detrimental to a successful performance of the completed Work.

2. Allow space on the submittals for the Contractor's, Design Agent’s, and Consultant's electronic review stamps.

3. Transmit each submittal with a dated Design Agent-accepted transmittal form.

4. Sequentially number the transmittal form. Mark revised submittals with an original number and a sequential alphabetic suffix.

5. Identify the Project, Contractor, subcontractor and supplier; the pertinent drawing and detail number, and the specification Section number, appropriate to the submittal.

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6. Apply a Contractor's electronic stamp certifying that the review, approval, verification of products required, field dimensions, adjacent construction Work, and coordination of the information is in accordance with the requirements of the Work and the Contract Documents.
7. Transmit printed copies and electronic PDF copy of each submittal to the Design Agent for review and comment as outlined in Section.

C. Submittal Review & Resubmission
1. For each submittal, allow fifteen (15) calendar days for review.
2. When revised for resubmission, identify the changes made since the previous submission.
3. Distribute copies of the reviewed submittals as appropriate. Reproduce as necessary to inform subcontractors without internet download capabilities. Instruct the parties to promptly report any inability to comply with the Contract requirements.
4. Produce additional copies as required for the Record Document purposes as described in Section 01 78 00.

1.3 SITE SUPERINTENDENT

A. Immediately after the issuance of the Purchase Order, Contractor shall submit the name, email, cell phone, resume of the proposed site superintendent for review and approval by the Design Agent and User Agency.

B. The site superintendent shall be familiar with the drawings and specifications.

C. No substitution or replacement of the site superintendent shall be made without notifying the Design Agent and User Agency.

1.4 CONSTRUCTION PROGRESS SCHEDULES

A. Submit initial progress schedule in duplicate within ten (10) days of issuance of Purchase Order for Design Agent and User Agency. Upon receipt of reviewed comments, Contractor to submit detailed schedules within five (5) days.

B. Distribute copies of the reviewed schedules to the Project site file, subcontractors, suppliers, and other concerned parties. Instruct the recipients to promptly report, in writing, the problems anticipated by the projections indicated in the schedules

C. Submit updated schedules with each Application for Payment, identifying changes since previous version as follows:
1. Indicate the progress of each activity to the date of submittal, and the projected completion date of each activity.
2. Identify the activities modified since the previous submittal, major changes in the scope, and other identifiable changes.
3. Provide a narrative report to define the problem areas, the anticipated delays, and impact on the Schedule. Report the corrective action taken, or proposed, and its effect including the effect of changes on the schedules of separate contractors.

D. Submit a computer-generated horizontal bar chart with separate line for each major portion of the Work or operation, identifying the first work day of each week.

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E. Show a complete sequence of construction by activity, identifying the Work of separate stages and other logically grouped activities. Indicate the early and late start, the early and late finish, float dates, and duration. Critical path items shall be clearly identified.

F. Indicate an estimated percentage of completion for each item of the Work at each submission.

G. Provide a separate schedule of submittal dates for shop drawings, product data, and samples, including User Agency-furnished Products and Products identified under Allowances, if any, and the dates reviewed submittals will be required from the Design Agent. Indicate the decision dates for selection of the finishes.

H. Indicate the delivery dates for User Agency furnished Products, and for Products identified under Allowances.

1.5 SUBCONTRACTOR LIST

A. Provide subcontractor list per General Conditions §5.2.1. For each subcontractor, provide contact name, phone number, trade and email. Indicate the SOV line item(s) for which the subcontractor will be providing and if labor will be provided.

1.6 PROPOSED PRODUCTS LIST

A. Within ten (10) days of issuance of Purchase Order, submit a list of major products proposed for use, with the name of the manufacturer, the trade name, and the model number of each product.

B. For the products specified only by reference standards, give the manufacturer, trade name, model or catalog designation, and reference standards.

C. With each product listed, indicate the submittal requirements specified to be adhered to, and an indication of relevant "long-lead-time" information, when appropriate.

1.7 PRODUCT DATA

A. Product Data: Submit to the Design Agent for review for the limited purpose of checking for conformance with the information given and the design concept expressed in the Contract Documents. Provide copies and distribute in accordance with the SUBMITTAL PROCEDURES article and for the record documents purposes described in Section 01 78 00.

B. Submit one (1) printed copy and one (1) electronic PDF copy for review. The Design Agent will retain the reviewed printed copy for record and return the reviewed electronic PDF copy to the Contractor for distribution.

C. Mark each copy to identify the applicable products, models, options, and other data. Supplement the manufacturers' standard data to provide the information specific to this Project.

D. Indicate the product utility and electrical characteristics, the utility connection requirements, and the location of utility outlets for service for functional equipment and appliances.

E. After a review distribute in accordance with the Submittal Procedures article above and provide copies for record documents described in Section 01 78 00.

1.8 SHOP DRAWINGS

A. Shop Drawings: Submit to the Design Agent for review for the limited purpose of checking for conformance with the information given and the design concept expressed in the Contract Documents. Produce copies and distribute in accordance with the SUBMITTAL

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PROCEDURES article and for the record documents purposes described in Section 01 78 00.

B. Submit two (2) printed copies and one (1) electronic PDF copy for review. The Design Agent and /or Consultants will retain the reviewed printed copies for record and return the reviewed electronic PDF copy to the Contractor for distribution.

C. Indicate the special utility and electrical characteristics, the utility connection requirements, and the location of utility outlets for service for functional equipment and appliances.

1.9 SAMPLES

A. Samples: Submit to the Design Agent for review for the limited purpose of checking for conformance with the information given and the design concept expressed in the Contract Documents. Produce duplicates and distribute in accordance with the SUBMITTAL PROCEDURES article and for the record documents purposes described in Section 01 78 00.

B. Samples for Selection as Specified in Product Sections:

1. Submit to the Design Agent for aesthetic, color, or finish selection.

2. Submit samples of the finishes in the colors selected for the Design Agent's records.

3. After review, produce duplicates and distribute in accordance with the SUBMITTAL PROCEDURES article and for the record documents purposes described in Section 01 78 00.

C. Submit samples to illustrate the functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate the sample submittals for interfacing Work.

D. Include identification on each sample, with the full Project information.

E. Submit at least the number of samples specified in the individual specification Sections; the Design Agent will retain two samples.

F. Reviewed samples, which may be used in the Work, are indicated in the individual specification Sections.

G. Samples will not be used for testing purposes unless they are specifically stated to be in the specification Section.

1.10 TEST REPORTS

A. Submit (1) printed and (1) electronic PDF lab reports in accordance with Section 01 40 00.

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

1.11 DESIGN DATA

A. Submit (1) printed and (1) electronic PDF data for the Design Agent’s knowledge as contract administrator for the User Agency.

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

1.12 CERTIFICATES

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A. When specified in the individual specification Sections, submit (1) printed and (1) electronic PDF certification by the manufacturer, installation/application subcontractor, or the Contractor to the Design Agent in the quantities specified for the Product Data.

B. Indicate that the material or product conforms to or exceeds the specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.

C. Certificates may be recent or previous test results on the material or product, but must be acceptable to the Design Agent and its Consultants.

1.13 MANUFACTURER'S INSTRUCTIONS

A. When specified in the individual specification Sections, submit (1) printed and (1) electronic PDF copy of instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, to the Design Agent for delivery to the User Agency in the quantities specified for Product Data.

B. Indicate the special procedures, and the perimeter conditions requiring special attention, and the special environmental criteria required for application or installation.

1.14 SUBMITTAL LIST

A. All materials to be installed .

B. All clarifications required per repetiteur division section.

C. All warranty information

D. All manufacturer installation requirements

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

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01 35 23 – HOT WORK PROCEDURE

PART 1 - GENERAL

1.1 PURPOSE

A. To establish regulations and rules for the safe uses of open flames and spark producing equipment in state owned or leased facilities. Applicable regulations pertinent to this guide include OSHA 29 CFR 1910.252-.255 and NFPA 51B, and the insurers Hot Work Requirements.

1.2 POLICY

A. Fire Protection

1. Contractors and employees shall comply with the regulations set forth in this policy to ensure the safe use of open flames and spark producing equipment.
2. When performing work within a state facility with a cutting torch or when using welding, brazing or soldering equipment a hot work permit is required to be filled out and precautions followed. The Hot Work Permits are available (free of charge) directly from the state's property insurer.
3. Prior to the start of the hot work operation, the contractor is to coordinate deactivation of related of the alarm system necessary to prevent false alarms prior to the start of the hot work operation with the User Agency.
4. Upon completion of the project the fire alarm system will be restored to operational status.
5. During the hot work operation the following precautions will be followed:

g. A fire watch will be required by the individual responsible for authorizing the hot work operation.
h. Welding leads and burning hoses are to be kept out of walkways as much as possible
i. Inspect all leads, grounds, clamps, torches and cylinders before use. Be sure all fittings, couplings and connections are tight.
j. In gas welding and cutting, mixtures of fuel gas and air or oxygen must not be permitted except prior to consumption.
k. Only approved apparatus must be used, and portable cylinders of compressed gas must be properly secured to prevent upset.
l. Use proper ventilation in the work area.
m. All exposed combustible and flammable material within 35 feet of the point of operation should be removed where possible. Otherwise, protect with Approved welding pads, blankets and curtains, fire resistive tarpaulins or metal shields.
n. Cutting or welding on pipes or other metal in contact with combustible walls, partitions, ceilings or roofs shall not be undertaken if the work is close enough to cause ignition by conduction.
o. All hoses and leads will be inspected frequently and will be replaced as necessary.
p. A cutting or welding prohibition will be required whenever an area contains or may contain flammable/explosive vapors. The prohibition can only be lifted when the area has been purged and cleaned and the area has been tested and shown to be free of a flammable/explosive mix.

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1.3 RESPONSIBILITY

A. Supervisor

1. Supervisor will train their employees in the potential fire hazards associated with hot work.
2. Supervisor will initiate a hot work permit prior to assigning work.
3. The supervisor will obtain confirmation that:
   a. Available sprinklers, hose streams and extinguishers are in service and operable.
   b. Hot work equipment is in good working condition.
   c. The following requirements within 35 feet of hot work shall be adhered to: a.) Flammable liquid, dust, lint and oily deposits have been removed. b.) Explosive atmosphere has been eliminated.
   d. The floors have been swept clean.
   e. Combustible floors have been wet down, covered with damp sand or fire resistive sheets are in place.
   f. All exposed combustible and flammable material within 35 feet of the point of operation should be removed where possible. Otherwise, protect with FM Approved welding pads, blankets and curtains, fire resistive tarpaulins or metal shields.
   g. All wall and floor openings are covered.
   h. FM approved welding pads, blankets and curtains installed under and around work.
   i. Protect or shut down ducts and conveyors that might carry sparks to distant combustible material.
4. The supervisor is responsible for assuring that a 60 minute fire watch is maintained at the completion of all hot work assignments, that a hot work permit has been acquired for work involving open flames or spark producing tools and for assuring all fire prevention procedures and precautions are followed for protection of people and property including a fire watch, deactivation of the fire alarm.
5. The supervisor will require that the area be monitored periodically for three hours after the fire watch is completed.
6. The supervisor will confirm that employees are trained in use of fire extinguishers and hoses, and that the employees are familiar with emergency procedures in the event of a fire.
7. At least once while the permit is in effect, the area should be inspected by the individual responsible for authorizing, cutting or welding operations to ensure that it is a fire safe area. (See article 3 above for fire safe conditions.)
8. Proper personnel protective equipment including helmets, eye wear, face and hand shields applicable to the equipment used will be provided by the supervisor.
   a. The equipment will be maintained and fit-tested by management.
9. Personal protective clothing consistent with OSHA standards will be worn.
10. Tarps or fire-resistant coverings sufficient to cover combustible materials within 35 feet of the operation will be provided.

B. Employees

1. The employee shall be responsible to work in a safe manner and follow all safety precautions as trained by the supervisor.

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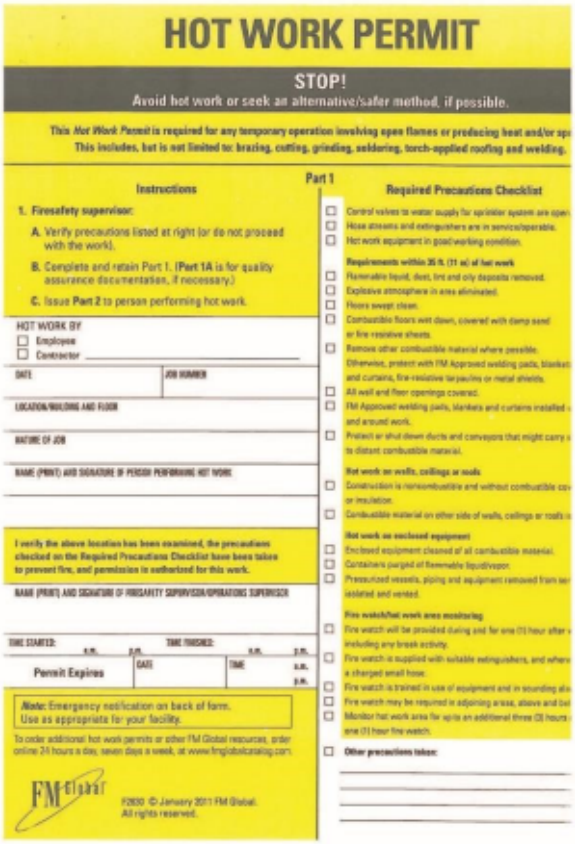
2. The employee charged with performing the hot work will initiate part 2 of the hot work permit and verify that a 60 minute fire watch has been maintained.
3. Employees performing hot work will be required to either properly remove or cover combustible materials in the 35 foot area surrounding the hot work operation.

C. Fire Safety Officer

1. The state employee charged with maintaining or inspecting the fire alarm system will deactivate the system.
2. The area will be evaluated by this individual to identify fire hazards and provide required suppression equipment.
3. The fire safety officer will ensure that combustible materials within 35 feet of the hot work operation are properly tarped or moved a safe distance.
4. In addition, this officer will ensure that personnel in close proximity to this work area are properly protected against heat, sparks and slug.

D. Management

1. Maintain a log of hot work permits.
2. Provide safety training for supervisors.
3. Confirm that all contractors follow all requirements of this protocol.



HOT WORK PERMIT

STOP!

Avoid hot work or seek an alternative/safer method, if possible.

This *Hot Work Permit* is required for any temporary operation involving open flames or producing heat and/or sp
This includes, but is not limited to: brazing, cutting, grinding, soldering, torch-applied roofing and welding.

Instructions

1. Firesafety supervisor:
   A. Verify precautions listed at right (or do not proceed with the work).
   B. Complete and retain Part 1. (Part 1A is for quality assurance documentation, if necessary.)
   C. Issue Part 2 to person performing hot work.

Part 1

Required Precautions Checklist

HOT WORK BY
☐ Employee
☐ Contractor _____

DATE | JOB NUMBER

LOCATION/BUILDING AND FLOOR

NATURE OF JOB

NAME (PRINT) AND SIGNATURE OF PERSON PERFORMING HOT WORK

I verify the above location has been examined, the precautions checked on the Required Precautions Checklist have been taken to prevent fire, and permission is authorized for this work.

NAME (PRINT) AND SIGNATURE OF FIRESAFETY SUPERVISOR/OPERATIONS SUPERVISOR

TIME STARTED: a.m. p.m. TIME FINISHED: a.m. p.m.

Permit Expires | DATE | TIME a.m. p.m.

Note: Emergency notification on back of form.
Use as appropriate for your facility.

To order additional hot work permits or other FM Global resources, order online 24 hours a day, seven days a week, at www.fmglobalcatalog.com.

FM Global

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Required Precautions Checklist

☐ Control valves to water supply for sprinkler system are ope
☐ Hose streams and extinguishers are in service/operable.
☐ Hot work equipment in good working condition.

Requirements within 35 ft. (11 m) of hot work

☐ Flammable liquid, dust, lint and oily deposits removed.
☐ Explosive atmosphere in area eliminated.
☐ Floors swept clean.
☐ Combustible floors wet down, covered with damp sand or fire resistive sheets.
☐ Remove other combustible material where possible. Otherwise, protect with FM Approved welding pads, blanket and curtains, fire-resistive tarpaulins or metal shields.
☐ All wall and floor openings covered.
☐ FM Approved welding pads, blankets and curtains installed and around work.
☐ Protect or shut down ducts and conveyors that might carry to distant combustible material.

Hot work on walls, ceilings or roofs

☐ Construction is noncombustible and without combustible co or insulation.
☐ Combustible material on other side of walls, ceilings or roofs

Hot work on enclosed equipment

☐ Enclosed equipment cleaned of all combustible material.
☐ Containers purged of flammable liquid/vapor.
☐ Pressurized vessels, piping and equipment removed from se isolated and vented.

Fire watch/hot work area monitoring

☐ Fire watch will be provided during and for one (1) hour after including any break activity.
☐ Fire watch is supplied with suitable extinguishers, and where a charged small hose.
☐ Fire watch is trained in use of equipment and in sounding al
☐ Fire watch may be required in adjoining areas, above and be
☐ Monitor hot work area for up to an additional three (3) hours one (1) hour fire watch.

☐ Other precautions taken:

_____
_____
_____
_____

END OF SECTION

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01 35 24 – MANAGING FIRE PROTECTION SYSTEM IMPAIRMENT

PART 1 - GENERAL

1.1 IMPLEMENTATION

A. The following management procedure applies to the Contract for Construction and is a part of the Contract Documents.

1.2 MANAGING FIRE PROTECTION SYSTEM IMPAIRMENT

A. Impairment to fire protection equipment is a situation in which the system is shut off, either in whole or in part. The impairment may be necessary to conduct scheduled maintenance of equipment or to make emergency repairs. Impairment may also be due to new construction. Normal system tests and inspections are not considered impairment.

B. Regardless of the reason, impairment results in the sprinkler system and/or fire alarm system being temporarily out of service, such a condition may result in severe property loss in the event of a fire. Locations protected by automatic sprinkler systems must have an impairment handling program to control situations when sprinkler systems must be shut down.

C. Whenever a sprinkler system has been impaired all hot work in the area of the impaired system should be prohibited.

D. A periodic fire watch should be established when either the sprinkler system or the fire alarm system is out of service.

E. The State's property insurance carrier recommends an impairment handling kit. The Red Tag Permit System consists of four key elements:
   1. A Red Tag Permit
   2. Fire Protection Equipment Decals: are to be affixed to fire protection equipment as a reminder that authorization is needed before any shut down can occur.
   3. Reusable Impairment Tag for Fire Service Connections: There is space on the notification tag for the phone numbers of the Fire department, Alarm Company, and the local Water Department as well.
   4. Red Tag Permit System Wall Hanger: contains pockets to keep other elements of the system organized and within reach; also the Hanger lists steps to be taken before, during and after impairment. The Wall Hanger also lists the contact to be notified of the impairment.

F. An engineer and/or client service representative can advise you on how to proceed and follow up until protection has been restored. In addition this representative may be able to help minimize downtime, if possible, reduce fire exposure to the area, arrange for temporary protection and determine how to restore protection as quickly as possible.

G. For scheduled maintenance of fire alarm systems, vendors must, as prescribed in Rhode Island Fire Codes, notify the User Agency 48 hours in advance of pending maintenance.

H. As part of base contract, the Contractor is required to provide a licensed electrician to oversee and perform the required temporary modifications to the fire alarm system during the impairment, including bypass control during fire sprinkler work. The College will not provide personnel for this purpose.

END OF SECTION

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Managing Fire Protection System Impairment 1

RHODE ISLAND COLLEGE

OFFICE OF CAPITAL PROJECTS | 600 MOUNT PLEASANT AVE, PHYSICAL PLANT, PROVIDENCE, RI 02908

FIRE SPRINKLER AND ALARM SYSTEM IMPAIRMENT NOTIFICATION FORM

To: RIC Office of Capital Projects

Date: _____

Start of Planned Impairment: _____

End of Planned Impairment: _____

Building occupied during impairment: Yes:____ No:___ Any hot work to be performed: Yes:___ No:___

Description of Work to be performed:

_____
_____
_____
_____
_____
_____
_____
_____

RIC Trade & Fire Alarm Safety Manager, David Benevides, can also be directly contacted at 401-456-4747.

Contractor supervisory personnel shall remain in the building for the entire duration of the impairment.

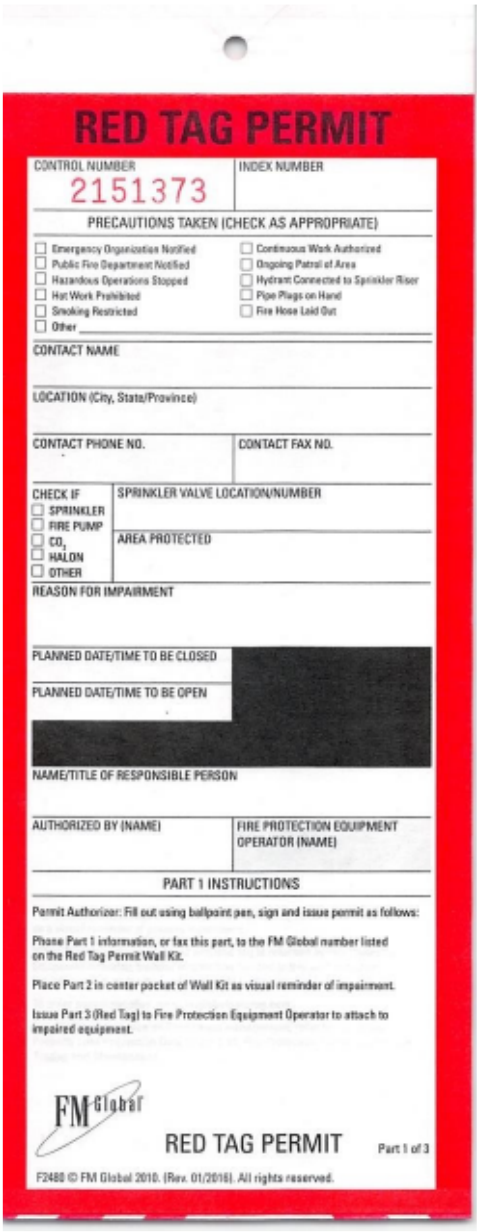
Name: _____
_____
_____

Company:

Phone:

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Fire Sprinkler and Alarm System Impairment Notification Form 1



RED TAG PERMIT

CONTROL NUMBER 2151373

INDEX NUMBER

PRECAUTIONS TAKEN (CHECK AS APPROPRIATE)

- ☐ Emergency Organization Notified
- ☐ Public Fire Department Notified
- ☐ Hazardous Operations Stopped
- ☐ Hot Work Prohibited
- ☐ Smoking Restricted
- ☐ Other
- ☐ Continuous Work Authorized
- ☐ Ongoing Patrol of Area
- ☐ Hydrant Connected to Sprinkler Riser
- ☐ Pipe Plugs on Hand
- ☐ Fire Hose Laid Out

CONTACT NAME

LOCATION (City, State/Province)

CONTACT PHONE NO.

CONTACT FAX NO.

CHECK IF
- ☐ SPRINKLER
- ☐ FIRE PUMP
- ☐ CO_2
- ☐ HALON
- ☐ OTHER

SPRINKLER VALVE LOCATION/NUMBER

AREA PROTECTED

REASON FOR IMPAIRMENT

PLANNED DATE/TIME TO BE CLOSED

PLANNED DATE/TIME TO BE OPEN

NAME/TITLE OF RESPONSIBLE PERSON

AUTHORIZED BY (NAME)

FIRE PROTECTION EQUIPMENT OPERATOR (NAME)

PART 1 INSTRUCTIONS

Permit Authorizer: Fill out using ballpoint pen, sign and issue permit as follows:

Phone Part 1 information, or fax this part, to the FM Global number listed on the Red Tag Permit Wall Kit.

Place Part 2 in center pocket of Wall Kit as visual reminder of impairment.

Issue Part 3 (Red Tag) to Fire Protection Equipment Operator to attach to impaired equipment.

FM Global

RED TAG PERMIT Part 1 of 3

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END OF ATTACHMENT

Fire Sprinkler and Alarm System Impairment Notification Form 2

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01 50 00 – TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Temporary Utilities:
   1. Temporary electricity.
   2. Temporary lighting for construction purposes.
   3. Temporary heating.
   4. Temporary ventilation.
   5. Telephone service.
   6. Temporary water service.
   7. Temporary sanitary facilities.

B. Construction Facilities:
   1. Field offices and sheds.
   2. Hoisting.
   3. Parking/Traffic.
   4. Project identification.
   5. Traffic regulation.
   6. Independent Food Vendors

C. Temporary Controls:
   1. Barriers.
   2. Enclosures and fencing.
   3. Security.
   4. Fire detection.
   5. Water control.
   6. Dust control.
   7. Erosion and sediment control.
   8. Noise control.
   9. Pest and rodent control.
   10. Pollution control.

D. Removal of utilities, facilities, and controls with reseeding and repair of grounds.

1.2 TEMPORARY ELECTRICITY

A. The User Agency will pay the cost of energy used. Exercise measures to conserve energy. Utilize the User Agency's existing power service.

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B. Complement the existing power service capacity and characteristics as required for construction operations.

C. Provide power outlets, with branch wiring and distribution boxes located at each floor or as required for construction operations. Provide flexible power cords as required for portable construction tools and equipment. All flexible power cords shall be suspended with hangers to eliminate trip hazards.

D. Provide main service disconnect and over-current protection at a convenient location or a feeder switch at the source distribution equipment or meter.

E. Permanent convenience receptacles may not be utilized during construction.

F. Provide distribution equipment, wiring, and outlets to provide single-phase branch circuits for power. Provide 20-ampere duplex outlets, single-phase circuits for power tools.

1.3 TEMPORARY LIGHTING FOR CONSTRUCTION PURPOSES

A. Provide and maintain incandescent lighting for construction (interior & exterior) operations to achieve a minimum lighting level of 2 watt/sq. ft. (21 watt/sq m).

B. Provide branch wiring from power source to distribution boxes with lighting conductors, pigtails, and lamps as required.

C. Maintain lighting and provide routine repairs.

D. Permanent building lighting may be utilized during construction where not removed.

1.4 TEMPORARY HEATING

A. Existing facilities will be occupied and heated by the College when temperatures require. Take care to avoid leaving doors open in exterior walls that could compromise heating operations. For new construction, the cost of energy will be borne by the Contractor. Provide temporary heating as necessary for construction operations.

B. Supplement with temporary heat devices if needed to maintain the specified conditions for construction operations even in existing buildings.

C. Maintain a minimum ambient temperature of 50 degrees F in the areas where construction is in progress, unless indicated otherwise in the product Sections.

D. In areas of work with mechanical hot-air heating, clean units and replace filters after Substantial Completion.

E. Do not use new equipment for heating after replacement during construction.

F. Provide temporary heating to occupied spaces if construction activities impact normal function of existing systems to occupied spaces. Submit an implementation plan for review and approval by RIC.

1.5 TEMPORARY VENTILATION

A. Ventilate the enclosed areas to achieve a curing of materials, to dissipate humidity, and to prevent the accumulation of dust, fumes, vapors, or gases.

B. If existing ventilation fans are used during construction, clean fans in areas of work after Substantial Completion.

C. Provide temporary ventilation to occupied spaces if construction activities impact normal function of existing systems to occupied spaces. Submit an implementation plan for review and approval by RIC.

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1.6 TELEPHONE SERVICE

A. Provide, maintain, and pay for cell phone service to the field supervisor at the time of project mobilization.

1.7 TEMPORARY WATER SERVICE

A. The User Agency will pay the cost of temporary water. Exercise measures to conserve energy. Utilize the User Agency's existing water system, extend and supplement with temporary devices as needed to maintain the specified conditions for construction operations.

B. Extend branch piping with outlets located so that water is available by hoses with threaded connections. Provide temporary pipe insulation if needed to prevent freezing.

1.8 TEMPORARY SANITARY FACILITIES

A. Contractor needs to provide and maintain temporary toilet facilities for use by all construction personnel. Trades people will not be permitted to use existing facilities within the building.

1.9 FIELD OFFICES AND SHEDS

A. Do not use existing facilities for storage. Job meetings will be held on campus at a location to be chosen by the College.

B. Storage Areas and Sheds: Size to the storage requirements for the products of the individual Sections, allowing for access and orderly provision for the maintenance and for the inspection of Products to the requirements of Section 01 60 00. Containers will be permitted within the project limit line.

C. Preparation: Fill and grade the sites for the temporary structures to provide drainage away from the buildings.

D. Removal: At the completion of the Work remove the buildings, foundations, utility services, and debris. Restore the areas.

1.10 HOISTING

A. Contractor is responsible for all hoisting required to facilitate, serve, stock, clean, and complete the Work. Include all costs for Operating Engineers, fuel, delivery and removal, mobilization, staging, protection of grades and surfaces, and equipment.

1.11 PARKING/TRAFFIC

A. Workers must park in lots assigned by the College with daily permits. See Site Utilization Plan.

B. Use of designated existing on-site streets and driveways for construction traffic is permitted. Tracked vehicles are not allowed on paved areas.

C. Do not allow heavy vehicles or construction equipment in parking areas.

D. Do not allow vehicle parking on existing sidewalks.

E. Provide and maintain access to fire hydrants and control valves free of obstructions.

F. Remove mud from construction vehicle wheels before entering streets. Cleanup dirt, rocks, and debris left on street from construction vehicles.

G. Use designated existing on-site roads for construction traffic.

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H. Maintenance:

1. Maintain the traffic and parking areas in a sound condition free of excavated material, construction equipment, products, mud, snow, and ice.
2. Maintain existing and permanent paved areas used for construction; promptly repair breaks, potholes, low areas, standing water, and other deficiencies, to maintain the paving and drainage in original, or specified, condition.
3. Plywood and other protections shall be provided when construction equipment is driven over concrete.

I. Removal, Repair:

1. Remove temporary materials and at Substantial Completion.
2. Remove underground work and compacted materials to a depth of 2 feet; fill and grade the site as specified.
3. Repair existing and permanent facilities damaged by use, to the original or specified condition.

1.12 INDEPENDENT FOOD VENDORS

A. Independent or contracted food vendor trucks are prohibited on Rhode Island College's campus. Contractors are permitted to use college dining facilities (Donovan Dining, Café in Student Union, and The Galley Cafe in Building 3).

1.13 PROJECT IDENTIFICATION (IF REQUIRED)

A. Project Identification Sign: One painted or printed sign, 32 sq ft area, bottom 6 feet above the ground.

1. Contents:
   a. Project title, and name of the User Agency as indicated on the Contract Documents.
   b. Names and titles of the authorities.
   c. Names and titles of the Design Agent and Consultants.
   d. Name of the Design Agent Contractor.
2. Graphic Design, Colors, and Style of Lettering: 3 colors, as designated by the Design Agent during construction.

B. Project Informational Signs:

1. Painted or printed informational signs of same colors and lettering as the Project Identification sign, or standard products; size lettering to provide legibility at 100-foot distance.
2. Provide sign at each field office, storage shed, and directional signs to direct traffic into and within site. Relocate as the Work progress requires.
3. No other signs are allowed without the User Agency's permission except those required by law.

C. Design all signs and their structures to withstand a 60-miles/hr-wind velocity.

D. Sign Painter or Printer: Experienced as a professional sign painter for a minimum of three years.

E. Finishes, Painting or Printing: Adequate to withstand weathering, fading, and chipping for the duration of construction.

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F. Show content, layout, lettering, color, foundation, structure, sizes, and grades of members.

G. Installation:

1. Install the project identification sign within 15 days after the date of receipt of the Purchase Order from State of Rhode Island Department of Administration, Division of Purchases.

2. Erect at the designated location.

3. Erect the supports and framing on a secure foundation, rigidly braced and framed to resist wind loadings.

4. Install the sign surface plumb and level, with butt joints. Anchor securely.

5. Paint exposed surfaces of the sign, supports, and framing.

H. Maintenance: Maintain the signs and supports clean, repair deterioration and damage.

I. Removal: Remove the signs, framing, supports, and foundations at the completion of the Project and restore the area.

1.14 TRAFFIC REGULATION

A. Signs, Signals, And Devices:

a. Post Mounted and Wall Mounted Traffic Control and Informational Signs: As approved by local jurisdictions.

b. Traffic Cones and Drums, Flares and Lights: As approved by local jurisdictions.

c. Flag person Equipment: As required by local jurisdictions.

d. Police Details: Provide all police details as required by local jurisdictions, including payment directly to applicable jurisdiction.

e. On Campus Police Details: The User Agency shall provide and over costs for details provided by RIC Campus Police. If RIC is unable to provide, contractor shall provide flaggers and will be compensated for the flagger’s hours.

B. Flag Persons: Provide trained and equipped flag persons to regulate the traffic when construction operations or traffic encroach on the public traffic lanes.

C. Flares and Lights: Use flares and lights during the hours of low visibility to delineate the traffic lanes and to guide traffic.

D. Haul Routes:

1. Consult with the authority having jurisdiction, establish the public thoroughfares to be used for haul routes and site access.

E. Traffic Signs and Signals:

1. At approaches to the site and on site, install at crossroads, detours, parking areas, and elsewhere as needed to direct the construction and affected public traffic.

2. Install and operate automatic traffic control signals to direct and maintain the orderly flow of traffic in areas under the Contractor's control, and areas affected by the Contractor's operations.

3. Relocate as the Work progresses, to maintain effective traffic control.

F. Removal:

1. Remove equipment and devices when no longer required.

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2. Repair damage caused by installation.
3. Remove post settings to a depth of 2 feet.

1.15 BARRIERS

A. Provide barriers to allow for the User Agency's use of the site and to protect existing facilities and adjacent properties from damage from the construction operations, or demolition.

B. Provide barricades and covered walkways required by RIC for public rights- of-way, or for public access to the building.

C. Provide protection for plants designated to remain. Replace damaged plants.

D. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

1.16 ENCLOSURES AND FENCING

A. Exterior: Contractor shall provide 6-ft. high commercial grade chain link fence that is properly secured and maintained around the building and/or site in order to protect the public and the work. Include in the Site Plan the location of the fence and pedestrian and vehicular gates for User Agency review. Access shall be available to all egress doors as designated by the User Agency. Provide visual screening on fence using fabric approved by the User Agency. Equip with vehicular and pedestrian gates with locks. Provide one set of keys to all gates and door locks to the User Agency.

B. Perform adjustment to the proposed layout as may be directed by the User Agency.

C. Contractor to provide overhead cover protection at all entrances and egresses from the building. Entrances and paths of egress must be clearly marked with signage with placement and language approved in advance by the User Agency.

D. Staging of equipment, dumpsters and materials must be situated within the project fenced-in areas.

E. Interior Enclosures:
1. Provide temporary partitions and ceilings as indicated to separate the work areas from User Agency-occupied areas, to prevent penetration of dust and moisture into User Agency-occupied areas, and to prevent damage to the existing materials and equipment.
2. Construction: Framing and reinforced polyethylene, plywood, or gypsum board sheet materials with closed joints and sealed edges at intersections with existing surfaces, as agreed with the User Agency: Maximum flame spread rating of 75 in accordance with ASTM E84.

1.17 SECURITY

A. Security Program:
1. Protect the Work, the existing premises, or the User Agency's operations from theft, vandalism, and unauthorized entry.
2. Initiate the program in coordination with the User Agency's existing security system at mobilization.
3. Maintain the program throughout the construction period until User Agency occupancy of each designated area.

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B. Entry Control: Coordinate the access of the User Agency's personnel to the site in coordination with the User Agency's security forces. The Contractor is responsible for providing adequate locks for the site and furnish the requested quantities of keys to the User Agency.

1.18 FIRE DETECTION

A. Before beginning any construction operation that can potentially trigger the existing fire alarm detection system, notify the User Agency through use of the form provided in Section 01 10 00.

B. Failure to notify the User Agency will subject the Contractor to a monetary fine for each occurrence, should the fire detection system be activated inadvertently by a construction activity.

C. Comply with the User Agency’s insurance underwriting standards and insurer recommendations for Hot Work, sprinkler impairment, and site maintenance.

1.19 WATER CONTROL

A. Grade the site to drain. Maintain excavations free of water. Provide, operate, and maintain the pumping equipment.

B. Protect the site from puddling or running water. Provide water barriers as required to protect the site from soil erosion.

1.20 DUST CONTROL

A. Execute the Work by methods to minimize raising dust from construction operations.

B. Provide positive means to prevent air-borne dust from dispersing into the atmosphere.

1.21 EROSION AND SEDIMENT CONTROL

A. Plan and execute construction by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas. Prevent erosion and sedimentation.

B. Minimize the amount of bare soil exposed at one time.

C. Provide temporary measures such as berms, dikes, and drains, to prevent water flow.

D. Construct fill and waste areas by selective placement to avoid erosive surface silts or clays.

E. Periodically inspect the earthwork to detect evidence of erosion and sedimentation; promptly apply corrective measures.

F. Follow Rhode Island DEM Soil Stabilization Requirements, including, but not limited to:

1. Stabilizations of disturbed areas must, at a minimum, be initiated immediately whenever any clearing, grading, excavating or other earth disturbance activities have permanently ceased on any portion of the site, or temporarily ceased on any portion of the site and will not resume for a period exceeding fourteen (14) calendar days.

2. Stabilization must be completed using vegetative stabilization measures or using alternative measures whenever vegetative measures are deemed impracticable or during periods of drought.

3. All disturbed soils exposed prior to October 15th shall be seeded by that date.

4. Any such areas which do not have adequate vegetative stabilization by November 15th must be stabilized through the use of non-vegetative erosion control measures.

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5. If work continues within any stabilized areas during the period from October 15th through April 15th, care must be taken to ensure that only the area required for that day's work is exposed, and all erodible soil must be stabilized within five (5) working days.

1.22 CLEANING

A. Refer to Section 01 74 13 – Cleaning. Contractor to maintain a neat and orderly work site. Trash shall be cleaned from site and surrounding area on a daily basis.

B. For projects within occupied buildings, contractor shall sweep and wet mop all floors on a daily basis for impacted spaces. Surfaces of desks, tables, etc. shall be covered during construction and cleaned of dust and debris.

1.23 NOISE CONTROL

A. Provide methods, means, and facilities to minimize noise produced by the construction operations.

1.24 PEST AND RODENT CONTROL

A. Provide methods, means, and facilities to prevent pests, insects and rodents from damaging the Work, or accessing or invading the facility.

1.25 POLLUTION CONTROL

A. Provide methods, means, and facilities to prevent the contamination of soil, water, and the atmosphere from discharge of noxious, toxic substances, and pollutants produced by the construction operations.

1.26 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

A. Remove temporary utilities, equipment, facilities, and materials, prior to Substantial Completion.

B. Remove the underground installations to a minimum depth of 2 feet. Grade the site as indicated.

C. Clean and repair the damage caused by installation or use of temporary work.

D. Restore the existing and new facilities used during construction to their original condition.

E. Restore any temporary exterior laydown or storage areas to the original condition. After each use, regrade and reseed as required to meet this requirement.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

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01 60 00 – PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Products.

B. Product delivery requirements.

C. Product storage and handling requirements.

D. Product options.

E. Product substitution procedures.

1.2 PRODUCTS

A. Products: Means new material, machinery, components, fixtures, or systems forming the Work; but does not include the machinery or equipment used for the preparation, fabrication, conveying, or erection of the Work. Products may include the existing materials or components required or specified for reuse.

B. Furnish products of qualified manufacturers suitable for the intended use. Furnish products of each type by a single manufacturer unless specified otherwise.

C. Do not use materials and equipment removed from the existing premises, except as specifically permitted by the Contract Documents.

D. Furnish interchangeable components of the same manufacturer for the components being replaced.

1.3 PRODUCT DELIVERY REQUIREMENTS

A. Transport and handle products in accordance with the manufacturer's instructions.

B. Promptly inspect shipments to ensure that the products comply with the requirements, the quantities are correct, and the products are undamaged.

C. Provide equipment and personnel to handle the products by methods to prevent soiling, disfigurement, or damage.

1.4 PRODUCT STORAGE AND HANDLING REQUIREMENTS

A. Store and protect the products in accordance with the manufacturers' instructions.

B. Store with seals and labels intact and legible.

C. Store sensitive products in weather tight, climate controlled, enclosures in an environment favorable to the product.

D. For exterior storage of fabricated products, place on sloped supports above the ground.

E. Provide bonded off-site storage and protection when the site does not permit on-site storage or protection.

F. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent the condensation and degradation of products.

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G. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.

H. Provide equipment and personnel to store the products by methods to prevent soiling, disfigurement, or damage.

I. Arrange storage of the products to permit access for inspection. Periodically inspect to verify that the products are undamaged and are maintained in acceptable condition.

1.5 PRODUCT OPTIONS

A. Products Specified by Reference Standards or by Description Only: Any Product meeting those standards or description.

B. Products Specified by Naming One or More Manufacturers: Products of one of the manufacturers named and meeting the specifications, no options or substitutions allowed.

C. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named in accordance with the following article.

1.6 PRODUCT SUBSTITUTION PROCEDURES

A. Instructions to Bidders specify the time restrictions for submitting requests for Substitutions during the bidding period to requirements specified in this section.

B. Substitutions may be considered after the bid only in the following circumstances:

1. When a product becomes no longer in production following the date of receipt of the Purchase Order for this Contract. Submit certification both that specified product was carried in Bid, and is no longer obtainable. Provide cost change documentation.

2. There is a significant cost savings offered to the User Agency. Provide price comparison of both bid and offered substitution products as well as all collateral costs of the change.

3. Code changes or site conditions require a different item from that bid. Submit as for 2 above.

C. Document each request with complete data substantiating the compliance of a proposed Substitution with the Contract Documents.

D. A request constitutes a representation that the Bidder:

1. Has investigated the proposed Product and determined that it meets or exceeds the quality level of the specified product.

2. Will provide the same warranty for the Substitution as for the specified Product.

3. Will coordinate the installation and make changes to other Work which may be required for the Work to be complete with no additional cost to the User Agency, including redesign.

4. Waives claims for additional costs or time extension which may subsequently become apparent.

5. Will reimburse the User Agency and the Design Agent for review or redesign services, including those associated with re-approval by the authorities having jurisdiction.

E. Substitutions will not be considered when they are indicated or implied on the Shop Drawing or Product Data submittals, without a separate written request, or when acceptance will require revision to the Contract Documents.

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F. Substitution Submittal Procedure, If Permitted Following Contract Award:

1. Submit three copies of a request for Substitution for consideration, no later than 20 working days following date of receipt of the Purchase Order for this Contract. Limit each request to one proposed Substitution. Identify product of fabrication or installation method to be replaced. Include Specification Section number and title and Drawing number and title.

2. Submit the Shop Drawings, Product Data, and the certified test results attesting to the proposed product equivalence. The burden of proof is on the proposer.

3. The Design Agent will notify the Contractor in writing of a decision to accept or reject the request. Costs for review time on unsuccessful requests will be included in the next change order.

PART 2 - PRODUCTS

A. “No variations in this section for this Project.”

PART 3 - EXECUTION (NOT USED)

END OF SECTION

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01 71 00 – EXAMINATION, PREPARATION AND EXECUTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Examination & preparation.

B. Protection of adjacent construction.

C. Protecting installed construction.

D. Materials used in cutting and patching.

E. Preparation of cutting and patching.

F. Special procedures.

G. Selective demolition.

H. Cutting and patching.

1.2 EXAMINATION & PREPARATION

A. Acceptance of Conditions:
   1. Verify that existing applicable site conditions, substrates, or substrate surfaces are acceptable or meet specific requirements of individual specifications Sections, for subsequent Work to proceed.
   2. Verify that existing substrate is capable of structural support or attachment of new Work being applied or attached.
   3. Examine and verify specific conditions described in individual specifications Sections.
   4. Verify that utility services are available, of correct characteristics, and in correct locations.
   5. Beginning of new Work, which relies upon the quality and proper execution of Work of a preceding trade, means acceptance of that preceding Work as appropriate for the proper execution of subsequent Work.
   6. Acceptance of preceding Work that can be shown later to have adversely affected proper performance of new Work may result in removal and repeat performance of all Work involved at no cost to the User Agency.

B. Clean substrate surfaces prior to applying next material or substance.

C. Seal cracks or openings of substrate prior to applying next material or substance.

D. Apply substrate primer, sealer, or conditioner, required or recommended by manufacturer, prior to applying any new material or substance in contact or bond.

E. Prior to the application, installation, or erection of any products and product components, perform any other preparatory operations, or surface or substrate modifications, as may be specified or directed by product manufacturers.

1.3 PROTECTION OF ADJACENT CONSTRUCTION

A. Protect existing adjacent properties and provide special protection where specified in individual Specification Sections.

B. Provide protective coverings at wall, projections, jambs, sills, and soffits of existing openings.

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C. Protect existing finished floors, stairs, and other existing surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.

D. Cover and protect furnishings, materials and equipment within the spaces receiving new work. Move items as necessary to install new work and return them to original locations at the close of construction in that area.

E. Repair adjacent properties damaged by construction operations to original condition to the satisfaction of the User Agency.

F. Prohibit unnecessary traffic from existing landscaped areas.

1.4 PROTECTING INSTALLED CONSTRUCTION

A. Protect installed Work and provide special protection where specified in individual specification sections.

1. IT wires shall not be painted. IT wires, faceplates, racks and other components shall be fully protected during painting activities. IT wires which have been painted or exposed to paint splatter shall be replaced and terminated at no cost to the User Agency upon request.

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. Repair or replace installed Work damaged by construction operations, as directed by the Design Agent.

PART 2 - PRODUCTS

2.1 MATERIALS USED IN CUTTING AND PATCHING

A. Unless otherwise indicated, the Contractor shall provide materials for cutting and patching which will result in an equal-or-better product than the material being cut and patched, in terms of performance characteristics and including visual effects where applicable. The Contractor shall use material identical with the original materials where feasible.

B. Match existing materials unless otherwise specified.

C. Restore Work with new Products in accordance with requirements of Contract Documents.

D. Materials shall comply with the requirements of the Technical Specifications found in individual Sections; match existing with new products, or salvaged products as appropriate, for patching and extending work.

E. Provide submittals for approval to the Design Agent and User Agency.

PART 3 - EXECUTION

3.1 PREPARATION

A. The Contractor shall provide adequate temporary support for Work to be cut to prevent failure

B. The Contractor shall provide adequate protection of other Work during cutting and patching.

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C. 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.

D. Identify any hazardous substance or conditions exposed during the Work to the User Agency and Design Agent for decision or remedy.

E. By careful study of the Contract Documents, determine the location and extent of selective demolition and repairs to be performed.

3.2 SPECIAL PROCEDURES

A. The Contractor shall use methods least likely to damage Work to be retained and Work adjoining. Provide proper surfaces to receive patching and finishing.

B. Where physical cutting action is required, the Contractor shall cut Work with sawing and grinding tools, not with hammering and chopping tools. Openings through concrete Work shall be core-drilled or using a masonry saw.

C. Remove ceiling tiles as necessary to access areas of work. Store and replace carefully to avoid damage. Replace all ceiling tiles damaged during the work with new tiles to match. Repair ACT grid damaged during the work in accordance with this section.

D. Fit Work tight to pipes, sleeves, ducts, conduits, and other penetrations through surfaces.

E. Maintain integrity of wall, ceiling, or floor construction; completely seal voids.

F. At penetration of fire rated partitions, ceiling, or floor construction, completely seal voids with fire rated or fire resistant material in accordance with Specifications, to full thickness of the penetrated element.

G. All demolition work shall be carried on in such a manner that the existing building and site and their component parts will not be damaged. Any damage to the building shall be corrected by the Contractor, to the satisfaction of the User Agency and Architect, at no additional cost to the User Agency.

H. Close openings in exterior surfaces to protect existing Work from weather and extremes of temperature and humidity.

I. Use means necessary to prevent dust becoming a nuisance to the public, to neighbors, and to other work being performed on or near the site.

3.3 SELECTIVE DEMOLITION

A. Carefully demolish and remove from the building and site those items specified to be demolished and removed.

B. Remove, cut, modify and patch as necessary to conduct Work in a manner to minimize damage and to provide means of restoring products and finishes to original or specified condition. Replace and restore at completion.

C. Prepare and follow an organized plan for demolition and removal of items:

1. Shut off, cap, and otherwise protect existing utility lines.

2. Completely remove items scheduled to be so demolished and removed, leaving surfaces clean, solid, and ready to receive new materials specified elsewhere.

D. Remove unsuitable material not marked for salvage, such as rotted wood, corroded metals, and deteriorated masonry and concrete. Replace materials as specified for finished Work.

E. Remove debris and abandoned items from area and from concealed spaces.

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F. The Contractor shall be responsible for the removal and disposal of all materials and equipment from the site and building during the project. Unless directed otherwise by the User Agency, all demolition materials to be removed from the site shall be disposed of in accordance with applicable laws and regulations. **User Agency shall have first right of refusal of any and all materials and equipment scheduled for removal.**

G. In the event of demolition of items not so scheduled to be demolished, promptly replace such items to the approval of the Architect and at no additional cost to the User Agency.

3.4 CUTTING AND PATCHING

A. Provide patching and repairs to all surfaces as indicated and as required for a complete and proper job, including all surfaces damaged as a result of the work of this Contract. Patch or replace portions of existing surfaces which are damaged, or shows imperfections not acceptable to the Design Agent or User Agency.

B. Employ skilled and experienced installers to perform cutting and patching.

C. Submit written request in advance of cutting or altering elements which affect:
   1. Structural integrity of element.
   2. Integrity of weather-exposed or moisture-resistant elements.
   3. Efficiency, maintenance, or safety of element.
   4. Visual qualities of sight-exposed elements.
   5. Existing construction, or Work of separate contractor.

D. Execute cutting, fitting, and patching including excavation and fill, to complete Work, and to:
   1. Fit the several parts together, to integrate with other Work.
   2. Uncover Work to install or correct ill-timed Work.
   3. Remove and replace defective and non-conforming Work.
   4. Remove samples of installed Work for testing.
   5. Provide openings in elements of Work for penetrations of mechanical and electrical Work.

E. Execute Work by methods that will avoid damage to other Work, and provide proper surfaces to receive patching and finishing.

F. Cut masonry, concrete, and other rigid materials using masonry saw or core drill.

G. Remove ceiling tiles as necessary to access areas of work. Store and replace carefully to avoid damage. Replace all ceiling tiles damaged during the work with new tiles to match. Repair ACT grid damaged during the work in accordance with this section.

H. Restore Work with new Products in accordance with requirements of Contract Documents.

I. Fit Work tight to pipes, sleeves, ducts, conduits, and other penetrations through surfaces.

J. Maintain integrity of wall, ceiling, or floor construction; completely seal voids.

K. At penetration of fire rated partitions, ceiling, or floor construction, completely seal voids with fire rated or fire resistant material in accordance with Specifications, to full thickness of the penetrated element.

L. Refinish surfaces to match adjacent finishes. For continuous surfaces, refinish to nearest intersection; for an assembly, refinish entire unit. Ensure a neat transition to adjacent finishes

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M. Identify any hazardous substance or conditions exposed during the Work to the Owner and Design Agent for decision or remedy.

N. Prepare surface and remove surface finishes to provide installation of new Work and finishes.

O. Trim existing doors as necessary to clear new floor finish. Refinish trim as required.

P. When completed, patches or repairs shall not be visible to the naked eye from a distance of 6 feet.

Q. Exterior Patching

1. Any damage to buildings, roads, public roads, bituminous concrete areas, fences, lawn areas, trees, shrubbery, poles, underground utilities, etc. shall be made good by and at the Contractor's own expense, all to the satisfaction of the User Agency.

2. The Contractor shall patch, repair and/or replace all adjacent materials and surfaces damaged after the installation of new work at no expense to the User Agency. All repair and replacement work shall match the existing in kind and appearance.

3. Restore grassed landscaped areas damaged by construction operations to full healthy growth, by installing loam and sod to the requirements, and under the supervision of the user agency.

R. See General Conditions for additional requirements.

END OF SECTION

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SECTION 01 73 00 - EXECUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:

1. Construction layout.
2. Installation of the Work.
3. Cutting and patching.
4. Coordination of Owner-installed products.
5. Progress cleaning.
6. Starting and adjusting.
7. Protection of installed construction.
8. Correction of the Work.

B. Related Requirements:

1. Division 01 Section "Submittal Procedures" for submitting surveys.
2. Division 01 Section "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.

1.3 DEFINITIONS

A. Cutting: Removal of in-place construction necessary to permit installation or performance of other work.

B. Patching: Fitting and repair work required to restore construction to original conditions after installation of other work.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For land surveyor and/or professional engineer.

B. Certificates: Submit certificate signed by land surveyor and/or professional engineer certifying that location and elevation of improvements comply with requirements.

C. Cutting and Patching Plan: Submit plan describing procedures at least 10 days prior to the time cutting and patching will be performed. Include the following information:

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1. Extent: Describe reason for and extent of each occurrence of cutting and patching.
2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building appearance and other significant visual elements.
3. Products: List products to be used for patching and firms or entities that will perform patching work.
4. Dates: Indicate when cutting and patching will be performed.
5. Utilities and Mechanical and Electrical Systems: List services and systems that cutting and patching procedures will disturb or affect. List services and systems that will be relocated and those that will be temporarily out of service. Indicate length of time permanent services and systems will be disrupted.

    a. Include description of provisions for temporary services and systems during interruption of permanent services and systems.

D. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.

E. Certified Surveys: Submit two copies signed by land surveyor and/ or professional engineer.

F. Final Property Survey: Submit two copies showing the Work performed and record survey data.

1.5 QUALITY ASSURANCE

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

B. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.

1. Structural Elements: When cutting and patching structural elements, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.

2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Operational elements include the following:

    a. Primary operational systems and equipment.
    b. Fire separation assemblies.
    c. Air or smoke barriers.
    d. Fire-detection and -alarm systems.

3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Other construction elements include but are not limited to the following:

    a. Water, moisture, or vapor barriers.
    b. Membranes and flashings.

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c. Exterior curtain-wall construction.
d. Sprayed fire-resistive material.
e. Equipment supports.
f. Piping, ductwork, vessels, and equipment.
g. Noise- and vibration-control elements and systems.

4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

C. Cutting and Patching Conference: Before proceeding, meet at Project site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

D. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Comply with requirements specified in other Sections.

1. For projects requiring compliance with sustainable design and construction practices and procedures, use products for patching that comply with requirements in Division 01 sustainable design requirements Section.

B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services, and other utilities.

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2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:

1. Description of the Work.
2. List of detrimental conditions, including substrates.
3. List of unacceptable installation tolerances.
4. Recommended corrections.

D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Existing Utility Information: Furnish information to Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Architect according to requirements in Division 01 Section "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.

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B. General: Engage a professional engineer to lay out the Work using accepted surveying practices.

1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
2. Establish limits on use of Project site.
3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
4. Inform installers of lines and levels to which they must comply.
5. Check the location, level and plumb, of every major element as the Work progresses.
6. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

C. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

D. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

3.4 FIELD ENGINEERING

A. Identification: Owner will identify existing benchmarks, control points, and property corners.

B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.

1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.
2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.

1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

D. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.

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E. Final Property Survey: Engage a land surveyor or professional engineer to prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by land surveyor or professional engineer, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.

1. Show boundary lines, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.
2. Recording: At Substantial Completion, have the final property survey recorded by or with authorities having jurisdiction as the official "property survey."

3.5 INSTALLATION

A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb and make horizontal work level.
2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.

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

E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.

F. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.

G. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
2. Allow for building movement, including thermal expansion and contraction.
3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

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I. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.

J. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.6 CUTTING AND PATCHING

A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.

C. Temporary Support: Provide temporary support of work to be cut.

D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

E. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to prevent interruption to occupied areas.

F. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
4. Excavating and Backfilling: Comply with requirements in applicable Division 31 Sections where required by cutting and patching operations.
5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
6. Proceed with patching after construction operations requiring cutting are complete.

G. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.

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2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.

    a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
    b. Restore damaged pipe covering to its original condition.

3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

    a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.

4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.

5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.

H. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.7 OWNER-INSTALLED PRODUCTS

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

B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel.

1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
2. Preinstallation Conferences: Include Owner's construction personnel at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction personnel if portions of the Work depend on Owner's construction.

3.8 PROGRESS CLEANING

A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.

1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F (27 deg C).

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3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

   a. Use containers intended for holding waste materials of type to be stored.

4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.

1. Remove liquid spills promptly.
2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Division 01 Section "Construction Waste Management and Disposal."

H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.9 STARTING AND ADJUSTING

A. Coordinate startup and adjusting of equipment and operating components with requirements in Division 01 Section "General Commissioning Requirements."

B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

C. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.

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D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Manufacturer's Field Service: Comply with qualification requirements in Division 01 Section "Quality Requirements."

3.10 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION 017300

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01 74 13 – CLEANING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Cleaning requirements during construction operations.

B. Final cleaning prior to turning the project over to the User Agency.

C. Scope

D. Related Documents

E. Quality

F. Contractor’s Failure to Clean

G. Cleaning Materials

H. Construction in an Occupied Building

I. Process Cleaning During Cleaning

J. Final Cleaning

1.2 SCOPE

A. This section specifies the requirements for maintaining a clean and orderly work site during and at the completion of the Work.

B. Pay special attention to work areas that affect occupied spaces and public areas.

1.3 RELATED DOCUMENTS

A. This section supplements Article 4.17 of the General Conditions.

B. Consult the individual sections of the specifications for cleaning of Work installed under those sections**.**

C. Cutting and Patching: Section 01 73 29.

D. Pest Control: Comply with pest control requirements in Section 01 50 00.

E. Construction Waste Disposal: Comply with waste disposal requirements in Section 01 74 19.

1.4 QUALITY

A. Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

B. Conduct all cleaning and disposal operations to comply with all federal, state, and local laws, regulations, codes, ordinances and by-laws.

1. Do not burn or bury rubbish and waste materials on the site.

2. Do not dispose of volatile wastes such as mineral spirits, oil, or paint thinner in storm or sanitary drains**.**

3. Do not dispose of wastes into streams or waterways.

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C. In cleaning items with manufacturer's finish or items previously finished by a Subcontractor, care shall be taken not to damage such manufacturer's or Subcontractor's finish Any damage to finishes caused by cleaning operations shall be repaired at the Contractor's expense.

1.5 CONTRACTOR'S FAILURE TO CLEAN

A. If the Contractor fails to maintain levels of cleanliness in work areas, satisfactory to the User Agency, then the User Agency shall have the right to cause such areas to be cleaned by others. The costs to the User Agency for such cleaning, plus 25% for administration, shall be the obligation of the Contractor and shall be deducted from any money due the Contractor hereunder.

PART 2 - PRODUCTS

2.1 CLEANING MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned.

B. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

PART 3 - EXECUTION

3.1 CONSTRUCTION IN AN OCCUPIED BUILDING

A. Efforts must be taken to limit dust, noise and odors from escaping the work area. Proper separation and protection of interior spaces shall be established and maintained during the project, to the satisfaction of the User Agency. Contractor shall provide and maintain walk-off mats and plastic barriers at work site entries.

B. Contractor shall provide appropriate masking of building supply air intakes to protect indoor air quality and limit transfer of odors. Contractor to provide air scrubbing and/or negative air machines to prevent odors from escaping the Project Site.

C. Do not leave debris, tools or materials in occupied areas.

D. Immediately following the completion of Work in an occupied area, Contractor shall pick up and stow all equipment and miscellaneous material leaving the site in a neat and safe condition.

1. Occupied spaces must be returned to original conditions to the greatest extent possible by 8am weekdays. If it is not feasible to do as such, notify the User Agency immediately. With approval, the area shall be cordoned off with cones and caution tape and computer generated signage shall be posted to the satisfaction of the User Agency.

E. Contractor shall ensure that horizontal and vertical surfaces in the occupied areas in the building impacted by construction activities are thoroughly vacuumed, wet mopped and cleaned to the satisfaction of the User Agency at the end of each shift, or upon request.

3.2 PROGRESS CLEANING DURING CONSTRUCTION

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A. Maintain areas under Contractor's control (including employee parking and Contractor's staging areas) free of waste materials, scraps, surplus material, debris and rubbish. Maintain site in a clean and orderly condition.

B. Clean interior areas daily to provide suitable conditions for Work and to prevent fire or accidents. Sufficient time to clean up work zones shall be allocated at the end of the shift.

C. All combustible waste materials shall be removed from buildings at the end of each working day.

D. Wet down dry materials and rubbish to lay dust and prevent blowing dust.

E. Vacuum clean interior building areas when ready to receive finish painting, and continue vacuum cleaning on an as-needed basis until Substantial Completion.

F. Waste Management

1. Collect and remove waste materials, debris, and rubbish from the site daily, as necessary to prevent an on-site accumulation of waste material, debris, and rubbish, and dispose off-site.

2. Remove debris and rubbish from pipe chases, plenums attics, crawl spaces and other closed or remote spaces, prior to closing the space.

3. Maintain the Site free from accumulations of waste, debris, and rubbish.

4. Do not allow materials and rubbish to drop free or be thrown from upper floors, but remove by use of a material hoist or rubbish chutes.

5. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

6. Provide on-site containers for collection of waste materials and rubbish.

G. Schedule cleaning operations so that dust and other contaminants resulting from cleaning process will not fall on wet, newly painted surfaces.

H. Broom clean interior areas prior to start of surface finishing and continue cleaning on a daily basis.

I. Control cleaning operations so that dust and other particulates will not adhere to wet or newly-coated surfaces. Responsibility for construction cleaning shall not be delegated to subcontractors performing construction work under this Contract.

J. Clean as required to ensure proper and lasting installation of equipment and finishes.

3.3 FINAL CLEANING

A. Unless otherwise specified under other sections of the Specifications, the Contractor shall perform final cleaning operations as herein specified prior to final inspection.

B. Cleaning shall include all surfaces, interior and exterior, which the Contractor has had access to, whether new or existing.

C. Remove grease, mastic, adhesive, dust, dirt, stains, labels, fingerprints, and other foreign materials from sight-exposed interior and exterior surfaces. This includes cleaning of the Work of all finishing trades where needed, whether or not cleaning by such trades is included in their respective specifications. Remove labels that are not permanent.

D. Repair, patch, and touch up marred surfaces to the specified finish, to match adjacent surfaces.

E. Polish glossy surfaces to a clear shine.

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F. Site & Exteriors

1. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
2. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
3. Rake grounds that are not planted, mulched, or paved to a smooth, even-textured surface.
4. Remove all cigarette buds and other litter.

G. Remove excess materials

1. Remove tools, construction equipment, machinery, and surplus material from Project site.
2. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
3. Remove all attic stock (extra materials) from the building and transmit per the User Agency's directive.

H. Interiors

1. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
2. Sweep concrete floors broom clean in unoccupied spaces.
3. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
4. Final Cleaning of resilient floors and wood floors shall be as specified under the respective sections of the Specifications.
5. Leave all architectural metals, hardware, and fixtures in undamaged, polished conditions.

I. Glass

1. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
2. Clean plastic glazing in accordance with the manufacturer's directions.
3. In cleaning glass and finish surfaces, care shall be taken not to use detergents or other cleaning agents which may stain adjoining finish surfaces.
4. All broken or defective glass caused by the Contractor's Work shall be replaced at the expense of the Contractor.

J. Cleaning of MEP Equipment

1. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
2. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
3. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.

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4. Clean ducts, blowers, and coils if units were operated during construction or that display contamination with particulate matter on inspection.
5. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
6. Leave pipe and duct spaces, plenums, furred spaces and the like clean of debris and decaying materials.

K. Prior to submitting a request to the Architect to certify Substantial Completion of the Work, the Contractor shall inspect all interior and exterior spaces and verify that all waste materials, rubbish, tools, equipment, machinery, and surplus materials have been removed, and that all sight-exposed surfaces are clean. Leave the Project clean and ready for occupancy.

L. User Agency's responsibility for cleaning commences at occupancy, however Contractor shall provide satisfactory cleaning as requested or required as a result of Contractor activity in the project area or occupied spaces. .

END OF SECTION

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SECTION 01 74 20 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for 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 Requirements:

1. Division 01 Section "Multiple Contract Summary" for coordination of responsibilities for waste management.
2. Division 02 Section "Selective Structure Demolition" for disposition of waste resulting from demolition of site improvements**.**

1.3 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.

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1.4 PERFORMANCE REQUIREMENTS

A. General: Achieve end-of-Project rates for salvage/recycling of **75** percent by weight of total non-hazardous solid waste generated by the Work. Practice efficient waste management in the use of materials in the course of the Work. Use all reasonable means to divert construction and demolition waste from landfills and incinerators. Facilitate recycling and salvage of materials, including the following:

1. Demolition Waste (which may include the following when within the project scope but not limited to):
   a. Asphalt Shingles.
   b. Built up Roof.
   c. Soffits
   d. Wood trim.
   e. Metals.
   f. Roofing.
   g. Insulation.
   h. Gypsum board.
   i. Electrical conduit.
   j. Ridge vents
   k. Downspouts & Gutters

2. Construction Waste (which may include the following when within the project scope):

   a. Masonry and CMU.
   b. Lumber.
   c. Wood sheet materials.
   d. Wood trim.
   e. Metals.
   f. Roofing.
   g. Insulation.
   h. Carpet and pad.
   i. Gypsum board.
   j. Piping.
   k. Electrical conduit.
   l. Packaging: Regardless of salvage/recycle goal indicated in "General" Paragraph above, salvage or recycle 100 percent of the following uncontaminated packaging materials:

      1) Paper.
      2) Cardboard.
      3) Boxes.
      4) Plastic sheet and film.
      5) Polystyrene packaging.
      6) Wood crates.
      7) Plastic pails.

1.5 ACTION SUBMITTALS

A. Waste Management Plan: Submit plan within 30 days of date established for the Notice to Proceed.

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1.6 INFORMATIONAL SUBMITTALS

A. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit report. Use Form CWM-7 for construction waste and Form CWM-8 for demolition waste. Include the following information:

1. Material category.
2. Generation point of waste.
3. Total quantity of waste in tons).
4. Quantity of waste salvaged, both estimated and actual in tons.
5. Quantity of waste recycled, both estimated and actual in tons.
6. Total quantity of waste recovered (salvaged plus recycled) in tons.
7. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.

B. Waste Reduction Calculations: Before request for Substantial Completion, submit calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.

C. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.

D. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.

E. 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.

F. 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.

G. Qualification Data: For waste management coordinator and recovery technician.

1.7 QUALITY ASSURANCE

A. Refrigerant Recovery Technician Qualifications: Certified by EPA-approved certification program.

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

C. Waste Management Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to waste management including, but not limited to, the following:

1. Review and discuss waste management plan including responsibilities of waste management coordinator.
2. Review requirements for documenting quantities of each type of waste and its disposition.
3. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.

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4. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
5. Review waste management requirements for each trade.

1.8 WASTE MANAGEMENT PLAN

A. General: Develop a waste management plan according to ASTM E 1609 and requirements in this Section. Plan shall consist of waste identification, waste reduction work plan, and cost/revenue analysis. Distinguish between demolition and construction waste. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.

B. Waste Identification: Indicate anticipated types and quantities of demolition and construction waste generated by the Work. Use Form CWM-1 for construction waste and Form CWM-2 for demolition waste. Include estimated quantities and assumptions for estimates.

C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Use Form CWM-3 for construction waste and Form CWM-4 for demolition waste. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.

1. 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.
2. Salvaged Materials for Sale: For materials that will be sold to individuals and organizations, include list of their names, addresses, and telephone numbers.
3. Salvaged Materials for Donation: For materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.
4. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
5. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
6. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location where materials separation will be performed.

D. Cost/Revenue Analysis: Indicate total cost of waste disposal as if there was no waste management plan and net additional cost or net savings resulting from implementing waste management plan. Use Form CWM-5 for construction waste and Form CWM-6 for demolition waste. Include the following:

1. Total quantity of waste.
2. Estimated cost of disposal (cost per unit). Include hauling and tipping fees and cost of collection containers for each type of waste.
3. Total cost of disposal (with no waste management).
4. Revenue from salvaged materials.
5. Revenue from recycled materials.
6. Savings in hauling and tipping fees by donating materials.
7. Savings in hauling and tipping fees that are avoided.
8. Handling and transportation costs. Include cost of collection containers for each type of waste.
9. Net additional cost or net savings from waste management plan.

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PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

A. General: Implement approved 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 operation, termination, and removal requirements in Division 01 Section "Temporary Facilities and Controls."

B. Waste Management Coordinator: Engage a waste management coordinator to be responsible for implementing, monitoring, and reporting status of waste management work plan.

C. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.

1. Distribute waste management plan to everyone concerned within three days of submittal return.
2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.

D. 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 Division 01 Section "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

3.2 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

A. General: Recycle paper and beverage containers used by on-site workers.

B. Recycling Receivers and Processors: Use only available recycling receivers and processors licensed to do business in the local area.

C. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall be shared equally by Owner and Contractor.

D. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.

E. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.

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1. Provide appropriately marked containers or bins for controlling recyclable waste until 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 from Owner's property and transport to recycling receiver or processor.

3.3 RECYCLING DEMOLITION WASTE

A. Asphalt Paving: Grind asphalt to maximum 1-1/2-inch (38-mm) size.

1. Crush asphaltic concrete paving and screen to comply with requirements in Division 31 Section "Earth Moving" for use as general fill.

B. Asphalt Paving: Break up and transport paving to asphalt-recycling facility.

3.4 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. 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.

    a. Comply with requirements in Division 32 Section "Plants." for use of clean sawdust as organic mulch.

C. Gypsum Board: Stack large clean pieces on wood pallets or in container 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.

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a. Comply with requirements in Division 32 Section "Plants." for use of clean ground gypsum board as inorganic soil amendment.

3.5 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: Remove waste materials from Owner's property and legally dispose of them.

3.6 FORMS

A. Form CWM-1 for construction waste identification.

B. Form CWM-2 for demolition waste identification.

C. Form CWM-3 for construction waste reduction work plan.

D. Form CWM-4 for demolition waste reduction work plan.

E. Form CWM-5 cost/revenue analysis of construction waste reduction work plan.

F. Form CWM-6 cost/revenue analysis of demolition waste reduction work plan.

G. Form CWM-7 for construction waste

H. Form CWM-8 for demolition waste.

END OF SECTION 01 74 20

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01 78 00 – CLOSEOUT PROCEDURES AND SUBMITTALS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Related Requirements
B. Definitions
C. Quality Assurance
D. Starting And Adjusting of Systems
E. Demonstration and Instructions
F. Substantial Completion
G. Spare Parts and Maintenance Products
H. Product Warranties and Product Bonds
I. Emergency Contacts List
J. Final Completion
K. Project Turnover
L. Mark-up Set of Construction Documents
M. Administrative Closeout
N. Owner's Manual
O. Project Record Documents
P. Final Application for Payment.

1.2 RELATED REQUIREMENTS

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

1.3 DEFINITIONS

A. Substantial Completion: refer to General Conditions A201 §9.8.1.
B. Project Closeout is the period of time after the Substantial Completion date until the Contractor, Design Agent and User Agency have completed all contract items, closeout obligations, and processed final payment. This time period may overlap a portion of the warranty period.
C. Warranty period is one year from the Substantial Completion date, unless specified otherwise. Individual products and work performed may have longer specific warranty periods as outlined in the Certificate of Substantial Completion. The warranty period may also be referred to as "Post Construction Phase".

1.4 QUALITY ASSURANCE

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A. Employ personnel assembling submittals experienced in the maintenance and the operation of the described products and systems.

1.5 STARTING AND ADJUSTING OF SYSTEMS

A. Coordinate schedule for starting and adjusting of various equipment and systems.

B. Notify Design Agent and User Agency seven days prior to starting and adjusting of each item.

C. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, or other conditions which may cause damage.

D. Verify that tests, meter readings and specified electrical characteristics agree with those required by the equipment or system manufacturer.

E. Verify wiring and support components for equipment are complete and tested.

F. Execute starting and adjusting under supervision of responsible Contractor's personnel or manufacturer's representative, in accordance with manufacturer's instructions.

G. Adjust operating Products and equipment to ensure smooth and unhindered operation.

H. When specified in individual specifications Section, require manufacturer to provide authorized representative to be present at the site to inspect, check, and approve equipment or system installation prior to starting, and to supervise placing of equipment or system in operation.

I. Submit a written report in accordance with Section 01 40 00 that equipment or system has been properly installed and is functioning correctly.

1.6 DEMONSTRATION AND INSTRUCTIONS

A. Provide training and demonstrations of the equipment and sequences of systems operation to User Agency's personnel two weeks prior to date of Substantial Completion.

B. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.

C. Training and demonstrations to include the following in conjunction with designated Operations personnel:

1. Operate the equipment and systems for a minimum of two hours or five repetitions, or as otherwise required. If problems occur, correct them and repeat the full demonstration.

2. Demonstrate proper equipment and systems operation, as well as procedures for cleaning, lubrication, maintenance, replacement of routine expendable parts and all other actions required for normal operations and maintenance.

3. Demonstrate and review both normal and failure modes of system controls operation where they are designed as such.

4. Review O&M manuals

5. Place systems into full operation

D. Utilize operation and maintenance manuals as basis for instruction. Review contents of manuals with User Agency's personnel in detail 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 at scheduled or agreed upon times, at equipment or system location.

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F. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.

G. For each training session, Contractor shall provide written verification of training including, date, time, name of trainer, systems demonstrated, and agenda. Contractor shall prepare and submit a sign in sheet with name, email, title, phone number and signature of all attendees. This shall be turned over as part of the closeout package.

1.7 SUBSTANTIAL COMPLETION

A. Refer to General Conditions §9.8 Substantial Completion for more information.

B. The User Agency will occupy all portions of the building after Substantial Completion as specified in Section 01 10 00.

C. Per RI General Laws § 37-12-10.1, Contractor shall notify User Agency and Design Agent that work is considered substantially complete utilizing the format indicated in the statute. A walk-though inspection for determining the date of Substantial Completion will be scheduled. Prior to the request, the following items shall be competed:

1. All security, network and telecommunications and door access shall be complete.
2. Complete startup and testing of mechanical, electrical and plumbing systems.
3. Completion of Demonstration and Instructions
4. Contractor shall prepare and submit a list of items to be completed and corrected (Contractor's punch list), indicating the value of each item on the list and reasons why the Work is incomplete. The Design Agent shall review and perform an inspection
5. Testing and balance reports are available.
6. Request and complete commissioning and inspection.
7. Deliver tools, spare parts, extra materials, and similar items to location designated by User Agency, per requirements, below.
8. Make final changeover of permanent locks and deliver keys and keying schedule to User Agency. Advise User Agency's personnel of changeover in security provisions.
9. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
10. Submit changeover information related to heat and other utilities, and User Agency's occupancy, use, operation, and maintenance.
11. Complete final cleaning requirements, including touchup painting.
12. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
13. Obtain and submit releases permitting User Agency unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar re-leases.

D. Following demonstration of compliance with the items above, and as stipulated in RI General Laws § 37-12-10.1, Design Agent shall prepare a Certificate of Substantial Completion. At such time, Contract may submit an Application for Payment releasing held retainage.

1.8 SPARE PARTS AND MAINTENANCE PRODUCTS

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A. Furnish spare parts, maintenance, and extra products (attic stock) in the quantities specified in the individual specification Sections.

B. Deliver to the Project site and place in a location as directed by the User Agency; obtain a receipt prior to final payment.

C. See Owner's Manual, below, on submission of documentation.

1.9 PRODUCT WARRANTIES AND PRODUCT BONDS

A. Warranty period shall commence at date of substantial completion.

B. Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within 10 days after completion of the applicable item of work. Except for items put into use with User Agency's permission, leave date of beginning of time of warranty until the Date of Substantial completion is determined.

C. Retain warranties and bonds until time specified for submittal.

D. Execute and assemble the transferable warranty documents and bonds from the subcontractors, suppliers, and manufacturers.

E. Verify that the documents are in the proper form, contain full information, and are notarized.

F. Include in the Operations and Maintenance Manuals within the appropriate material specification section, indexed separately on Table of Contents.

G. Closeout Submittals Warranties and Bonds:

1. For equipment or component parts of equipment put into service during construction with User Agency's permission, submit documents within 10 days after acceptance.

2. Make other submittals within 10 days after Date of Substantial Completion, prior to final Application for Payment.

3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within 10 days after acceptance, listing the date of acceptance as the beginning of the warranty period.

H. See §3.3 Owner's Manual, below, on submission of documentation. At Final Completion of all work as certified by the College and Architect/Engineer, the Contractor shall deliver a Letter of Warranty to the College. This Warranty certifies that the Contractor shall promptly replace or repair any defects in equipment, materials or workmanship that becomes apparent within one (1) year from the date of Final Completion, or the College's acceptance of the Project, whichever is later.

I. The Warranty shall include repairs and corrections to pipe covering, paint, woodwork, or any other material and equipment caused to be imperfect due to defective workmanship or materials. All direct and consequential repairs shall be entirely at the expense of the Contractor.

J. Additional manufacturers' extended warranties for major equipment shall be supplementary to this guarantee.

1.10 EMERGENCY CONTACT LIST:

A. Construction Contacts:

1. During the course of construction, the Contractor shall supply a telephone number that the College may call on a twenty–four (24) hour/day basis for emergency repairs or service made necessary because of Contract work in progress.

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2. Coordinate with the Project Manager to complete and file form with Facilities Service Response Center.

B. Warranty Period Contacts:

1. Provide a telephone number that the College may call on a twenty–four (24) hour/day basis to receive immediate repairs and service, during the Warranty period. If the College is unable to contact the Contractor to obtain service, the College shall arrange for service from another service provider or College employees and shall charge the expenses to the Contractor.

1.11 FINAL COMPLETION

A. Refer to General Conditions Article 9.10 Substantial Completion for more information.

B. In order for Final Payment to be accepted, the following must be complete:

1. Resolution of all outstanding punch list items
2. Final inspection of the project by the User Agency, Design Agent and Contractor
3. Final inspections and certifications from authorities having jurisdiction.
4. Acceptance of all Closeout Documentation (See Part 3 – Execution for Details).
   a. Administrative Closeout
   b. Owner's Manual
   c. Project Record Documents
   d. Final Application for Payment

C. See Owner's Manual, below, on submission of documentation.

1.12 PROJECT TURNOVER:

A. Sign off of the punch list is required for approval of the final Application for Payment.

B. At the time of Substantial Completion, the Contractor shall coordinate with the College's Project Manager to schedule a project turnover meeting. This meeting shall include the College's Project Manager, Contractor, Sub-Contractors, Architect/Engineers (if applicable) and the College's Operations & Engineering representatives.

C. Commissioning Review: The project Commissioning Agent's final report detailing their findings, recommendations, and summary of any open issues shall be made available and reviewed in the course of the Project Turnover Meeting(s).

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 MARK-UP SET OF CONTRACT DOCUMENTS

A. During construction, Contractor shall maintain one set of contract documents at the site, dedicated for use as a Mark-Up Set of Contract Documents. The Mark-Up Set is separate from documents used for construction and shall include:

1. Drawings and Specifications, including any bid addenda
2. Specifications.

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3. RFIs, ASIs and Sketches
4. Change Orders and other modifications to the Contract.
5. Reviewed Shop Drawings, Product Data, and Samples.
6. Manufacturer's instructions for assembly and installation.

B. Contractor shall record actual revisions of the Work for all trades, marking up plans and specifications as construction progresses and maintain continuously during the project.

C. The plans shall be marked to show deviations in actual construction from the contract drawings. Deviations shall be shown in the same general detail utilized in the contract drawings. The drawings shall show the following information, but not be limited to:
1. Locations and descriptions of any utilities constructed or located within the construction limits. Provide survey point numbers on the plans for reference.
2. Locations and dimensions of changes within the facility. Floor plan/layout changes should also include revised room numbers, as physically tagged in the field.
3. Changes in grade, alignment, location, elevations, details, and dimensions of all work including facilities, structures, roads and utilities.
4. Incorporate approved sketch (SK) drawings.
5. Where the contract drawings show options, show only the option used in construction.

D. Record information concurrent with the construction progress, not less than weekly.

E. Failure to maintain accurate as-built mark-ups will constitute sufficient justification for withholding payments to the Contractor.

F. Maintain the Mark–Up Set (site “red–lines”) so that it may be available for review by the Architect, College, and the College’s representatives.

G. The corrections on the Mark–Up set shall be incorporated into original contract plan CAD files for final delivery to the College as part of Project Record Documents, below. All plans shall be included in the set.

3.2 ADMINISTRATIVE CLOSEOUT

A. Prepare and submit electronically and one (1) hard copy the following documentation to the User Agency. Each of the sections of Administrative Closeout shall be individual .pdf files emailed to the User Agency’s Representative, copied to the Design Agent. All submissions shall be accompanied by a Transmittal Form indicating the date of the transmission and items included in the package.
1. Certification of Work: Submit a written certification that the Contract Documents have been reviewed, the Work has been inspected, and that the Work is complete in accordance with the Contract Documents and is ready for the User Agency's review.
2. Asbestos Abatement Compliance: Provide submittals to Design Agent that are required by governing or other authorities, including abatement documentation, including but not limited to waste manifests, air clearance testing reports and other documentation correctly prepared as proscribed in the abatement plan. Failure to include correctly prepared abatement documentation will delay issuing of final payment.
3. AIA Document G706 - Contractor's Affidavit of Payment of Debts and Claims
4. AIA Document G706A - Contractor's Affidavit of Release of Liens
5. AIA Document G707 - Consent of Surety to Final payment

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3.3 OWNER'S MANUAL

A. Content of Owner's Manual:
   1. Title Page
   2. Table of Contents
   3. Project Overview
   4. Project Team Contact List
   5. Summary Equipment List
   6. Operations and Maintenance Documentation, Organized by Specification Section
   7. Materials and Finishes Schedule
   8. Roofing and Building Envelope
   9. Spare Parts and Maintenance Products Turnover Documentation

B. Preparation of Owner's Manual: Project Overview.
   1. Provide Summary of the scope of work of the project.
   2. Schedule summary including start date, completion date, and start and end date of the project Guarantee.

C. Preparation of Owner's Manual: Project Team Contact List
   1. Directory, listing the names, addresses, and telephone numbers of the Design Agent, its Consultants, Contractor, Subcontractors, and major equipment suppliers.
   2. Specifically list out Emergency contact list with contact names and twenty-four (24) hours contact information for use during the guarantee/maintenance period.

D. Preparation of Owner's Manual: Summary Equipment List
   1. The Contractor shall compile a Summary Equipment List for all new equipment provided under the project. For renovation projects, include a separate spreadsheet for all equipment removed under the project
   2. Contractor shall utilize the Owner's Standard Building Equipment Data Sheet template, providing information including but not limited to: make, model name, model number, serial number, location and area served. Include the name of subcontractors and suppliers, including local source of supplies and replacement parts. Ensure that all subcontractors, suppliers and replacement part providers are included in the Project Team Contact List.
   3. Summary Equipment List shall be provided in both .pdf and editable Microsoft Excel.

E. Preparation of Owner's Manual: The Operations and Maintenance Documentation. Contractor shall assemble a complete set of Operations and Maintenance (O&M) manuals indicating the operation and maintenance of each system, subsystem, and piece of equipment not part of a system. The Operations and Maintenance Documentation shall be organized by specification section and divided by each product or system. Provide the following information as applicable, separated with subdivides within each :
   1. Product cover page: System Name; Brand; Warranty Summary & Contact; Specification section; Description of purpose and area served; Names, addresses, and telephone numbers of the Subcontractors and suppliers.
   2. Significant design criteria.

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3. Each Item of Equipment and Each System: Include a description of the unit or system, size capacity, pressure drops, horsepower and the component parts. Identify the function, normal operating characteristics, and limiting conditions. As applicable, include performance curves, with priming data and tests, and complete nomenclature and model number of replaceable parts.
4. Final approved shop drawings, submittal and cut sheet data detailing equipment performance data and features. For shop drawings: Provide with reinforced punched binder tab. Bind in with the text; fold the larger drawings to the size of the text pages.
5. For each component, include the original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
6. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shutdown, and emergency instructions. Include summer, winter, and special operating instructions.
7. Routine and Preventative Maintenance Requirements: Include the manufacturer's printed operation and maintenance instructions. Include routine procedures and guide for preventative maintenance and troubleshooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions. Include a servicing and lubricating schedule, and a list of lubricants required. Include a list of the original manufacturer's spare parts, Predicted life of parts subject to wear current prices, and recommended quantities to be maintained in storage.
8. Maintenance instructions for [special] finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents.
9. Originals of product warranties and bonds.
10. Other information as specified in the individual product specification Sections.
11. Building Products, Applied Materials, and Finishes: Include product data, with the catalog number, size, composition, and the color and texture designations. Include information for re- ordering custom manufactured products.
12. Instruction for Care and Maintenance: include manufacturer's instructions for cleaning agents and methods, precautions against detrimental agents and methods, and a recommended schedule for cleaning and maintenance.
13. Moisture Protection and Weather Exposed Products: Include product data listing applicable reference standards, chemical composition, and details of installation. Include recommendations for inspections, maintenance, and repair.
14. Charts of valve tag numbers, with the location and function of each valve.
15. Equipment performance field test results, including HVAC system Test and Balancing (TAB) Report, motor alignment tests, etc.
16. Electrical short circuit studies, circuit protective device coordination studies and arc flash studies
17. Electrical panelboard and switchboard schedules
18. As installed schedules for lighting fixtures, lamps, and ballasts
19. Other data as required under pertinent sections of specifications
20. Provide and install framed charts in appropriate building MEP rooms for One Line diagrams, process flow diagrams and valve charts.
21. Software: Provide copies of system software and device configuration files for all electronic systems installed under the project. Files to be provided on formatted CD, mass

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storage device or other acceptable media. Include applicable software documentation and User Manuals. Systems requiring software backup include but are not limited to:

a. Building Automation Systems (BAS)

b. Fire Alarm Systems and Smoke Control Systems

c. Elevator Controls

d. Lighting Controls

22. Door Access Control Systems

23. Additional information required for Electrical, Controls and HVAC Sections:

a. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications; typed.

b. Include sequence of operation by the controls manufacturer.

c. Include color-coded wiring diagrams and process flow diagrams as installed for applicable systems: One Line and Process Flow diagrams (11x17) for applicable systems: Mechanical (heating, cooling, piping, process water and specialty systems), HVAC (Air handlers, ductwork, piping), Plumbing, Electrical (normal, standby power systems and specialty systems), Fire Alarm and Security and Telecom

d. Include control diagrams by the controls manufacturer as installed.

e. Include the Contractor's coordination drawings, with color-coded piping diagrams as installed.

f. Include charts of valve tag numbers, with the location and function of each valve, keyed to the flow and control diagrams.

g. Include test and balancing reports as specified in Section 01 40 00.

h. Boiler and elevator and other applicable certificates and operating permits/licenses, DEM permits including generator permits

i. Test and inspection documentation including fire pump test data, asbestos abatement plans and manifests.

F. Materials and Finishes Schedule shall be submitted in conjunction with O&M manual general requirements. Materials and Finishes manual is for architectural products, applied materials and finishes.

1. Final As–Built surfaces finish schedule, keyed to reduced size floor plans.

2. Additional Requirements: As specified in the individual product specification Sections.

G. Spare Parts and Maintenance Products Turnover Documentation: provide signed transmittals indicating materials delivered, date, location, name, title and signature of person who received the items.

H. Formatting

1. Submit the Owner’s Manual bound in 8-1/2 x 11 inch text pages, in minimum 2 inch size three D side ring commercial quality binders with durable cleanable plastic covers. Pages shall be duplex printed.

2. Prepare binder covers with the typed title of the manual, title of the project, and the subject matter of binder. Label each spine with the following: Building, project or facility name, project number, submission date.

3. Internally subdivide the binder contents with typed permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated

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plastic tabs. Tabs shall match the headings provided in 3.3.A, Content of Owner's Manual, above.

4. The Electronic format shall be organized by Construction Specification Institute (CSI) divisions and include all materials/equipment/systems installed in the building. There shall be one pdf file created for each CSI division.

5. Electronic .pdf shall be "OCR" keyword searchable, bookmarked by section. File and folder names shall be as mutually agreed.

I. Draft Submission

1. Submit electronically a preliminary draft of the Owner's Manual thirty (30) calendar days prior to the contractual Substantial Completion date. The Design Agent and its consultants will review drafts and return electronically with comments. Contractor shall make revisions as noted.

2. A resubmitted draft shall be provided electronically and as one (1) hard copy at contractual Final Completion. This copy will be reviewed and returned after final inspection, with the Design Agent's comments. Revise the content of the document sets as required prior to final submission.

J. Final Submission: Submit three (3) sets of revised final volumes plus electronic copy in final format within ten (10) days after receipt of final comments.

3.4 PROJECT RECORD DOCUMENTS

A. Project Record Documents shall comprise of the following:

1. As-Built Drawings.

2. Record Specifications.

3. Record Contract.

B. Preparation of As-Built Drawings

1. At the end of construction, the Design Agent will provide to the Contractor a complete set of CAD file(s) with all the plan adjustments (bid addenda, bulletins and sketches produced by the Design Agent) fully incorporated into the base CAD file(s). This shall happen within 14 days of Substantial Completion.

2. The Contractor shall retain Competent Drafting Personnel and will coordinate the process to take all field changes/adjustments by all Subcontractors. The Competent Drafting Personnel shall transfer this information and the Mark-Up Set accurately to the CAD file(s). All hand–drawn SK's that are not included in the Design Team's electronic update must be added to the CAD file(s) by the Contractor.

3. The Contractor shall also include any electronic "MEP coordination drawings" produced by the construction team in the final electronic As–Builts. The coordination drawings shall not replace any of the original contract drawings, and they shall be fully labeled both to demonstrate the area of the building shown and to identify all elements shown on the plan. If abbreviations are used, a key must be included on these plans.

4. Include site surveys and As Built. Measured horizontal and vertical locations of the underground utilities and appurtenances, referenced to permanent surface improvements. Include the locations and description of any existing utility lines and other existing installations of any kind or description encountered during construction. Note all changes in size, material, location, and elevation of all new or abandoned underground utility lines and pertinent work, including site grading. Document topography and drainage changes. Show the location of all valves, manholes, etc. and include dimensions to permanent fea-

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tures such as building corners. Note direction of each new valve opening. Show clearances between new utilities and existing crossed lines. Locate all bends, thrust blocks, and other restraints.

5. The placement, size, and type of any fire extinguishers.
6. Measured locations of internal utilities and appurtenances concealed in the construction.
7. Details not on the original Contract drawings, including field changes of dimension and detail.
8. The Contractor will ensure that all notes and schedules included in the design drawings are updated to accurately reflect actual installed conditions.
9. The As-Built Drawings shall include a cover page and content index.
10. As-built Drawings shall be labeled so that the following information is legible when rolled as well as on a cover page: Building, project or facility name, Design Agent's project number, and submission date.

C. Preparation of Record Specifications: Include cover page, title page, table of contents and tabulated and divided by Specification Section. Prepare in binders and electronically as per 3.4.E, Format, below. For each Specification, prepare a summary and provide documentation as follows. Each page shall include the Specification Section Number and Title.
   1. Part 1 – General: Statement of compliance with General subsection or description of any deviations
   2. Part 2 – Products: For each installed item covered in the Specification Section, provide a copy of the Product Cover Page (from the Owner's Manual).
   3. Part 3 – Execution: Statement of compliance with Execution subsection or description of any deviations. Include any ASI or RFI responses in support of actual installation.

D. Preparation of Record Contract: Include cover page, title page, table of contents and tabulated and divided. This list is not all inclusive; final list shall be agreed upon with Design Agent and User Agency, based on review of the draft.
   1. State Purchase Order
   2. Bid Form
   3. Executed AIA A101 as amended by the state and A201 as amended by the state
   4. State Change Orders, including Purchase Order, AIA Cover Sheet and Backup. Provide a tab for each Change Order.
   5. Correspondence and Project Meeting Minutes.
   6. Copies of Contractor's project warranty letter, Subcontractor warranty letters and special guarantees and warranties such as roofing, waterproofing, windows and doors as applicable.
   7. Project Documents and Certificates (trade permits and 128 Forms, Final Certificate of Occupancy, etc.).
   8. Certificate of Substantial Completion
   9. Original and Updated Project Schedules
   10. Project Progress Photographs
   11. Additional Associated Materials. Each shall be considered a separate section, identified in the table of contents and divided as such. Example items include but not limited to:

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a. National Grid Rebate Applications.

b. If the project required geotechnical, archeological, or other miscellaneous studies or other reports, these shall also be submitted as Record Documents.

E. Project Record Documents Format: Printed

1. As Built Drawings shall be organized into 3 sets, stapled with edge binding. The title block, visible when drawings are rolled, shall state the building name, title of the project, substantial completion date, Design Agent and Contractor.

2. Record Specifications and Record Contract Documents shall be printed duplex on 8-1/2 x 11 inch text pages, in minimum 2 inch size three D side ring commercial quality binders with durable cleanable plastic covers.

3. Prepare binder covers and spline labels with the printed title of “Project Record Documents”, building name, title of the project, substantial completion date, Design Agent and Contractor, and the subject matter of binder.

4. Provide cover pages and internally subdivide the binder contents with permanent page dividers, based on the following sections, as applicable.

F. Project Record Documents Format: Electronic

1. All .pdf shall include bookmarks for Sections and be “OCR” keyword searchable.

2. Folder structures and file names shall be as agreed.

G. Project Record Document Draft

1. Contractor shall prepare an electronic draft of the project record documents for review by the Design Agent and the User Agency fifteen (15) days prior to final inspection, or within twenty-one (21) days of receipt of updated electronic files from the Design Team, whichever comes first.

2. Ensure the entries are complete and accurate, enabling future reference by the User Agency.

3. All Design Agent and User Agency comments/mark-ups on the draft package shall be returned to the Contractor within twenty-one (21) calendar days. The Contractor shall make corrections as noted and resubmit within twenty-one (21) calendar days.

H. Final Submission

1. Within fifteen (15) calendar days of receiving final approval of the corrected drafts, the Contractor shall submit three (3) printed, bound copies and one (1) electronic copy of all documents.

3.5 FINAL APPLICATION FOR PAYMENT

A. Refer to AIA A101-2017 as amended by the state §5.2. Following the requirements of Section 01 20 00, submit the final Application for Payment identifying total adjusted Contract Sum, previous payments, and sum remaining due to the Design Agent.

B. Design Agent shall work with the User Agency to determine that all requirements have been fulfilled, and if so, issue a final Certificate for Payment.

END OF SECTION

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SECTION 01 78 30 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for project record documents, including the following:

1. Record Drawings.
2. Record Specifications.
3. Record Product Data.
4. Miscellaneous record submittals.

B. Related Requirements:
1. Division 01 Section "Execution" for final property survey.
2. Division 01 Section "Closeout Procedures" for general closeout procedures.
3. Divisions 02 through 10 Sections for specific requirements for project record documents of the Work in those Sections.

1.3 CLOSEOUT SUBMITTALS

A. Record Drawings: Comply with the following:
1. Number of Copies: Submit copies of record Drawings as follows:

a. Initial Submittal:
1) Submit PDF electronic files of scanned record prints.
2) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.

b. Final Submittal:
1) Submit PDF electronic files of scanned record prints and one set(s) of prints.
2) Print each drawing, whether or not changes and additional information were recorded.

B. Record Specifications: Submit annotated PDF electronic files of Project's Specifications, including addenda and contract modifications.

C. Record Product Data: Submit annotated PDF electronic files and directories of each submittal.

1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.

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D. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit annotated PDF electronic files and directories of each submittal.

E. Reports: Submit written report weekly indicating items incorporated into project record documents concurrent with progress of the Work, including revisions, concealed conditions, field changes, product selections, and other notations incorporated.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.

1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.

    a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
    b. Accurately record information in an acceptable drawing technique.
    c. Record data as soon as possible after obtaining it.
    d. Record and check the markup before enclosing concealed installations.
    e. Cross-reference record prints to corresponding archive photographic documentation.

2. Content: Types of items requiring marking include, but are not limited to, the following:

    a. Dimensional changes to Drawings.
    b. Revisions to details shown on Drawings.
    c. Depths of foundations below first floor.
    d. Locations and depths of underground utilities.
    e. Revisions to routing of piping and conduits.
    f. Revisions to electrical circuitry.
    g. Actual equipment locations.
    h. Duct size and routing.
    i. Locations of concealed internal utilities.
    j. Changes made by Change Order or Construction Change Directive.
    k. Changes made following Architect's written orders.
    l. Details not on the original Contract Drawings.
    m. Field records for variable and concealed conditions.
    n. Record information on the Work that is shown only schematically.

3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
5. Mark important additional information that was either shown schematically or omitted from original Drawings.

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6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:

1. Format: Same digital data software program, version, and operating system as the original Contract Drawings.
2. Format: Annotated PDF electronic file.
3. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
4. Refer instances of uncertainty to Architect for resolution.
5. Architect will furnish Contractor one set of digital data files of the Contract Drawings for use in recording information.

    a. See Division 01 Section "Submittal Procedures" for requirements related to use of Architect's digital data files.
    b. Architect will provide data file layer information. Record markups in separate layers.

C. Newly Prepared Record Drawings: Prepare new Drawings instead of preparing record Drawings where Architect determines that neither the original Contract Drawings nor Shop Drawings are suitable to show actual installation.

1. New Drawings may be required when a Change Order is issued as a result of accepting an alternate, substitution, or other modification.
2. Consult Architect for proper scale and scope of detailing and notations required to record the actual physical installation and its relation to other construction. Integrate newly prepared record Drawings into record Drawing sets; comply with procedures for formatting, organizing, copying, binding, and submitting.

D. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

1. Record Prints: Organize record prints and newly prepared record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
2. Format: Annotated PDF electronic file.
3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
4. Identification: As follows:

    a. Project name.
    b. Date.
    c. Designation "PROJECT RECORD DRAWINGS."
    d. Name of Architect.
    e. Name of Contractor.

2.2 RECORD SPECIFICATIONS

A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.

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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 and record Drawings where applicable.

B. Format: Submit record Specifications as annotated PDF electronic file.

2.3 RECORD PRODUCT DATA

A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
3. Note related Change Orders, record Specifications, and record Drawings where applicable.

B. Format: Submit record Product Data as 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.

2.4 MISCELLANEOUS RECORD SUBMITTALS

A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

B. Format: Submit miscellaneous record submittals as PDF electronic file.

1. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.

B. Maintenance of Record Documents and Samples: Store record documents and Samples in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean,

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dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Architect's reference during normal working hours.

END OF SECTION 01 78 30

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SECTION 02 41 20 - SELECTIVE STRUCTURE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Demolition and removal of selected site elements.

B. Related Requirements:

   1. Division 01 Section "Summary" for restrictions on the use of the premises, Owner-occupancy requirements, and phasing requirements.
   2. Division 31 Section "Site Clearing" for site clearing and removal of above- and below-grade improvements.

1.3 DEFINITIONS

A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or removed and reinstalled.

B. Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.4 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

1.5 PREINSTALLATION MEETINGS

A. Pre-demolition Conference: Conduct conference at Project site.

   1. Inspect and discuss condition of construction to be selectively demolished.
   2. Review structural load limitations of existing structure.
   3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
   4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
   5. Review areas where existing construction is to remain and requires protection.

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1.6 INFORMATIONAL SUBMITTALS

A. Proposed Protection Measures: Submit report, including drawings, that indicates the measures proposed for protecting individuals and property for environmental protection, for dust control and for noise control. Indicate proposed locations and construction of barriers.

B. Schedule of Selective Demolition Activities: Indicate the following:

1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's building manager's and other tenants' on-site operations are uninterrupted.
2. Interruption of utility services. Indicate how long utility services will be interrupted.
3. Coordination for shutoff, capping, and continuation of utility services.
4. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.

C. Pre-demolition Photographs or Video: Submit before Work begins.

1.7 CLOSEOUT SUBMITTALS

A. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

1.8 FIELD CONDITIONS

A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.

B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
1. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.
2. Do not disturb hazardous materials or items suspected of containing hazardous materials except under procedures specified elsewhere in the Contract Documents.

E. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1. Maintain fire-protection facilities in service during selective demolition operations.

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PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ANSI/ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting selective demolition operations.

B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

C. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.

D. Survey of Existing Conditions: Record existing conditions by use of measured drawings, preconstruction photographs, preconstruction videotapes and/or templates as indicated. If not indicated, provide preconstruction photographs for record.

1. Comply with requirements specified in Division 01 Section "Photographic Documentation."

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.

1. Comply with requirements for existing services/systems interruptions specified in Division 01 Section "Summary."

B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.

1. **Owner** or **Building manager** will arrange to shut off indicated services/systems when requested by Contractor.
2. Arrange to shut off indicated utilities with utility companies.
3. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.

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4. Disconnect, demolish, and remove HVAC systems, equipment, and components indicated to be removed.

    a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
    b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
    c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
    d. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.

3.3 PREPARATION

A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Comply with requirements for access and protection specified in Division 01 Section "Temporary Facilities and Controls."

B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
4. Cover and protect furniture, furnishings, and equipment that have not been removed.
5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Division 01 Section "Temporary Facilities and Controls."

C. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

1. Strengthen or add new supports when required during progress of selective demolition.

3.4 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction.

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Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.

3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.
5. Maintain adequate ventilation when using cutting torches.
6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
7. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
8. Dispose of demolished items and materials promptly. Comply with requirements in Division 01 Section "Construction Waste Management and Disposal" when provided.

B. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Concrete: Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least 3/4 inch (19 mm) at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.

B. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, then remove concrete between saw cuts.

C. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw; and then remove masonry between saw cuts.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
4. Comply with requirements specified in Division 01 Section "Construction Waste Management and Disposal."

B. Burning: Do not burn demolished materials.

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3.7 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 02 41 20

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SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

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 cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:

1. Slabs-on-grade.

B. Related Sections:

1. Division 03 Section "Architectural Concrete" for general building applications of specially finished formed concrete.
2. Division 31 Section "Earth Moving" for drainage fill under slabs-on-grade.

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, and other pozzolans that do not retard short term strength of concrete; ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

B. Fly-Ash: Fly-ash is not allowed for this project.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.
1. .

B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1. Indicate amounts of mixing water to be withheld for later addition at Project site.

C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

D. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer detailing fabrication, assembly, and support of formwork.

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1. Shoring and Reshoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal, and reshoring installation and removal.

E. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.

1. Location of construction joints is subject to approval of the Architect.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Welding certificates.

C. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.
2. Admixtures.
3. Form materials and form-release agents.
4. Steel reinforcement and accessories.
5. Fiber reinforcement.
6. Curing compounds.
7. Floor and slab treatments.
8. Bonding agents.
9. Adhesives.
10. Vapor retarders.
11. Semirigid joint filler.
12. Joint-filler strips.

D. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:

1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.

E. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.

F. Field quality-control test and inspection reports.

G. Minutes of preinstallation conference.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.

B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

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1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

C. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated as documented according to ASTM E 548.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

E. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

F. Preinstallation Conference: Conduct conference at Project site.

1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:

a. Contractor's superintendent.
b. Independent testing agency responsible for concrete design mixtures.
c. Ready-mix concrete manufacturer.
d. Concrete subcontractor.

2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, semirigid joint fillers, forms and form removal limitations, shoring and reshoring procedures, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings on steel reinforcement.]

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.

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2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

1. Plywood, metal, or other approved panel materials.

a. High-density overlay, Class 1 or better.

B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

C. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.

D. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch (19 by 19 mm), minimum.

E. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

F. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

2.3 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.

2.4 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.

B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.

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2.5 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:

1. Portland Cement: ASTM C 150, Type I/II. Supplement with the following:

a. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

B. Normal-Weight Aggregates: ASTM C 33, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.

1. Maximum Coarse-Aggregate Size: 3/4 inch (19 mm) nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Water: ASTM C 94/C 94M and potable.

2.6 ADMIXTURES

A. Air-Entraining Admixture: ASTM C 260.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.

B. Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete and complying with ASTM C 494/C 494M, Type C.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include:

a. Euclid Chemical Company (The), an RPM company; EUCON CIA.
b. Grace Construction Products, W. R. Grace & Co.; DCI.
c. Sika Corporation; Sika CNI.
d. Master Builders, Inc., Rheocrete, CNI
e. Boral Material Technologies, Boral BCN

C. Non-Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, non-set-accelerating, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include:

a. BASF Construction Chemicals - Building Systems; Rheocrete 222+.
b. Cortec Corporation; MCI- 2000 and/or 2005NS.
c. Grace Construction Products, W. R. Grace & Co.; DCI-S.
d. Sika Corporation; FerroGard 901.
e. Axim Concrete Technologies, Gatexol 1000CI
f. Boral Material Technologies, Inc., Boral BCN2

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2.7 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, the following:

a. Axim Italcementi Group, Inc.; CATEXOL CimFilm.
b. BASF Construction Chemicals - Building Systems; Confilm.
c. ChemMasters; SprayFilm.
d. Conspec by Dayton Superior; Aquafilm.
e. Dayton Superior Corporation; Sure Film (J-74).
f. Edoco by Dayton Superior; BurkeFilm.
g. Euclid Chemical Company (The), an RPM company; Eucobar.
h. Kaufman Products, Inc.; Vapor-Aid.
i. Lambert Corporation; LAMBCO Skin.
j. L&M Construction Chemicals, Inc.; E-CON.
k. Meadows, W. R., Inc.; EVAPRE.
l. Metalcrete Industries; Waterhold.
m. Nox-Crete Products Group; MONOFILM.
n. Sika Corporation; SikaFilm.
o. SpecChem, LLC; Spec Film.
p. Symons by Dayton Superior; Finishing Aid.
q. TK Products, Division of Sierra Corporation; TK-2120 TRI-FILM.
r. Unitex; PRO-FILM.
s. Vexcon Chemicals, Inc.; Certi-Vex Envio Set.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.

C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering. Contractor to coordinate with floor covering manufacturer.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include:

a. Anti-Hydro International, Inc.; AH Curing Compound #2 DR WB.
b. BASF Construction Chemicals - Building Systems; Kure 200.
c. ChemMasters; Safe-Cure Clear.
d. Conspec by Dayton Superior; W.B. Resin Cure.
e. Dayton Superior Corporation; Day-Chem Rez Cure (J-11-W).
f. Edoco by Dayton Superior; Res X Cure WB.
g. Euclid Chemical Company (The), an RPM company; Kurez W VOX; TAMMSCURE WB 30C.
h. Kaufman Products, Inc.; Thinfilm 420.
i. Lambert Corporation; AQUA KURE - CLEAR.
j. L&M Construction Chemicals, Inc.; L&M Cure R.
k. Meadows, W. R., Inc.; 1100-CLEAR.
l. Nox-Crete Products Group; Resin Cure E.

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m. Right Pointe; Clear Water Resin.
n. SpecChem, LLC; Spec Rez Clear.
o. Symons by Dayton Superior; Resi-Chem Clear.
p. TK Products, Division of Sierra Corporation; TK-2519 DC WB.
q. Vexcon Chemicals, Inc.; Certi-Vex Enviocure 100.

F. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering; Contractor to coordinate with floor covering manufacturer and installers.

2.8 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber at exterior condition and ASTM D 1752, cork or self-expanding cork at interior conditions.

B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 per ASTM D 2240.

1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
2. 5000 psi (34.5 MPa) at 28 days when tested according to ASTM C 109/C 109M.

2.9 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301. Contractor shall also conform to all material provisions set forth in the Rhode Island Department of Transportation (RIDOT) for roads and bridge construction 2004 Edition with all revisions.

1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:

1. Ground Granulated Blast-Furnace Slag: 40 percent.
2. Combined Pozzolan and Ground Granulated Blast-Furnace Slag: 40 percent portland cement minimum, with pozzolan not exceeding 25 percent.
3. Silica Fume: 10 percent.
4. Combined Pozzolans, and Silica Fume: 35 percent with pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
5. Combine Pozzolans, Ground Granulated Blast-Furnace Slag, and Silica Fume: 50 percent with pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.

C. Limit water-soluble, chloride-ion content in hardened concrete to 0.06 percent by weight of cement.

D. Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing, high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.

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2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use corrosion-inhibiting admixture in concrete mixtures where indicated.

2.10 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Exterior Concrete Sidewalks, Concrete Paving (for pedestrians and/or vehicles) and stairs: Proportion normal-weight concrete mixture as follows:

1. Provide concrete walks, paving and exterior steps with one course construction, finish thickness, as detailed. Provide 4,000 psi air-entrained concrete for all exterior concrete.
2. Provide a subgrade of undisturbed natural soil or thoroughly compacted fill. Remove all loose material and test subgrade for slope and grade before proceeding. Maintain all subgrade in satisfactory condition, protected against traffic and properly drained until the surfacing is placed. Place concrete only on moist subgrade; place no concrete on muddy or frozen subgrade. Do not concrete pouring until the subgrade has been approved.
3. Apply the specified clear curing and sealing compound to these surfaces immediately after final finishing.
4. Provide grade stakes not more than 25 feet apart for all walk and terrace construction. Check tops of forms for grade before placing concrete. Introduce short vertical curves at points where change in grade exceeds 2 percent. Provide slope across sidewalks, as shown. Make slight adjustments as necessary in slopes at intersection of walks.
5. Reinforce all walks with welded wire fabric 6x6/1.4x1.4 W.W.F. unless noted otherwise on drawings.
6. Provide expansion joints in concrete pads of pre-moulded joint filler, 1/2 “ thick and the full depth of the slab, located as indicated and generally not over 20’-0” apart. Between expansion joints, cut grooves 1/8” to 1/4” wide at least one-half inch deep as indicated; fill expansion joints with approved traffic-proof joint sealer.

B. Concrete Bases, Curbs, Etc.:

1. provide bases, curbs, and special foundations required for mechanical and electrical equipment. Verify the final sizes, details and locations with the equipment to be furnished.
2. Where indicated, attach bases, curbs, etc., to the supporting structural concrete by use of specified epoxy adhesive. Prepare surface to receive adhesive, mix and apply materials in strict accordance with the manufacturers recommendations.
3. Use interior slab on grade concrete design mix. A contractor option may use 6x6/1.4x1.4 W.W.F. in lieu of fiber reinforcing.

2.11 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.12 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and ASTM C 1116/C 1116M, and furnish batch ticket information.

1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

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PART 3 - EXECUTION

3.1 FORMWORK

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:

1. Class A, 1/8 inch (3.2 mm) for smooth-formed finished surfaces.

D. Construct forms tight enough to prevent loss of concrete mortar.

E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.

1. Install keyways, reglets, recesses, and the like, for easy removal.
2. Do not use rust-stained steel form-facing material.

F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

H. Chamfer (unless specifically noted on drawings “do not chamfer”), exterior corners and edges of permanently exposed concrete.

I. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

J. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

K. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 REMOVING AND REUSING FORMS

A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.

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B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.3 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

1. Weld reinforcing bars according to AWS D1.4, where indicated.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

F. Epoxy-Coated Reinforcement: Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M. Use epoxy-coated steel wire ties to fasten epoxy-coated steel reinforcement.

G. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

H. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches (38 mm) into concrete.

I. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch (3.2 mm). Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3.2-mm-) wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

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J. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
2. Terminate full-width joint-filler strips not less than 1/2 inch (13 mm) or more than 1 inch (25 mm) below finished concrete surface where joint sealants, specified in Division 07 Section "Joint Sealants," are indicated.
3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

3.4 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.

C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches (150 mm) into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
2. Maintain reinforcement in position on chairs during concrete placement.
3. Screed slab surfaces with a straightedge and strike off to correct elevations.
4. Slope surfaces uniformly to drains where required.
5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

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F. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average high and low temperature is expected to fall below 40 deg F (4.4 deg C) for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

G. Hot-Weather Placement: Comply with ACI 301 and as follows:

1. Maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.5 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces not exposed to public view.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

C. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:

1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.

D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.6 FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

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B. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.

a. Specified overall values of flatness, F(F) 25; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 17; and of levelness, F(L) 15.

C. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces where ceramic or quarry tile is to be installed by either thickset or thin-set method. While concrete is still plastic, slightly scarify surface with a fine broom.

1. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.

D. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

3.7 MISCELLANEOUS CONCRETE ITEMS

A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.

3.8 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

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3.9 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 (1.18-mm) sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch (13 mm) in any dimension to solid concrete. Limit cut depth to 3/4 inch (19 mm). Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch (0.25 mm) wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
2. After concrete has cured at least 14 days, correct high areas by grinding.
3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.

E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.10 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage a special inspector and Contractor will engage qualified testing and inspecting agency unless noted otherwise to perform field tests and inspections and prepare test reports.

B. Testing and Inspecting: Engage a qualified testing and inspecting agency subject to approval by Architect and/or Owner to perform tests and inspections and to submit reports.

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C. Inspections:

1. Steel reinforcement placement.
2. Steel reinforcement welding.
3. Verification of use of required design mixture.
4. Concrete placement, including conveying and depositing.
5. Curing procedures and maintenance of curing temperature.
6. Verification of concrete strength before removal of shores and forms from beams and slabs.

D. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd. (4 cu. m), but less than 25 cu. yd. (19 cu. m), plus one set for each additional 50 cu. yd. (38 cu. m) or fraction thereof.

    a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; ASTM C 173/C 173M, volumetric method, for structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when 80 deg F (27 deg C) and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C 31/C 31M.

    a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
    b. Cast and field cure two sets of two standard cylinder specimens for each composite sample.

6. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.

    a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
    b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.

7. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
8. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa).

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9. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
10. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
11. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.
12. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
13. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

E. Measure floor and slab flatness and levelness according to ASTM E 1155 (ASTM E 1155M) within 48 hours of finishing.

END OF SECTION 03 30 00

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SECTION 05 50 00 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. DESCRIPTION OF THE WORK:

1. The extent of metal fabrication work is shown and includes items fabricated from iron and steel shapes, plates, bars, strips, tubes, pipes and castings which are not part of structural steel or other metal systems in other sections of these specifications. Such work includes but is not limited to:

2. Section Includes:

a. Miscellaneous steel framing and supports.
b. Miscellaneous steel trim.
c. Bolts, anchors, nuts, washers, fastening devices, etc.

C. Products furnished, but not installed, under this Section:

1. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
2. Steel weld plates and angles for casting into concrete.

1.2 PERFORMANCE REQUIREMENTS

A. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

1.3 RELATED WORK UNDER OTHER SECTIONS;

A. Division 05 Section Cold-Formed Metal Framing.

B. Division 08 Section Louvers.

C. Division 09 Section Painting

1.4 QUALITY ASSURANCE;

A. Code and Standards:

1. AISC “Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings”, including “Commentary of the AISC Specifications”.

2. AISC “Specification for the Design of Cold-Formed Steel Structural Members”.

3. AWS “Structural Welding Code”.

B. Qualification for Welding Work: Qualify welding processes and welding operators in accordance with AWS “Standard Qualification Procedure”. Welding operators shall be qualified

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in accordance with Section 05 of AWS D1.1 Qualification records shall be maintained at the site for review by the Inspection Agency representative and the Architect, when requested.

C. Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication, where possible. Do not delay job progress; allow for trimming and fitting wherever taking field measurements before fabrication might delay work.

D. Inserts and Anchorages: Furnish inserts and anchoring devices which must be set in concrete or built into masonry for installation of miscellaneous metal work. Provide setting drawings, templates, instructions and directions for installation of anchorage devices. Coordinate delivery with other work to avoid delay.

1. See concrete and masonry sections of these specifications for installation inserts and anchorage devices.

E. Shop Assembly: Pre-assemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

1.5 SUBMITTALS

A. Product Data: For the following:

1. Metal nosings and treads.

2. Paint products.

3. Grout.

B. Manufacturer's Data: For information only, submit copies of manufacturer's specifications, anchor details and installation instructions for products to be used in the fabrication of miscellaneous metal work, including paint products. Transmit copy of instructions to Installer.

C. Shop Drawings: Submit shop drawings for fabrication and erection of miscellaneous metal assemblies. Include plans and elevations at not less than 1" to 1'-0" scale, and include details of sections and connections at not less than 3" to 1'-0" scale. Show anchorage and accessory items. Provide templates for anchor and bolt installation by others.

D. Samples: For each type and finish of extruded nosing and tread.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces without blemishes.

2.2 FERROUS METALS

A. Metal Surfaces, General: For fabrication of miscellaneous metal work which will be exposed to view, use only materials which are smooth and free of surface blemishes including pitting, seam marks, roller marks, rolled trades names and roughness.

B. Recycled Content of Steel Products: Provide products with average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent

C. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

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D. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.

E. Steel Tubing: ASTM A 500, cold-formed steel tubing.

F. Steel Pipe: ASTM A 53/A 53M, standard weight (Schedule 40) unless otherwise indicated.
1. Material: Cold-rolled steel, ASTM A 1008/A 1008M, commercial steel, Type B; 0.0966-inch minimum thickness; coated with rust-inhibitive, baked-on, acrylic enamel or hot-dip galvanized after fabrication for exterior applications.

2.3 NONFERROUS METALS

A. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T6.

B. Aluminum-Alloy Rolled Tread Plate: ASTM B 632/B 632M, Alloy 6061-T6.

C. Aluminum Castings: ASTM B 26/B 26M, Alloy 443.0-F.

2.4 ANCHORS:

A. Threaded-Type Concrete Inserts: Galvanized ferrous castings, internally threaded to receive 3/4” diameter machine bolts; either malleable iron complying with ASTM A 47 or cast steel complying with ASTM A 27; hot dipped galvanized.

B. Wedge-Type Concrete Inserts: Galvanized box-type ferrous castings, designed to accept 3/4” diameter bolts having special wedge-shaped heads; either malleable iron complying with ASTM A 47 or cast steel complying with ASTM A 27; hot dipped galvanized.

1. Provide carbon steel bolts having special wedge-shaped heads, nuts, washers and shims; all galvanized in compliance with ASTM A 153.

C. Slotted-Type Concrete Inserts: Galvanized 1/8” thick pressed steel plate complying with ASTM A 283; box-type welded construction with slot designed to receive 3/4” diameter square head bolt and with knockout cover; hot dipped galvanized.

2.5 FASTENERS

A. General: Provide zinc-coated fasteners, with galvanizing complying with ASTM A 153, for exterior use or where built into exterior walls. Select fasteners for the type, grade and class required for the installation of miscellaneous metal items.

1. Standard Bolts and Nuts: ASTM A 307, Grade A, regular hexagon head.
2. Lag Bolts: FS FF-B-561, square head type.
3. Machine Screws: FS FF-S-92, cadmium plated steel.
4. Plain Washers: FS FF-W-92, round general assembly, grade carbon steel.
5. Lock Washers: FS FF-W-84, helical spring type, carbon steel.
6. Masonry Anchorage Devices: Expansion shields, FS FF-S-325.

B. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, at exterior walls.

1. Provide stainless-steel fasteners for fastening aluminum.
2. Provide stainless-steel fasteners for fastening stainless steel.

C. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.

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D. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel is Indicated: Alloy [**Group 1 (A1)**] [**Group 2 (A4)**] stainless-steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).

2.6 PAINT:

A. Metal primer Paint: Primer selected must be compatible with finish coats of paint. Coordinate selection of metal primer with finish paint requirements specified in Division 09.

B. Galvanizing Repair Paint: High zinc dust content paint for regalvanizing welds in galvanized steel, complying with Military Specification MIL-P-21035 (Ships).

1. Product conforming to above specification: ZRC cold galvanizing compound.

C. Where galvanizing prior to completing fabrication cannot be avoided, joints shall be welded after fabrication, ground smooth and finished with four (4) full coats of California Products Corp. WW Totrust, Sealube ZRC, ZIRP by Duncan Galvanizing or approved equal.

2.7 FABRICATION, GENERAL

A. Workmanship: Use materials of size and thickness shown or, if not shown, of required size and thickness to produce strength and durability in finished product. Work to dimensions shown or accepted on shop drawings, using proven details of fabrication and support. Use type of materials shown or specified for various components of work.

B. Shop Assembly: Preassemble items in the shop to greatest extent possible. Use connections that maintain structural value of joined pieces.

C. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges. Ease exposed edges to a radius of approximately 1/32” unless otherwise shown. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Weld corners and seams continuously, complying with AWS recommendations. Grind exposed welds smooth and flush, to match and blend adjoining surfaces.

E. Provide for anchorage of type shown, coordinated with supporting structure. Fabricate and space anchoring devices as shown and as required to provide adequate support for intended use.

F. Cut, reinforce, drill and tap miscellaneous metal work as required to receive finish hardware and similar items.

G. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges. Remove sharp or rough areas on exposed surfaces.

H. Galvanizing: provide a hot-dip zinc coating, with the addition of 0.05 – 0.09% Nickel to the zinc bath, for those items supporting or built-into exterior masonry or concrete, steel items exposed to the weather, and other items shown or specified to be galvanized, as follow:

1. ASTM A 153 for galvanizing iron and steel hardware.

2. ASTM A 123 for galvanizing rolled, pressed and forged steel shapes, plate, bars and strip 1/8” thick and heavier.

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3. After pickling and prior to galvanizing, the steel shall be immersed in a bath of zinc ammonium chloride. The dry kettle process shall be used to eliminate any flux inclusions on the surface of the galvanized material.

I. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors as indicated. If not indicated, at not more than 24 inches o.c. maximum spacing.

K. Shop Painting:

1. Shop paint miscellaneous metal work, except members or portions of members to be embedded in concrete or masonry, surfaces and edges to be field welded, and galvanized surfaces, unless otherwise specified.
2. Remove scale, rust and other deleterious materials before applying shop coat. Clean off heavy rust and loose mill scale in accordance with SSPC SP-2 “Hand Tool Cleaning”, or SSPC SP-3 “Power Tool Cleaning”, or SSPC SP-7 “Brush-off Blast Cleaning”.
3. Remove oil, grease and similar contaminants in accordance with SSPC SP-1 “Solvent Cleaning”.
4. Apply one shop coat of metal primer paint to fabricated metal items, except apply two coats of paint to surfaces inaccessible after assembly or erection. Change color of second coat to distinguish it from the first.
5. Immediately after surface preparation, brush or spray on metal primer paint, applied in accordance with manufacturer’s instructions, and at a rate to provide uniform dry film thickness of 1.5 mils for each coat. Use painting methods which will result in full coverage of joints, corners, edges and exposed surfaces.
6. Where painting of galvanized steel is indicated, provide factory-applied polyamide epoxy primer, 2.0 milsDFT, minimum, in preparation for field applied topcoat. Apply primer within twelve hours after galvanizing at the galvanizer’s plant in a controlled environment meeting applicable environmental regulations, and as recommended by the coating manufacturer.

    a. Provide Duncan PrimerGalv for all galvanized surfaces indicated to be field painted.

7. Shop Marking: When shop markings are utilized on metal items for the convenience of the fabricator, or installer, use marking devices which are compatible to the subsequent paint coatings; otherwise remove markings upon installation and prepare surfaces for their finish coatings.

2.8 MISCELLANEOUS METAL FABRICATIONS:

A. Rough Hardware:

1. Furnish bent or other custom fabricated bolts, plates, anchors, hangers, dowels and other miscellaneous steel and iron shapes as required for framing and supporting woodwork and for anchoring or securing woodwork to concrete or other structures. Straight bolts and other stock rough hardware are specified in Division 06.

2. Manufacture or fabricated items of sizes, shapes and dimensions required. Furnish malleable iron washers for heads and nuts which bear on wood structural connections; elsewhere, furnish steel washers.

B. Miscellaneous Framing and Supports:

1. Provide miscellaneous steel framing and supports which are not a part of structural steel framework, as required to complete work.
2. Reinforce openings through steel deck, greater than 12” x 12” (144 sq. in.), with angle framing as detailed, and indicated on the Structural Drawings.

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3. Fabricate miscellaneous units to sizes, shapes and profiles shown or, if not shown, of required dimensions to receive adjacent other work to be retained by framing. Except as otherwise shown, fabricate from structural steel shapes and plates and steel bars, of welded construction using mitered joints for field connection. Cut, drill and tap units to receive hardware and similar items.
4. Equip units with integrally welded anchor straps for casting into poured concrete or building into masonry wherever required. Furnish inserts if units must be installed after concrete is placed. Except as otherwise shown, space anchors 24” o.c. and provide minimum anchor units of 1-1/4” x 1/4” x 8” steel straps.
    a. Galvanize exterior miscellaneous frames and supports.
5. Miscellaneous Steel trim:
    a. Galvanize exterior miscellaneous steel trim.

2.9 FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

C. Fabricate steel girders for wood frame construction from continuous steel shapes of sizes indicated.
1. Bearing Bars: Rectangular bar 2” depth x 3/8” width minimum on a maximum of 15/16” centers. Design system to support H-20 loading.
2. Cross Bars: To be welded at right angles to bearing bars at 4” centers maximum.
3. Surface: Serrated.
4. Loading: Minimum H-20.
5. Finish: The gratings shall be provided galvanized after fabrication.
6. Fabrication and Tolerances shall be in accordance with ANSI/ NAAMM Metal Bar Grating Manual.

2.10 FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

2.11 MISCELLANEOUS STEEL TRIM

A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.

B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.

C. Galvanize exterior miscellaneous steel trim.

2.12 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

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B. Finish metal fabrications after assembly.

2.13 STEEL AND IRON FINISHES

A. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.

B. Preparation for Shop Priming: Prepare surfaces to comply with requirements indicated below:

1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

C. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

PART 3 - EXECUTION

3.1 INSPECTION:

A. Examine the areas and conditions under which miscellaneous metal items are to be installed. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.2 PREPARATION:

A. Furnish setting drawings, diagrams, templates, instructions, and directions for installation of anchorages, such as concrete inserts, anchor bolts and miscellaneous items having integral anchors, which are to be embedded in concrete or masonry construction. Coordinate delivery of such items to project site.

3.3 GALVANIZING:

A. Completely clean interior as well as exterior surfaces and coat with zinc. Provide vent holes for air and frothy fluxes to be allowed to flow upward and completely out; cleaning solutions and molten zinc must be allowed to flow in and completely wet surfaces.

B. Locate vent holes at the highest point and drainage holes at the lowest point each member.

C. Interconnect all sections of fabricated pipework with full open tee or with miter joints. Each enclosed section must be provided with a vent hole at each end.

D. Base plates and end plates must be designed to facilitate venting and draining. Fully cutting the plate provides minimum obstruction to a full, free flow into and out of the pipe. Since this is not always possible, the use of vent holes in the plate often provides a solution.

E. Close vent holes with drive caps or plugs installed after galvanizing, hammer in and file off flush with surrounding surfaces.

F. Completely submerge tubular structures in one dip in the galvanizing kettle.

G. Provide vent and drainage holes in internal gusset plates and end flanges. In circular hollow shapes these should be located diametrically opposite to each other at opposite ends of the member.

H. In rectangular hollow shapes, the four corners of the internal gusset plates should be cropped. Internal gusset plates in all large hollow sections should be provided with an additional opening at the center.

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SECTION 07 72 00 - ROOF ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   a. Snow Guard

1.3 RELATED WORK UNDER OTHER SECTIONS:

A. Division 06 Section ‘Rough Carpentry’

B. Division 07 Section ‘Flashing and Sheet Metal’

1.4 SUBMITTALS:

A. Shop Drawings: Submit project specific shop drawings showing layout, profiles and product components, including anchorage, flashings and accessories.

B. Product Data:

A. For information only, submit copies of manufacturer's drawings, rough-in diagrams, specifications and installation instructions for each roof accessory required. Include data substantiating that products comply with the requirements.

1.5 JOB CONDITIONS:

A. Coordinate the installation of roof accessories with roofing and flashing.

B. Provide all manufacturer required and/or recommended adhesives, cleaners, and/or fastening devices to install all roof accessories properly to the substrates indicated.

PART 2 - PRODUCTS

2.1 PRODUCTS, MATERIALS AND FABRICATION, GENERAL:

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A. Provide manufacturer's standard products, except as otherwise indicated and comply with applicable recommendations and details of the "Architectural Sheet Metal Manual" by SMACNA for custom fabricated work.

2.2 SNOW GUARD FENCE with BARRICADES

A. Basis of Design: Gem 21 MEM as manufactured by Sno-Gem, Inc., 4800 Metalmaster Way; McHenry, IL 60050; Toll Free Tel: 888-766-4367; Tel: 815-477-GEMS; Fax: 815-455-GEMS; Email: request info (bzayas@snogem.com); Web: www.snogem.com

B. Acceptable manufacturer providing compatible system approved by the Architect.

C. Deck Mount Bar System for Membrane Roofs: Mechanically fastened base plate for membrane roofing systems.

a. 1 inch Retention Bar System

b. Type: Double Retention Bar

c. Components:

1) Bracket: 304 Stainless steel

2) Base Plate: Stainless steel

3) 1 inch Square Tubing: Aluminum 6061-T6

4) Inserts: Zinc Zamack #3 Alloy

5) End Caps: Aluminum

6) Barricade Plates: Aluminum

7) Fasteners: Non-corrosive type compatible with the roofing system

8) Barricade Plate to stop melting ice and snow from sliding underneath the bar.

PART 3 - PART 3 - EXECUTION

3.1 INSTALLATION:

A. Separate metal surfaces of roof accessories from dissimilar metals, and from wood and cementitious substrates, by a thick coating of fibrated bituminous compound or other separation as recommended by the metal manufacturer, and as required to prevent corrosive action.

B. Provide for thermal expansion in the installation of continuous-run accessory items, where the run is more than 15 ft. in length.

C. Bed flanges of set-on accessories in mastic or compound which is compatible with roofing and flashing. On sloping decks, shingle flanges with other work for proper water shed.

D. Anchor roof accessories permanently to the substrate, by methods which are adequate for the sizes and locations of units.

E. Install roof accessory as recommended by manufacturer for a weather-tight installation.

F. Snow Guard Fence, Deck Mount Bar System Models: Deck Mount Bar System for Membrane Roofs: Mechanically fasten base plate for membrane roofing

systems in accordance with the manufacturer's instructions and shop drawing layouts. Following installation inspect and verify the following:

a. Inspect each bracket/base plate to insure assembly is intact.

b. Inspect all fasteners in to the roof deck through 2x8 pressure treated blocking full thickness of roof insulation. Secure wood blocking to roof deck as required for roofing system wind loading.

c. Inspect any snow guard related waterproofing and replace or repair where necessary.

d. Inspect tubing has bent or shows any other evidence of failure or damage, contact the manufacturer immediately.

e. Inspect Barricade Plate set screw for tightness.

G. At Snow Guard Fence stanchion/posts provide a cap flashing compatible with roofing membrane over the bracket for a weathertight installation per the manufacturer’s recommendations.

3.2 CLEANING AND PROTECTION:

A. Clean surfaces of roof accessories as required to prevent deterioration and uneven weathering.

B. Advise the Contractor, in writing, of protection and surveillance requirements, to insure that roof accessory units will be without deterioration or damage at the time of acceptance.

END OF SECTION 07 72 00

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3.4 FASTENING TO IN-PLACE CONSTRUCTION:

A. Provide anchorage devices and fasteners where necessary for securing miscellaneous metal items, including ladder, cages, alternating tread ladders, etc. to in-place construction; using threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, wood screws and other connectors as required.

3.5 CUTTING, FITTING AND PLACEMENT:

A. Perform cutting, drilling and fitting required for installation of miscellaneous metal items. Set work accurately in location, alignment and elevation, plumb, level, true and free of rack, measured from established lines and levels. Provide temporary bracing or anchors in formwork for items which are to be built into concrete, masonry, or similar construction.

B. Fit exposed connections accurately together to form tight hairline joints. Weld connections which are not to be left as exposed joints, but cannot be shop welded because of shipping size limitations. Grind joints smooth and touch-up shop paint coat. Do not weld, cut or abrade the surfaces of exterior units which have been hot-dip galvanized after fabrication, and are intended for bolted or screwed field connections.

3.6 FIELD WELDING:

A. Comply with AWS Code for procedures of manual shielded metal-arc welding, appearance and quality of welds made, and methods used in correcting welding work.

3.7 ADJUSTING AND CLEANING:

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

3.8 TOUCH-UP PAINTING:

A. Cleaning and touch-up painting of field welds, bolted connections and abraded areas of the shop paint on miscellaneous metal is specified in Division 09.

3.9 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 05 50 00

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SECTION 07 92 00 - JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes: The extent of each type of joint sealer is indicated. Provide "sealant" for all exterior joints, certain indicated interior joints, and where "mastic" is indicated. Provide "calking" at all remaining interior joints.

B. The required applications include, but are not limited to the following:

1. Pavement and sidewalk joints subjected to foot traffic.
2. Exterior building wall joints.
3. Flashing and coping joints.
4. Miscellaneous concrete construction joints.
5. Masonry control joints.
6. Floor (interior) joints.
7. Sealant between floor and plumbing fixtures.
8. Partition and ceiling joints.
9. Joints at openings and indicated frames or subframes.
10. Equipment and isolation joints.
11. Security sealant.

1.3 PRE-INSTALLATION MEETING:

A. Pre-Installation Meeting: Meet at the project well in advance of the time scheduled for work, (a minimum of one week), and review requirements for the work and conditions which could possibly interfere with successful performance of the work. Require all parties concerned with the work, or required to coordinate with it, or to protect it thereafter, to attend the meeting, including:

1. Owner or Representative
2. General Contractor
3. Installer
4. Manufacturer(s) Representatives
5. Architect

1.4 QUALITY ASSURANCE:

A. At the Owner's option, testing of depth of joint material may be undertaken to insure compliance with the specification and conformance to manufacturer's specifications and recommendations for joint design. If the joint fails to comply with design requirements, the Contractor shall pay for the cost of testing and replacement of all affected joints.

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1.5 SUBMITTALS:

A. Product Data:

1. For information only, submit copies of manufacturer's specifications, recommendations and installation instructions for each type of material required. Include manufacturer's published data, or letter of certification, or certified test laboratory report indicating that each material complies with the requirements and is intended generally for the applications shown.

B. Samples:

1. Submit samples of each color required (except black) for each type of joint sealer exposed to view. Install sample between two strips of material similar to or representative of typical surfaces where sealer will be used, held apart to represent typical joint widths. Samples will be reviewed for color and texture only. Compliance with all other requirements is the exclusive responsibility of the Contractor.

C. Guarantee:

1. Submit copies of written two-year guarantee agreeing to repair or replace joint sealers which fail to perform as air-tight and water-tight joints; or fail in joint adhesion, cohesion, abrasion resistance, weather resistance, extrusion resistance, migration resistance, stain resistance, or general durability; or appear to deteriorate in any other manner not clearly specified by submitted manufacturer's data as an inherent quality of the material for the exposure indicated.

a. Provide guarantee signed by the Installer and Contractor.

1.6 JOB CONDITIONS:

A. Examine the joint surfaces and backing, and their anchorage to the structure, and the conditions under which the joint sealer work is to be performed. Do not proceed with the joint sealer work until unsatisfactory conditions have been corrected.

B. Weather Conditions: Do not proceed with installation of sealants under adverse weather conditions, or when temperatures are below or above manufacturer's recommended limitations for installation. Proceed with the work only when weather conditions are favorable for proper cure and development of high early bond strength. Where joint width is affected by ambient temperature variations, install elastomeric sealants when temperatures are in the lower third of manufacturer's recommended installation temperature range.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL:

A. Colors: For exposed materials provide color as indicated or, if not indicated, as selected from manufacturer's standard colors. For concealed materials, provide the natural color which has the best overall performance characteristics.

B. Hardness: As recommended by manufacturer for application shown.

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C. Modulus of Elasticity: Provide the lowest available modulus of elasticity which is consistent with exposure to weathering, indentation, vandalism, abrasion, support of loading, and other requirements.

D. Compatibility: Before purchase of each required material, confirm its compatibility with each material it will be exposed to in the joint system.

E. Size and Shape: As shown or, if not shown, as recommended by the manufacturer for the type and condition of joint, and for the indicated joint performance or movement.

F. Grade of Sealant: For each application, provide the grade of sealant (non-sag, self-leveling, no-track, knife grade, preformed, etc.) recommended by the manufacturer for the particular condition of installation (location, joint shape, ambient temperature, and similar conditions), to achieve the best possible overall performance. Grades specified herein are for normal condition of installation.

2.2 SEALANTS (See Sealant Schedule at end of Section for specific use of sealants.)

A. Urethanes:

1. Type “A1”: Two-Part Urethane: Self-Leveling, ASTM C920, Type M, Grade P, Class 25. (Fed. Spec. TT-S-00227E Type I, Class A.)

   a. Chem-Calk CC-550, by Bostik.
   b. Vulkem 245, by Tremco.
   c. Vulkem 255, Wide-Joint, by Tremco.
   d. NR-200 Urexpan, by Pecora Corporation.
   e. Sikaflex-2c NS/SL, by Sika Corporation.
   f. SL-2, by Sonneborn

2. Type “A2”: Two-Part Urethane: Non-Sag, ASTM C920, Type M, Grade NS, Class 25. (Fed. Spec. TT-S-00227E Type II, Class A.)

   a. Chem-Calk 500, by Bostik.
   b. Vulkem 227, by Tremco.
   c. Dynatrol II, by Pecora Corporation.
   d. Sikaflex-2c NS/SL, by Sika Corporation.
   e. Sonolastic NP 2, by Sonneborn Building Products, ChemRex Inc.
   f. Dymeric, by Tremco

3. Type “A3”: One-Part Urethane: Self-Leveling, ASTM C920, Type S, Grade P, Class 25. (Fed. Spec. TT-S-00230C Type I, Class A.)

   a. Vulkem 45, by Tremco.
   b. Urexpan NR-201, by Pecora Corporation.
   c. Sonolastic SL1, by Sonneborn Building Products, ChemRex Inc.

4. Type “A4”: One-Part Urethane: Non-Sag, ASTM C920, Type S, Grade NS, Class 25. (Fed. Spec. TT-S-00230C Type II, Class A.)

   a. Chem-Calk 900, by Bostik.
   b. Vulkem 116, by Tremco.
   c. Sonolastic NP I, by Sonneborn Building Products, ChemRex Inc.
   d. Dymonic, by Tremco.

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B. Silicones:

1. Type “B1”: One-Part Silicones: ASTM C920, Type S, Grade NS, Class 25. Vertical Surfaces Only.

   a. 795 Silicone Structural Glazing, Glazing, and Weatherproofing Sealant, by Dow Corning.
   b. 864 Architectural Silicone, by Pecora Corporation.
   c. Sonolastic 150 Silyl Terminated polyether, by Sonneborn
   d. Spectrem 3, by Tremco.

2. Type “B2”: One-Part Silicones: ASTM C920, Type S, Grade NS, Class 25. Vertical Surfaces Only.

   a. 795 Silicone Structural Glazing, Glazing, and Weatherproofing Sealant, by Dow Corning. (colors only)
   b. 999-A, Dow Corning.
   c. Construction 1200 Sealant, General Electric Company.
   d. Sonolastic 150 Silyl Terminated polyether, by Sonneborn (Not for wet glazing)
   e. Spectrem 2, by Tremco.

3. Type “B3”: One-Part Silicones: ASTM C920, Type S, Grade NS, Class 25. Vertical Surfaces Only.

   a. 795 Silicone Structural Glazing, Glazing, and Weatherproofing Sealant, by Dow Corning. (colors only)
   b. Construction 1200 Sealant, General Electric Company.
   c. 999-A, Dow Corning.
   d. 864 Architectural Silicone, by Pecora Corporation. (colors only)
   e. Sonolastic 150 Silyl Terminated polyether, by Sonneborn
   f. Spectrem 1, by Tremco.

4. Type “B4”: One-Part Silicones: ASTM C920, Type S, Grade NS, Class 25.

   a. 786 Mildew Resistant Silicone Sealant, Dow Corning.
   b. SCS 1700 Sanitary Sealant, General Electric.
   c. 898 Silicone Sanitary Sealant, Pecora Corporation.
   d. Omniseal or Omniplus (Sanitary applications), by Sonneborn
   e. Tremsil, by Tremco.

C. Acrylics, Latex: (For interior use only.)

1. Type “C1”: One-Part Acrylic Latex, Non-Sag, ASTM-C-834-76.

   a. Chem-Calk 600, by Bostik.
   b. LC-130, by MACCO Adhesives, The Glidden Company.
   c. Easa-ply ALS, by W. R. Meadows, Inc.
   d. AC-20+Silicone Acrylic Latex, by Pecora Corporation.
   e. Sonolac, Sonneborn Building Products, ChemRex Inc.

D. Acoustical Sealants:

1. Type “D1”:

   a. AC-20 FTR Acoustical and Insulation Sealant, by Pecora Corporation.

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b. 60+ Unicrylic, by Pecora Corporation.
c. Sheetrock Acoustical Sealant, by United States Gypsum.

E. Butyls:

1. Type “E1”: One-Part Butyl, Non-Sag, FS TT-S-1657.

a. Chem-Calk 300, by Bostik.
b. BC-158 Butyl Rubber, by Pecora Corporation. (ASTM C1085)

F. Preformed Compressible & Non-Compressible Fillers:

1. Type “F1”: Backer Rod - Closed cell polyethylene foam:

a. HBR Backer Rod, by Nomaco.
b. #92 Greenrod, by Nomaco.
c. Sonolastic Closed-Cell Backer Rod, Sonneborn Building Products, ChemRex Inc.
d. Soft Cell Backer Rod (Non-gassing), by Sonneborn.

2. Type “F2”: Backer Rod - Open cell polyurethane foam:

a. Denver Foam, by Backer Rod Mfg. Inc.
b. Foam Pack II, by Nomaco.

3. Type “F3”: Neoprene compression seals:

a. WE, WF, and WG Series, by Watson Bowman & Acme Corp.
b. Will-Seal 150 Precompressed Expanding Foam Sealants, by Will-Seal, a Division of Illbruck.

4. Type “F4”: Butyl Rod:

a. Kirkhill Rubber Co. (714)529-4901.

5. Type “G1”:

a. Bond Breaker Tape: Polyethylene tape of plastic as recommended by sealant manufacturer, to be applied to sealant-contact surfaces where bond to substrate of joint filler must be avoided for proper performance of sealant

2.3 PAVING SEALANTS:

A. Type “P1”: Two-Part Urethane: Self-Leveling, ASTM C920, Type M, Grade P, Class 25.

1. Vulkem 202, by Tremco. (Jet Fuel Resistant) (FS SS-S-200D, Type H only)
2. NR-300 Urexpan, by Pecora Corporation. (FS SS-S-200E)
3. Sonomeric 2, by Sonneborn

B. Type “P2”: One-Part Urethane: Self-Leveling, ASTM C920, Type S, Grade P, Class 25.

1. Sonomeric 1 Sealant, by Sonneborn Building Products, ChemRex Inc. (FS SS-S-200E)
2. Vulkem 45, by Tremco.

C. Type “P3”: Epoxy Joint Filler (Heavy Traffic Areas)

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1. Epolith P or Epolith G, by Sonneborn

2.4 SECURITY SEALANT

A. Manufacturer: Pecora Corporation, 165 Wambold Road, Harleysville, PA 19438, Phone: 215-723-605, 800-523-6688, Fax: 215-721-0286, Website:www.pecora.com.

B. Product: Dynapoxy EP-1100, a two-part, non-sag chemically curing epoxy adhesive/sealant, specially formulated for security areas and other areas where tenacious bonding properties and durability are required.

2.5 MISCELLANEOUS ACCESSORIES:

A. Joint Primer/Sealer: Provide the type of joint primer/sealer recommended by the sealant manufacturer for the joint surfaces to be primed or sealed.

B. Bond Breaker Tape: Polyethylene tape or other plastic tape recommended by the sealant manufacturer to be applied to sealant-contact surfaces where bond to the substrate or joint filler must be avoided for proper performance of sealant. Provide self-adhesive tape where applicable.

C. Sealant Backer Rod: Compressible rod stock of polyethylene foam, polyethylene jacketed polyurethane foam, butyl rubber foam, neoprene foam; or other flexible, permanent, durable non-absorptive material as recommended by the sealant manufacturer.

PART 3 - EXECUTION

3.1 Manufacturer's Instructions:

1. Comply with manufacturer's printed instructions except where more stringent requirements are shown or specified, and except where manufacturer's technical representative directs otherwise.

B. Joint Preparation:

1. Clean joint surfaces immediately before installation of sealant or calking compound. Remove dirt, insecure coatings, moisture and other substances which would interfere with bond of sealant or calking compound. Etch concrete and masonry joint surfaces and roughen vitreous or glazed joint surfaces as recommended by sealant manufacturer.
2. Prime or seal the joint surfaces where recommended by the sealant manufacturer. Do not allow primer/sealer to spill or migrate onto adjoining surfaces.

3.2 INSTALLATION:

A. Set joint filler units at proper depth or position in the joint to coordinate with other work, including the installation of bond breakers, backer rods and sealants. Do not leave voids or gaps between the ends of joint filler units.

B. Install sealant backer rod for liquid elastomeric sealants, except where shown to be omitted or recommended to be omitted by sealant manufacturer for the application shown.

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C. Install bond breaker tape where required by manufacturer's recommendations to ensure that elastomeric sealants will perform properly.

D. Employ only proven installation techniques, which will ensure that sealants will be deposited in uniform, continuous ribbons without gaps or air pockets, with complete "wetting" of the joint bond surfaces equally on opposite sides. Fill sealant rabbet to a slightly concave surface, between a horizontal surface and vertical surface, fill joint to form a slight cove, so that joint will not trap moisture and dirt.

E. Install sealants to depths recommended by the sealant manufacturer but within the following general limitations, measured at the center (thin) section of the bead:

1. For sidewalks, pavements and similar joints sealed with elastomeric sealants and subject to traffic and other abrasion and indentation exposures, fill joints to a depth equal to 75% of joint width, but neither more than 5/8" deep nor less than 3/8" deep.
2. For normal moving joints sealed with elastomeric sealants but not subject to traffic, fill joints to a depth equal to 50% of joint width, but neither more than 1/2" deep nor less than 1/4" deep.
3. For joints sealed with non-elastomeric sealants and calking compounds, fill joints to a depth in the range of 75% to 125% of joint width.
4. Spillage: Do not allow sealants or compounds to overflow or spill onto adjoining surfaces, or to migrate into the voids of adjoining surfaces. Clean the adjoining surfaces by whatever means may be necessary to eliminate evidence of spillage.
5. Do not overheat hot-applied sealants.
6. Recess exposed edges of joint fillers slightly behind adjoining surfaces, so compressed units will not protrude from the joint.

3.3 CURE AND PROTECTION:

A. Cure sealants and calking compounds in compliance with manufacturer's instructions and recommendations, to obtain high early bond strength, internal cohesive strength and surface durability. Advise the Contractor of procedures required for the cure and protection of joint sealers during the construction period, so that they will be without deterioration or damage (other than normal wear and weathering) at the time of acceptance.

3.4 SEALANT SCHEDULE

A. Exterior Joints:

1. Perimeters of exterior openings where frames and other penetrations meet exterior facade of building: precast concrete, brick, CMU, reinforced concrete.

    a. Sealant Type - A2
    b. Sealant Type - B1 (for prefinished materials only)

2. Expansion and control joints in exterior surfaces of cast-in-place concrete walls, precast architectural wall panels.

    a. Sealant Type - A2
    b. Sealant Type - A4
    c. Backer Material Type - F1

3. Expansion and control joints in exterior surfaces of unit masonry walls.

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a. Sealant Type - A2

4. Coping joints, coping-to-facade joints, cornice and wash, or horizontal surface joints not subject to foot or vehicular traffic.

a. Sealant Type - A2
b. Sealant Type - A4
c. Sealant Type - B1 (for prefinished materials only)

5. Exterior joints in horizontal wearing and non-wearing surfaces.

a. Sealant Type - A1
b. Sealant Type - A3
c. Backer Material Type - F1

6. Paving joints and curbs.

a. Sealant Type - A4
b. Sealant Type - P1 or P2

7. Setting bed for threshold and saddles.

a. Sealant Type - E1

8. Painted metal lap or flashing joints.

a. Sealant Type - B1

B. Interior Joints:

1. Seal interior perimeters of exterior openings.
2. Expansion and control joints on interior of exterior cast-in-place concrete walls.
3. Expansion and control joints on interior of exterior surfaces of masonry walls.
4. Perimeters of interior hollow metal and aluminum frames.
5. Interior masonry vertical control joints and intersecting masonry walls; CMU-to-CMU, CMU-to-concrete.

a. For all of the above interior joints:

1) Sealant Type - A2
2) Sealant Type - A4
3) Sealant Type - B1 (for prefinished materials only)

6. Exposed interior control joints in drywall and concealed joints.

a. Sealant Type - C1
b. Sealant Type - D1

7. Joints of underside of precast beams or planks.

a. Sealant Type - A2
b. Sealant Type - A4

8. Joints at tops of non-load bearing masonry walls at underside of cast-in-place concrete.

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a. Sealant Type - A2
b. Sealant Type - A4

9. Perimeter of bath fixtures: sinks, urinals, water closets, basins, vanities, etc.

a. Sealant Type - B4

10. Interior expansion and control joints in floor surfaces exposed to foot traffic.

a. Sealant Type - A1
b. Sealant Type - A3
c. Backer Material Type - F1

11. Interior saw-cut contraction joints in exposed concrete floors exposed to heavy industrial type traffic.

a. Sealant Type - P1
b. Sealant Type - P3

12. Interior non-moving joints, including control, contraction, or construction joints, in interior floor slabs exposed to heavy duty traffic.

a. Sealant Type - P1
b. Sealant Type - P3

13. Painted metal lap joints.

a. Sealant Type - B1

C. Glazing:

1. Structural Glazing.

a. Sealant Type - B2
b. Sealant Type - B3

2. General Purpose Glazing.

a. Sealant Type - B3

3. End Damming.

a. Sealant Type - E1

END OF SECTION 07 90 00

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SECTION 09 91 00 – PAINTING INTERIOR & EXTERIOR

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. Painting and finishing of interior and exterior exposed items and surfaces throughout the project, except as otherwise indicated.
2. Surface preparation, priming and coats of paint specified are in addition to shop-priming and surface treatment specified under other sections of the work.
3. Field painting of exposed bare and covered pipes and ducts, and hangers, exposed steel and iron work, and primed metal surfaces of equipment installed under the mechanical and electrical work, except as otherwise noted.

B. "Paint", as used herein, is defined as all coating systems materials, including primers, emulsions, enamels, stains, sealers and fillers, and other applied materials whether used as prime, intermediate or finish coats.

C. Paint all exposed surfaces except where the natural finish of the material is specifically noted as a surface not to be painted. Where items or surfaces are not specifically mentioned, paint these the same as adjacent similar materials or areas.

D. Paint prefinished metal items such as:
1. All pre-primed metal building components

E. Color Coding and Identification: Is specified in respective sections of Divisions 21, through Division 28.

F. Colors: As selected.

1.3 PAINTING NOT INCLUDED:

A. The following categories of work are not included as part of the field-applied finish work, or are included in other sections of these specifications.

1. Shop Priming: Unless otherwise specified, shop priming of ferrous metal items is included under the various sections for structural steel, miscellaneous metal, hollow metal work, and similar items. Also, for fabricated components such as architectural woodwork, wood casework, and shop-fabricated or factory-built mechanical and electrical equipment or accessories.
2. Pre-Finished Items: Unless otherwise indicated, do not include painting when factory-finishing is specified for such items as (but not limited to), prefinished partition systems, acoustic materials, light fixtures, switchgear and distribution cabinets. Prefinished items to be painted are hereinbefore indicated.

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3. Concealed Surfaces: Unless otherwise indicated, painting is not required on surfaces such as walls or ceilings in concealed areas and generally inaccessible areas, foundation spaces, furred areas, utility tunnels, pipe spaces, duct shafts and elevator shafts.
4. Finished Metal Surfaces: Metal surfaces of anodized aluminum, stainless steel, and chromium plate, copper, bronze and similar finished materials will not require finish painting. (Note: Copper tubing and piping is not a finished metal.)
5. Operating Parts and Labels:

    a. Moving parts of operating units, mechanical and electrical parts, such as valve and damper operators, linkages, sinkages, sensing devices, and motor and fan shafts will not require finish painting.
    b. Do not paint over code-required labels, such as Underwriters' Laboratories and Factory Mutual, or equipment identification, performance rating, name, or nomenclature plates. Permanently remove all other labels, prior to painting.

1.4 QUALITY ASSURANCE:

A. Product Data: For information only, submit copies of manufacturer's technical information including paint label analysis and application instructions for each material proposed for use.

1. Submit a list of manufacturer's products proposed for use.
2. Upon approval of the list, submit a detailed schedule of each surface to be painted, and include the specific sealer, primer, underbody and finish coats proposed for each such surface.
3. After approval is granted, submit complete color catalog(s) for color selections.

B. Samples: Submit samples for review of color and texture only. Compliance with all other requirements is the exclusive responsibility of the Trade Contractor. Provide a listing of the material and application for each coat of each finish sample.

C. Maintenance Sample Stock: Provide the Owner with one (1) gallon, air-tight covered, of each applied paint color for future use. Identify each container with manufacturer's name, number and color designation.

D. Submit certification that materials proposed herein conform to the above requirements and to the fire test requirements of ASTM E84, Class “A” - 0-25 Flame Spread.

1. Flame Spread Rating: Provide materials with ratings in accordance with NFPA #101, "Life Safety Code", 25 or less in exitways, corridors, stairways, storage rooms or other areas of high hazard; 75 or less elsewhere.

E. VOC Compliance: Provide LOW VOC materials conforming to the State and local regulations as relating to VOC/VOS requirements at the time of application, and as follows:

1. VOC Compliance: All paints and coatings must comply with Green Seal Testing Program Limits as follows:

    a. Non-Flat Primer / Paint: 150g/L. VOC Limit
    b. Flat Primer / Paint: 50g/L. VOC Limit

F. Mock-Up:

1. Before proceeding with the Work of this Section, finish one complete space or item of each color scheme required. Show selected colors, finish textures, materials and workmanship.

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2. Accepted sample spaces or items will serve as the standard for similar work throughout the project.

1.5 DELIVERY AND STORAGE:

A. Delivery:

1. Deliver all materials to the job site in original, new and unopened packages and containers bearing manufacturer's name and label, and application instructions thereon.
2. Provide labels on each container with the following information:

a. Name of title of material.
b. Fed. Spec. number, if applicable.
c. Manufacturer's stock number.
d. Manufacturer's name.
e. Contents by volume, for major pigment and vehicle constituents.
f. Thinning instructions.
g. Application instructions.

B. Storage:

1. Provide a secure space for the storage of all paint materials and equipment for the exclusive use of this work, and maintain and leave it free from fire hazards due to improperly stored rags or thinners.

1.6 JOB CONDITIONS:

A. Apply water-base paints when the temperature of surfaces to be painted and the surrounding air temperatures are between 50 degrees F. and 90 degrees F., unless otherwise permitted by the paint manufacturer's printed instructions.

B. Apply solvent-thinned paints when the temperature of surfaces to be painted and the surrounding air temperatures are between 45 degrees F. and 95 degrees F., unless otherwise permitted by the paint manufacturer's printed instructions.

C. Do not apply paint in snow, rain, fog or mist; or when the relative humidity exceeds 85% or to damp or wet surfaces; unless otherwise permitted by the paint manufacturer's printed instructions.

1. Continue painting during inclement weather, if the areas and surfaces to be painted are enclosed and heated within the temperature limits specified by the paint manufacturer during application and drying periods.

PART 2 - PRODUCTS

2.1 COLORS AND FINISHES:

A. Painting, surface treatments and finishes, are to be determined by the Owner. The color selection for the metal components of the building are to be chosen from the Premiere Color options of the metal building manufacturer and associated components.

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B. Upon completion of the first coat, notify the Architect for his review and approval. This review and approval procedure may be done on a room by room basis so as not to impede the progress of the work.

C. Color Pigments: Pure, non-fading, applicable types to suit the substrates and service indicated.

1. Lead content in the pigment, if any, is limited to contain not more than 0.06% lead, as lead metal based on the total non-volatile (dry-film) of the paint by weight.

D. Paint Coordination: Provide finish coats, compatible with prime paints used. Review other sections of these specifications in which prime paints are to be provided to ensure compatibility of total coatings system for various substrates. Upon request, furnish information on characteristics of finish materials proposed for use, to ensure compatible prime coats are used. Provide barrier coats over incompatible primers or remove and reprime, as required. Notify the Architect, in writing, of any anticipated problems using specified coating systems with substrates primed by others.

2.2 MATERIAL QUALITY:

A. Provide the best quality grade of the various types of coatings as regularly manufactured by acceptable paint materials manufacturers. Materials not displaying the manufacturer's identification as a standard, best-grade product will not be acceptable.

B. Exterior Paint Manufacturers:

1. Sherwin Williams, as specified.
2. Benjamin Moore, as specified.
3. Or equivalent products by the following: PPG Industries or Devoe

C. Interior Paint Manufacturers:

1. Sherwin-Williams Co. "Harmony” Coating System as specified.
2. Benjamin Moore Company "Eco-Spec", as specified.
3. Or equivalent products by the following:

a. PPG Industries “Pure Performance” Low VOC line
b. Devoe "Wonder-Pure" Low VOC line

D. Proprietary names, used to designate colors or materials, are not intended to imply that products of the named manufacturers are required to the exclusion of equivalent products of other manufacturers.

E. Provide undercoat paint produced by the same manufacturer as the finish coats. Use only thinners approved by the paint manufacturer, and use only within recommended limits.

2.3 EXTERIOR PAINT SYSTEMS:

A. Provide the following paint systems for the various substrates, as indicated.

B. Ferrous Metal: (including steel doors and frames, overhead doors, coiling doors, handrails, etc.)

Gloss Finish: (4 mils wet, 1.3 mils dry per coat)

1st Coat - S-W All Surface Enamel Latex Primer, A41W210 (10 mils wet, 5 mils dry)
2nd Coat - S-W A-100 Exterior Latex Gloss, A8 Series

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3rd Coat - S-W A-100 Exterior Latex Gloss, A8 Series
(4 mils wet, 1.3 mils dry per coat)

Semi-Gloss Finish : (3-5 mils dry per coat)

1st Coat - S-W All Surface Enamel Latex Primer, A41W210 (10 mils wet, 5 mils dry)
2nd Coat - S-W Metalatex Semi-Gloss Coating, B42 Series
3rd Coat - S-W Metalatex Semi-Gloss Coating, B42 Series

First coat not required on items delivered shop primed.

or;

1st coat - Benjamin Moore M07 Universal Metal Primer- M07
2nd coat - Benjamin Moore D.T.M. Acrylic (Semi-Gloss M29) (Gloss M28)
3rd coat - Benjamin Moore D.T.M. Acrylic (Semi-Gloss M29) (Gloss M28)

C. Galvanized/Zinc Coated Metal: (architecturally exposed structural steel, including fascia; if not aluminum)

Gloss Finish: (4 mils wet, 1.3 mils dry per coat)

1st Coat - S-W All Surface Enamel Latex Primer, A41W210 (10 mils wet, 5 mils dry)
2nd Coat - S-W A-100 Exterior Latex Gloss, A8 Series
3rd Coat - S-W A-100 Exterior Latex Gloss, A8 Series

Semi-Gloss Finish (3-5 mils dry per coat)

1st Coat - S-W All Surface Enamel Latex Primer, A41W210 (10 mils wet, 5 mils dry)
2nd Coat - S-W Metalatex Semi-Gloss Coating, B42 Series
3rd Coat - S-W Metalatex Semi-Gloss Coating, B42 Series

or;

1st coat - Benjamin Moore M04 Acrylic Metal Primer - M04
2nd coat - Benjamin Moore D.T.M. Acrylic (Semi-Gloss M29) (Gloss M28)
3rd coat- Benjamin Moore D.T.M. Acrylic (Semi-Gloss M29) (Gloss M28)

D. Aluminum: (including roof top mechanical units; fascia, if not zinc coated)

Semi-Gloss Finish (3-5 mils dry per coat)

1st Coat: S-W Metalatex Semi-Gloss Coating, B42 Series
2nd Coat: S-W Metalatex Semi-Gloss Coating, B42 Series
3rd Coat: S-W Metalatex Semi-Gloss Coating, B42 Series

Gloss (4 mils wet, 1.3 mils dry per coat)

1st Coat: S-W A-100 Exterior Latex Gloss, A8 Series
2nd Coat: S-W A-100 Exterior Latex Gloss, A8 Series
3rd Coat: S-W A-100 Exterior Latex Gloss, A8 Series
(4 mils wet, 1.3 mils dry per coat)

or;

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1st coat - Benjamin Moore M04 Acrylic Metal Primer - M04
2nd coat - Benjamin Moore D.T.M. Acrylic (Semi-Gloss M29) (Gloss M28)
3rd coat - Benjamin Moore D.T.M. Acrylic (Semi-Gloss M29) (Gloss M28)

2.4 LOW ODOR - LOW VOC COMPLIANT INTERIOR PAINTS

A. Coordinate with Finish Schedule for material and colors required.

B. Masonry:

1st coat - Sherwin-Williams PrepRite Masonry Primer or Harmony Interior Latex Primer B11W900
2nd coat - Sherwin-Williams Harmony Interior Latex Eg-Shel B9 Series
3rd coat - Sherwin-Williams Harmony Interior Latex Eg-Shel B9 Series

or;

1st coat- Benjamin Moore Acrylic Masonry Sealer-066 or Eco Spec Interior Latex Primer Sealer-231
2nd coat - Benjamin Moore Eco Spec Interior Latex Eggshel 223
3rd coat- Benjamin Moore Eco Spec Interior Latex Eggshel 223

C. Ferrous Metals: (for all exposed to view metal, in finished rooms, including grilles, diffusers, piping, ducts, conduit, metal doors and frames and miscellaneous metals. When concealed from view and in mechanical equipment rooms, spot prime, only):

1st coat - Sherwin-Williams DTM Acrylic Primer/Finish
2nd coat - Sherwin-Williams Harmony Interior Latex Eg-Shel B9 Series
3rd coat - Sherwin-Williams Harmony Interior Latex Eg-Shel B9 Series

or;

1st coat - Benjamin Moore M04 Acrylic Metal Primer-M04
2nd coat - Benjamin Moore Eco Spec Interior Latex Eggshell 223
3rd coat- Benjamin Moore Eco Spec Interior Latex Eggshell 223

D. Aluminum: (for all exposed to view items, including grilles, diffusers, louvers, ducts, conduit and miscellaneous items not prefinished)

Semi-Gloss Finish (4 mils wet, 1.6 mils dry per coat)

1st Coat - S-W ProCryl Universal Primer, B66-310 Series (110 g/L)
2nd Coat - S-W Harmony Low Odor Interior Latex Semi-Gloss, B10 Series (0 VOC)
3rd Coat - S-W Harmony Low Odor Interior Latex Semi-Gloss, B10 Series (0 VOC)

PART 3 - EXECUTION

3.1 INSPECTION:

A. Examine the areas and conditions under which painting work is to be applied and do not proceed with the work until unsatisfactory conditions have been corrected.

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B. Starting of painting work will be construed as acceptance of the surfaces and conditions within any particular area.

C. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions otherwise detrimental to the formation of a durable paint film.

3.2 PREPARATION:

A. New Substrates:

1. General: Perform preparation and cleaning procedures in strict accordance with the paint manufacturer's instructions and as specified, for each particular substrate condition.

a. Remove all hardware, hardware accessories, machined surfaces, plates, lighting fixtures, and similar items in place and not to be finish-painted, or provide surface-applied protection prior to surface preparation and painting operations. Remove, if necessary, for the complete painting of the items and adjacent surfaces. Following completion of painting of each space or area, reinstall the removed items by workmen skilled in the trades involved.
b. Clean surfaces to be painted before applying paint or surface treatments. Remove oil and grease prior to mechanical cleaning. Program the cleaning and painting so that contaminants from the cleaning process will not fall onto wet, newly-painted surfaces.
c. Equipment, factory primed, including but not limited to fire extinguisher cabinets; electric panels, in finished areas; grilles; diffusers; and similar equipment not indicated to be painted "electro-statically" shall be dulled by sanding with #00 sandpaper or other approved material prior to receiving finish coats. Remove all sanding residue with water-moistened rags or other approved method.

2. Cementitious Materials: Prepare cementitious surfaces of concrete, concrete block, and cement plaster to be painted by removing all efflorescence, chalk, dust, dirt, grease, oils, and by roughening as required to remove glaze.

a. Determine the alkalinity and moisture content of the surfaces by performing appropriate tests. If the surfaces are found to be sufficiently alkaline to cause blistering and burning of the finish paint, correct this condition before application of paint. Do not paint over surfaces where the moisture content exceeds that permitted in the manufacturer's printed directions.
b. Coordinate with Division 4. If liquid cleaning solutions are used, determine the condition of the surfaces for paint application.
c. Shot blast concrete floors scheduled to be painted to provide a surface texture to receive paint.
d. If approved, prepare concrete floor surfaces with a commercial solution of muriatic acid, or other etching cleaner, flush floor with clean water to neutralize acid, and allow to dry before painting. Test slabs for dryness prior to commencing painting.

3. Wood: Clean wood surfaces to be painted of all dirt, oil or other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sandpaper smooth those finished surfaces exposed to view, and dust off. Scrape and clean small, dry, seasoned knots and apply a thin coat of white shellac or other recommended knot sealer, before application of the priming coat. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood-filler. Sandpaper smooth when dried.

a. Wood Items Not Prefinished: Coordinate with respective sections of Divisions 6 and 8. If items are not prefinished, adhere to the following requirements:

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1) Prime, stain, or seal wood required to be job-painted immediately upon delivery to job. Prime edges, ends, faces, undersides, and backsides of such wood, including cabinets, counters, cases, paneling, etc.
2) When transparent finish is required, use spar varnish for backpriming.
3) Backprime paneling on interior partitions only where masonry, plaster or other wet wall construction occurs on backside.
4) Seal tops, bottoms, and cut-outs of unprimed wood doors with a heavy coat of varnish or equivalent sealer immediately upon delivery to job.

4. Ferrous Metals: Clean ferrous surfaces, which are not galvanized or shop-coated, of oil, grease, dirt, loose mill scale and other foreign substances by solvent or mechanical cleaning.

a. Coordinate with Division 4. Determine if liquid cleaning solutions have been removed from surfaces abutting masonry.
b. Wire brush or mechanically sand rust spots to bright metal and spot prime.
c. Touch-up shop-applied prime coats wherever damaged or bare, where required by other sections of these specifications. Clean and touch-up with the same type shop primer.

5. Galvanized Surfaces: Clean free of oil and surface contaminate with an acceptable non-petroleum based solvent.

3.3 MATERIALS PREPARATION:

A. Mix and prepare painting materials in accordance with manufacturer's directions.

B. Store materials not in actual use in tightly covered containers. Maintain containers used in storage, mixing and application of paint in a clean condition, free of foreign materials and residue.

C. Stir materials before application to produce a mixture of uniform density, and stir as required during the application of the materials. Do not stir surface film into the material. Remove the film and if necessary, strain the material before using.

3.4 APPLICATION:

A. General:

1. Apply paint in accordance with the manufacturer's directions. Use applicators and techniques best suited for the substrate and type of material being applied.

B. Apply primer, intermediate and finish coats to not less than the manufacturer’s recommended wet film and dry film thicknesses and spreading rates for each of the various types of materials specified.

1. Verify mil thickness, wet or dry, by use of recommended gauges.

C. Apply additional coats when undercoats, stains or other conditions show through the final coat of paint, until the paint film is of uniform finish, color and appearance. Give special attention to insure that all surfaces, including edges, corners, crevices, welds and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.

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D. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Paint surfaces behind permanently-fixed equipment or furniture with prime coat only before final installation of equipment.

E. Paint interior surfaces of ducts, where visible through registers or grilles, with a flat, non-specular black paint.

F. Paint the back sides of access panels, and removable or hinged covers to match the exposed surfaces.

G. Finish doors on tops, bottoms and side edges the same as the faces, unless otherwise indicated.

H. Sand lightly between each succeeding enamel or varnish coat.

I. Omit the first coat (primer) on metal surfaces which have been shop-primed and touch-up painted, unless otherwise indicated.

J. Scheduling Painting:

1. Apply the first-coat material to surfaces that have been cleaned, pretreated or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
2. Allow sufficient time between successive coatings to permit proper drying. Do not recoat until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and the application of another coat of paint does not cause lifting or loss of adhesion of the undercoat.

K. Minimum Coating Thickness: Apply each material at not less than the manufacturer's recommended spreading rate, to establish a total dry film thickness as indicated or, if not indicated, as recommended by coating manufacturer.

L. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to those items exposed to view on the building exterior, in mechanical equipment rooms and in finished spaces.

1. Mechanical items to be painted include, but are not limited to, the following:

a. Roof appurtenances including fan housings, exhaust hoods, fan covers, vent stacks, vent covers and grilles.
b. Convectors, radiation units, cabinet heaters, unit ventilators.
c. Piping, pipe hangers and supports.
d. Heat exchangers.
e. Tanks.
f. Ductwork, insulation.
g. Motors and mechanical equipment and supports.
h. Accessory items, including grilles, diffusers and louvers.

2. Electrical items to be painted include, but are not limited to, the following:

a. Conduit and fittings.
b. Panels.
c. Panel backboards.

M. Prime Coats: Apply a prime coat of material which is required to be painted or finished, and which has not been prime coated by others.

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1. Recoat primed and sealed surfaces where there is evidence of suction spots or unsealed areas in first coat, to assure a finish coat with no burn-through or other defects due to insufficient sealing.
2. Apply prime coat to all surfaces including surfaces indicated to receive other finishes.

N. Pigmented (Opaque) Finishes: Completely cover to provide an opaque, smooth surface of uniform finish, color, appearance and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness or other surface imperfections will not be acceptable.

O. Transparent (Clear) Finishes: Use multiple coats to produce glass-smooth surface film of even luster. Provide a finish free of laps, cloudiness, color irregularity, runs, brush marks, orange peel, nail holes or other surface imperfections.

1. Provide satin finish for final coats, unless otherwise indicated.

P. Completed Work: Match approved samples for color, texture and coverage. Remove, refinish or repaint work not in compliance with specified requirements.

3.5 CLEAN-UP AND PROTECTION:

A. Clean-up: During the progress of the work, remove from the site all discarded paint materials, rubbish, cans and rags at the end of each work day.

1. Upon completion of painting work, clean window glass and other paint-spattered surfaces. Remove spattered paint by proper methods of washing and scraping, using care not to scratch or otherwise damage finished surfaces.

B. Protection: Protect work of other trades, whether to be painted or not, against damage by painting and finishing work. Correct any damage by cleaning, repairing or replacing, and repainting, as acceptable to the Architect.

1. Provide "Wet Paint" signs as required to protect newly-painted finishes. Remove temporary protective wrappings provided by others for protection of their work, after completion of painting operations.
2. At the completion of work of other trades, touch-up and restore all damaged or defaced painted surfaces.

END OF SECTION 09 91 00

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SECTION 315000 – EARTHWORK FOR SMALL PROJECTS

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 DESCRIPTION OF WORK:

A. Strip soil as herein specified or indicated.

B. Stockpile surplus topsoil, if any, on site where directed.

C. Excavation for foundations, rough grading, utility services and extensions. Excavation of all trades is included herein.

D. Provide additional material hereinafter specified or needed for fills. Remove from site excess material and that which is unsuitable for filling, and legally dispose of it.

E. Backfilling (including all trades).

F. Compact fills as hereinafter specified.

G. Repair any major deformations caused by the removal of large boulders, cave-ins, etc., with concrete, compacted bank run gravel or crushed stone.

H. Protection and Precautionary Measurements:

1. Carefully maintain bench marks, monuments and other reference points. If disturbed or destroyed, replace as directed.

2. Protect active pipes, if encountered, and notify persons owning same. If encountered, remove inactive utilities from within building lines. Plug or cap where indicated or directed.

3. Protect persons and property from damage and discomfort caused by dust. Water as necessary to quell dust.

I. Erosion Control:

1. Employ satisfactory methods and operations to minimize erosion of soil during earthwork operations. Follow accepted standards of the R.I.D.O.T. for erosion control.

1.3 RELATED WORK UNDER OTHER SECTIONS:

A. Spreading and/or providing new topsoil - Section 329200 Landscaping.

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1.4 ELEVATION AND OBSTRUCTIONS:

A. The Contract is based upon the following: that the surface elevations, utilities and physical features are as indicated and the contractor shall be responsible to verify its accuracy both underground and overhead. There will be no extra payment for additional work required due to conflicts with the survey information either shown or not shown.

B. Ground water levels indicated are those existing at the time subsurface investigations were made and do not necessarily represent permanent ground water levels. It is the Contractor's responsibility to determine seasonable variations in ground water levels which may affect the work. There will be no extra payment for any class of rock excavation.

1.5 QUALITY ASSURANCE:

A. Materials, methods and compaction tests will be subject to approval of an approved inspection agency specified in Section 014000.

B. Code and Standards: Perform excavation work in compliance with applicable requirement of governing authorities having jurisdiction.

1.6 REQUIREMENTS:

A. One gradation curve and moisture-density curve for each type of material specified or proposed for use for approval. (AASHTO T-27 and AASHTO T-180)

B. A minimum of two in-place density tests for each lift of material placed or two for each 200 cubic yards of material placed, whichever results in the greatest number of tests. (AASHTO T-191, T-205 or T-310 In-Place Density Testing by Nuclear Methods)

1. Topsoil Analysis - documenting pH and organic content of on-site material and material to be hauled in.

2. Material delivered to the project shall be tested for compliance with the approved gradation, one test shall be made for each 750 cubic yards of material delivered.

C. Prior to production and delivery to the site the Contractor shall, together with a representative of the Testing Laboratory chosen by the Owner, obtain at the source two representative 50 lb. samples of all materials proposed for use. Samples shall be placed in lined containers so as to prevent any loss of material during transportation. One sample will be analyzed by the Testing Laboratory for conformance with this specification, should the material be rejected a second at the source sampling shall be made. Upon approval of a material, the second sample taken at the source and not used for analysis shall be delivered by the Testing Laboratory to the Owner's representative at the site for his use. Each sample taken shall be clearly marked as follows:

1. Project Name
2. Architect's Name
3. Contractor's Name
4. Supplier's Name and Source
5. Date Sample Taken
6. Name of Sampler
7. Intended Use and Specification Reference

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D. Test results shall be approved before delivery of any material to the site. Any change in source of materials or quality will require a new series of tests at no additional expense to the Owner.

E. All unsatisfactory work and any settlement within one (1) year of final acceptance shall be removed, replaced and retested at the Contractor's expense.

1.7 MISCELLANEOUS REQUIREMENTS:

A. Traffic: Conduct operations and the removal of debris to ensure minimum interference with roads, streets, walks and other adjacent occupied or used facilities.

1. Do not close or obstruct streets, walks or other occupied or used facilities without permission from authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.

2. Provide all traffic control required and pay all costs incurred.

B. Damages: Promptly repair damages caused to adjacent facilities by operations, as directed and at no additional cost.

PART 2 - PRODUCTS

NOT APPLICABLE.

PART 3 - EXECUTION

3.1 EXCAVATIONS:

A. Topsoil Removal:

1. Before starting to excavate, strip available topsoil, subsoil and unsuitable material from areas to be covered by improvements and where cuts or fills are required.

2. Topsoil is defined as friable clay from surface soil found in a depth of not less than 4". Satisfactory topsoil is reasonably free of subsoil, clay lumps, stones, and other objects over 2" in diameter, and without weeds, roots, and other objectionable material.

a. pH - 5.5 to 7.6 Organic content - 5% minimum, 20% maximum.

3. Verify depth of topsoil within contract limits. If additional topsoil is needed to fulfill topsoil spread requirements, contractor shall provide topsoil from off-site sources as part of this contract, at his expense.

4. Strip topsoil to whatever depths encountered, unless shown otherwise, and in such manner so as to prevent intermingling with the underlying subsoil or other objectionable material. Remove heavy growths of grass from areas before stripping.

5. Remove unsuitable materials and legally dispose of off site.

6. Stockpile topsoil in storage piles in areas shown, or where otherwise indicated. Construct storage piles to freely drain surface water. Cover storage piles if required to prevent windblown dust. Topsoil remains property of Owner.

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B. General Open Earth Excavation:

1. Excavate as necessary for work shown or specified. Remove earth, rocks, boulders, and other obstructions as herein defined.

2. Allow ample space for form work.

3. Leave bearing surfaces undisturbed, level and true. Excavate to solid bearing at elevations no higher than those shown.

C. Rock Excavation:

1. Remove all rock to the levels indicated below, or as directed.

2. There will be no extra payment for all classifications of rock removal.

3. Rock is defined as boulders; stone or hard shale in original ledge; concrete footings, foundations, etc.; and other obstructions, in excess of one cubic yard, which cannot be broken and removed from site by normal job equipment (power shovels, 1-1/2 cubic yard capacity scoops, or bulldozers).

4. Level off or shelve rock surfaces to a slope not exceeding one (1) vertical to twelve (12) horizontal, or as directed; before placing masonry or concrete on it.

D. Extent of Rock Removal:

1. For structures or portions thereof: one foot outside the base of walls or footings.

2. For floor slabs or existing building slab removal: six (6) inches below the bottom of slabs on grade.

3. Walks, Plaza, and paved areas: eight (8) inches below the subgrade lines.

4. Lawn and shrub areas: eighteen (18) inches below finish grade.

E. Unauthorized Excavation:

1. Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction of Architect.

a. Under footings, foundation bases or retaining walls, fill unauthorized excavation by extending the indicated bottom elevation of the footing or base to the excavation bottom without altering required top elevation. Lean concrete fill may be used to bring elevations to proper position, only when acceptable.

b. Elsewhere, backfill and compact unauthorized excavations as specified for authorized excavations of same classification, unless otherwise directed.

c. Do all corrective work as specified above at no expense to the Owner.

F. Stability of Excavations:

1. Slope sides of excavations to comply with local codes and ordinances having jurisdiction. Shore and brace where sloping is not possible either because of space restrictions or stability of material excavated.

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2. Maintain sides and slopes of excavations in a safe condition until completion of backfilling.

G. Water and Frost:

1. Keep earth under footings and slabs dry and free from frost.

2. Should bearing surfaces be softened by water or frost, re-excavate to solid bearing and fill with concrete or gravel as directed at no expense to Owner.

3.2 FILLING:

A. General:

1. Remove debris and organic matter before filling.

2. Use approved materials only for fills.

3. Obtain Architect's approval before filling.

4. Make fills as soon as feasible thereafter to insure maximum settlement.

5. Do not place fill on frozen ground.

6. Provide all material free from frost, roots and other vegetable matter, large rocks, rubbish, brick and other undesirable material.

7. Install fills in indicated thicknesses.

8. Provide neat, uniform side slopes (smooth and graded) to those excavations not required to be filled.

B. Fill Materials: Unless specifically shown otherwise, use the following materials:

1. "Graded Gravel Fill" (under slab on grade at building, Plaza and sidewalks; although a similar graded bank-run gravel may be acceptable) free from loam, recycled materials, and other specified undesirable materials, conforming to the following analysis:

Sieve Size	% Passing by Weight
3"	100
1-1/2	75-95
3/4"	60-85
3/8"	45-75
#4	30-65
#40	6-25
#200	0-4

a. On-site material may be used under Plaza and sidewalks areas only after satisfactory test data has been submitted, and only with the Architect's approval.

2. "Bank Run Gravel" in pipe trenches, around manholes and catch basins, against dampproofed foundation walls, where indicated as "gravel fill", and where else shown, free from loam, recycled materials, and other specified undesirable material, and conforming to the following analysis:

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Sieve Size	% Passing by Weight
3"	100
1/2"	50-85
3/8"	45-80
#4	40-75
#40	15-35
#200	0-8

a. On-site material may be used, only after satisfactory test data has been submitted, and only with the Architect's approval.

3. "Stone" (to stabilize utilities and foundations as necessary and where indicated) conforming to the following analysis:

Sieve Size	% Passing by Weight
2-1/4"	100
2"	90-100
1-1/2"	30-55
1-1/4"	0-25
1"	0-5
#200	0

4. "Filter Stone" (around french drains and combination drains, at retaining walls and where else indicated) shall be washed and free from clay, silt, organic matter, or other objectionable material and conforming to the following analysis:

Sieve Size	% Passing by Weight
1"	100
3/4"	70-85
1/2"	10-40
3/8"	0-20
#4	0-5
#200	0

5. "Sand" (if indicated) consisting of clean, inert, hard, durable grains of quartz or other hard durable rock; free from loam or clay, surface coatings and deleterious material; and conforming to the following analysis:

Sieve Size	% Passing by Weight
#8	100
#50	25-40
#100	0-10
#200	0-5

6. Fill Material for Other Areas:

a. Any of the aforementioned.

b. Excess on-site material, as approved.

3.3 COMPACTION:

A. General:

1. Prior to the placement of any fill or backfill, the natural ground under the building area and areas to be paved shall be compacted using an approved vibratory compactor.

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Where area is sufficient for proof rolled with vehicle, provide at least two passes of a fully loaded ten wheel dump truck or equivalent to verify firm ground, in areas inaccessible to proof rolling, an approved vibratory compactor shall be used.

2. Place fill in horizontal layers, beginning with the lowest areas and building up until the entire area to be filled is at a uniform elevation.

3. Compact each layer with an approved vibratory device to achieve minimum density requirements.

4. Continue compaction of each layer until there is no evidence of weaving or creeping. Compact places inaccessible to large equipment with approved mechanical tampers as well as around the perimeter of foundations, walls and around column pedestals and footings.

5. Do not use rolling equipment in the area adjacent to the foundation and retaining walls.

6. Earth in cut sections for roadway and parking lot areas shall be excavated to subgrade. The resulting surface of the cut shall be compacted as required, to not less than 95% of maximum density.

7. Earth in embankment section for roadway and parking lot areas, below a plane of one foot below subgrade shall be compacted to not less than 95% of maximum density in 12 inch loose layers.

8. Remainder of the roadway section up to subgrade shall be compacted to 95% of maximum density in two 6 inch layers.

9. For compaction within building areas and/or beneath structures with foundations, see "Controlled Compacted Fill".

10. Elsewhere, compact to 95% of maximum density in 12 inch loose layers, except for two 6 inch layers directly over pipes.

11. Attention is directed to the grain size characteristics of the material and necessity for and difficulty of controlling and maintaining optimum moisture content during compaction. Material in each layer shall contain optimum moisture for maximum density compaction and the optimum moisture content shall be uniformly distributed throughout the layer. Harrowing or other working of the material may be required to produce uniformity and control of the water content.

12. Slope the surface of each layer 1%, plus or minus .25% at the conclusion of each day's work to provide surface drainage.

13. Maximum density for compacted soils shall be determined by ASTM D 1557, Method C.

14. Whenever in-place densities are below minimum acceptable limits, as determined by AASHTO T-191, T-205 or T-310 In-Place Density Testing by Nuclear Methods, additional compaction will be required to produce the specified densities, without additional cost to the Owner. When greater densities than the minimum specified are required by the Architect, the work will be subject to contract unit prices.

3.4 CONTROLLED COMPACTED FILL:

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A. All fills within the building area and/or beneath foundations shall be constructed prior to construction of foundations and shall be constructed under laboratory control to result in 98% of maximum density at optimum moisture below footing elevations and 95% of maximum density from elevation of bottom of footing to underside of slab. The extent of this fill is within 3 feet of foundations, proceeding out at a 45 degree angle, or as indicated on the site plan and in the typical earthwork section, or as directed.

B. The area to be filled shall be cleared of all loose material and inspected and approved by the Geotechnical Engineer.

1. Fill material shall be free from frost and shall not be placed on frozen ground. Fill shall be deposited in layers of such thickness as required by its nature or as directed, but the uncompacted thickness of each layer shall not exceed 8".

2. Each layer shall be separately compacted to a uniform solid mass by use of vibratory compactors or other approved equipment. Fill shall be placed in horizontal layers, beginning with the lowest areas and building up until the entire area to be filled is at a uniform elevation.

3. The Contractor shall control the moisture content of the fill material, as directed by the laboratory to insure maximum density by either the addition of water, or by harrowing and working prior to compacting.

4. Each layer shall be free of ruts and shall meet compaction requirements before a succeeding layer is placed. Compaction of each layer shall continue until no weaving or creeping takes place.

C. Backfill in areas excavated after construction of the fill shall be constructed in layers whose loose thickness shall not exceed 6" and shall be thoroughly compacted with approved hand equipment to the density hereinbefore specified.

D. Field tests of moisture content prior to compaction and dry weight after compaction shall be made by the laboratory to insure thorough and uniform compaction. Testing shall be performed on the layer just compacted.

E. At least two tests of moisture content shall be made each day. Additional tests shall be made if material or moisture conditions change.

3.5 ROUGH GRADING:

A. General:

1. Grade entire area of work area on property to reasonably true and even surfaces, thoroughly compacted to indicated elevations.
2. Slope ground away from existing and/or new building walls to facilitate drainage.
3. Grade to uniform levels or slopes between points where grades are noted or as necessary to facilitate proper drain per building codes.
4. Round surfaces at abrupt changes in levels.
5. Should figures conflict with contours, consult Architect.

B. Levels:

1. Grade paving, walks and other surfaces areas to subgrade.
2. Grade lawn areas to 6" below finish grades.

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3. Ground cover areas to 9" below finish grade.
4. Shrub beds to 3" below finish grade.

C. Grading Around Trees:

1. Raising Grade: (not more than 16 inches)
2. Place washed gravel directly around trunk before any earth fill is placed near tree.
3. Extend gravel not less than 18 inches around all sides of tree, top approximately 2 inches above finished grade at tree.

3.6 USE OF EXPLOSIVES:

A. The use of explosives will not be permitted.
B. Mechanical means shall be employed for rock removal.
C. Non explosives agents such as Bustar (formally called Bristar) may be used when approved by Owner and Architect prior.

END OF SECTION 31 50 05

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PART 1 GENERAL

1.1 SECTION INCLUDES

A. Modular and pre-formed panels and support framing for site screening including the following:
1. Powder coated metal.
2. Painted metal.
3. Operable access gates.

B. Related Work:
1. Section 099000 – Painting for touch-up painting required for scratches and screw heads and field painting of prime painted screens.

1.2 REFERENCE STANDARDS

A. ASTM International (ASTM):
1. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts (Inch and Metric)
2. ASTM B 209 - Aluminum and Aluminum Alloy Sheets and Plates.
3. ASTM B 221 - Aluminum and Aluminum Alloy Extruded Bars, Rods, Wire Profiles, and Tubes.
4. ASTM F436 - Standard Specification for Hardened Steel Washers Inch and Metric Dimensions
5. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength

B. The Aluminum Association, Inc. (AA): AA ADM - Aluminum Design Manual.

C. American Society of Civil Engineers (ASCE): ASCE 7 - Minimum Design Loads for Buildings and Other Structures.

1.3 SUBMITTALS

A. Submit under provisions of Section 01 30 00.

B. Product Data:
1. Manufacturer's data sheets on each product to be used.
2. Preparation instructions and recommendations.
3. Storage and handling requirements and recommendations.
4. Typical installation methods.
5. Sufficient data and detail to indicate compliance with these specifications.

C. Verification Samples: Two representative units of each:
1. Material Type:
a. Powder coated metal.
b. Painted metal.
2. Color Selection: Submit paint chart with full range of colors available for Architect's selection. Custom color samples available upon purchase.

D. Shop Drawings: Prior to commencement of fabrication, submit detailed shop drawings, showing profiles, sections of components, finishes, and fastening details. Include plan elevation pages to clearly outline screenwall or enclosure locations.

E. Color Charts: Color charts showing manufacturer’s full range of colors from standard line

F. Closeout Submittals: Warranty documents, issued and executed by manufacturer, countersigned by Contractor.

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1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with a minimum two years documented experience.

B. Installer Qualifications: Company specializing in performing Work of this section with minimum two years documented experience with projects of similar scope and complexity.

C. Source Limitations: Provide each type of product from a single manufacturing source to ensure uniformity.

1.5 PRE-INSTALLATION CONFERENCE

A. Pre-Installation Conference: Convene approximately two weeks before scheduled commencement of the Work. Attendees shall include Architect, Contractor and trades involved. Agenda shall include schedule, responsibilities, critical path items, and approvals.
1. Notify Architect a minimum of four calendar days in advance of scheduled meeting date.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly indicating manufacturer and material.

B. Storage and Handling: Protect materials and finishes during handling and installation to prevent damage.

C. Protection: Protect from damage due to weather, excessive temperature, and construction operations.

1.7 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

B. Field Measurements: Take measurements of supporting paving, footings, or piers. Indicate measurements on shop drawings fully documenting any field condition that may interfere with the screen system installation.

1.8 COORDINATION

A. Installer for work under this Section shall be responsible for coordination of panel and framing sizes and required options with the Contractor's requirements.
1. Request information on sizes and options required from the Contractor.

B. Submit shop drawings and obtain written approval of shop drawing prior to fabrication.

C. Confirm size, type, and location of supporting construction as adequate to resist column supports.

1.9 WARRANTY

A. Warranty: Provide manufacturer’s standard limited warranty, starting from the date of substantial completion of the project.

PART 2 PRODUCTS

2.1 MANUFACTURERS

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A. Bases of design Covrit Gates and Screening System by CityScapes International Inc; 4200 Lyman Ct., Hilliard, OH 43026; Toll Free: 877-SCREENS; Phone: 614-850-2549; Email: contact@cityscapesinc.com; www.cityscapesinc.com.

B. Requests for substitutions will be considered in accordance with provisions of Division 01.

2.2 PERFORMANCE AND DESIGN REQUIREMENTS

A. Regulatory Requirements: Comply with requirements of building authorities having jurisdiction in Project location.

B. Design Criteria: Manufacturer is responsible for the structural design of all materials, assembly, and attachments to resist snow, wind, suction, and uplift loading at any point without damage or permanent set.
1. Framing: Designed in accordance with the Aluminum Design Manual to resist the following loading:
a. ASCE 7 - Minimum Design Loads for Buildings and Other Structures; American Society of Civil Engineers.

2.3 MATERIALS

A. Basis of Design: Covrit Enclosures and Ground Screens as manufactured by CityScapes.

B. Fasteners and Hardware: Zinc plated or stainless steel.

C. Mounting: Determined by site conditions and/or engineering recommendations
1. Post Embedment: As detailed on the Drawings.

D. Posts, Gate Frame, and Top and Bottom Rails: Material: Al 6005-T5 Extruded Material
1. Post Cap: Fitted.

E. Wall and Gate Infill:
1. Material: Al 6063-T6. Louver Blades

F. Hardware:
1. Hinges: Cradle.
2. Handles: Modern.
3. Latches: Modern.
4. Drop Bolts: Stainless steel. Size: 40 x 0.56 inches (1016 x 14.3 mm).
5. Secure Access Latches for Pedestrian Doors: Keyed entry.

G. Paneling: Minimum Thickness: 0.050 inches (1.27 mm).
1. Aluminum Extruded Shapes: Powder coated.

H. Operable Access Gates: Minimum Panel thickness: 0.050 inches (1.27 mm).
1. Powder coated extruded Aluminum shapes.

I. Threaded Fasteners: Screws, bolts, nut, and washers to be Stainless Steel.
1. Post Backer assembly fasteners shall be No. 10-16 stainless steel Self-Drilling screws.
2. Provide lock washer or other locking device at all bolted connections.

2.4 FABRICATION

A. Modular and Factory-Formed Panel Systems: Continuous interlocking panel connections and indicated or necessary components.
1. Form components true to shape, accurate in size, square and free from distortion or defects. Cut panels to precise lengths indicated on approved shop drawings.

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B. Fabricate products to the following configurations:
1. Panel Style: Metal louver.
2. Gate Style: Custom.
3. Panel Height: Custom.
4. Panel and Gate Height: Custom.
5. Gate Width: 78 inches (1981 mm).
6. Post Cap Style: Aluminum fitted cap.
7. Enclosure Layout: 60 x15 ft.
8. Trim and Closures: Fabricated and finished with Manufacturer’s standard coating system, unless shown otherwise on drawings.

C. Framing: Fabricate and assemble components in largest practical sizes, for delivery to the site.
1. Construct corner assemblies to required shape with joints tightly fitted.
2. Provide components required for anchorage of framing. Fabricate anchors and related components of material and finish as required, or as specifically noted.

D. Gate Hardware: Provide manufacturer’s adjustable standard of size required to fit support pipe provided.
1. Hinge Type: Hold open pipe.

2.5 FINISHES

A. Panel Coating: Manufacturer's standard powder coating system, factory applied.
1. Color: Selected from full range of manufacturer's standard colors.

PART 3 EXECUTION

3.1 EXAMINATION

A. Installer's Examination: Examine conditions under which construction activities of this section are to be performed.
1. Submit written notification to Architect and Screen manufacturer if such conditions are unacceptable.
2. Beginning erection constitutes installer's acceptance of conditions.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

A. Install units in accordance with the manufacturer's instructions and approved shop drawings. Keep perimeter lines straight, plumb, and level. Provide brackets, anchors, and accessories necessary for complete installation.

B. Fasten structural supports to/into paving, footings, or piers at spacing as indicated on approved shop drawings.

C. Where aluminum materials would contact dissimilar materials, insert rubber grommets at attachment points, thus eliminating where dissimilar metals would otherwise be in contact.

D. Do not cut or abrade finishes which cannot be restored. Return items with such finishes to shop for required alterations.

3.4 ERECTION TOLERANCES

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A. Tolerances: Maximum misalignment from true position 1/4 inch (6 mm).

3.5 CLEANING AND PROTECTION

A. Remove protective masking from material immediately after installation.

B. Protection:
1. Ensure that finishes and structure of installed systems are not damaged by subsequent construction activities.
2. If minor damage to finishes occurs, repair damage in accordance with manufacturer's recommendations; provide replacement components if repaired finishes are unacceptable to Architect.

C. Prior to Substantial Completion: Remove dust or other foreign matter from component surfaces; clean finishes in accordance with manufacturer's instructions.
1. Clean units in accordance with the manufacturer's instructions.

END OF SECTION

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SECTION 230500 – BASIC MECHANICAL MATERIALS AND METHODS

PART 1 – GENERAL

1.1 PROVISIONS INCLUDED

A. Include General Conditions.

B. Supplementary General Conditions

C. See Division 21 for Fire Protection

D. See Division 22 for Plumbing.

E. See Divisions 26 and 28 for Electrical.

F. Examine all other Sections of the specifications for requirements which affect work under this Section whether or not such work is specifically mentioned in this Section.

G. Coordinate work with that of all other Trades affecting, or affected by work of this Section. Cooperate with such Trades to ensure the steady progress of all work under the Contract.

1.2 DEFINITIONS

A. Words in the singular shall also mean and include the plural, wherever the context so indicates and words in the plural shall mean the singular, wherever the context so indicates.

B. Wherever the terms "shown on drawings" are used in the specifications, they shall mean "noted", "indicated", "scheduled", "detailed", or any other diagrammatic or written reference made on the drawings.

C. Wherever the term "provide" is used in the specifications it will mean "furnish" and "install", "connect", "apply", "erect", "construct", or similar terms, unless otherwise indicated in the specifications.

D. Wherever the term "material" is used in the specifications it will mean any product", "equipment", "device", "assembly", or "item" required under the Contract, as indicated by trade or brand name, manufacturer's name, standard specification reference or other description.

E. The terms "approved", or "approval" shall mean the written approval of the Architect.

F. The term "specification" shall mean all information contained in the bound or unbound volume, including all "Contract Documents" defined therein, except for the drawings.

G. The terms "directed", "required", "permitted", "ordered", "designated", "prescribed" and similar words shall mean the direction, requirement, permission, order, designation or prescription of the Architect. The terms "approved", "acceptable", "satisfactory" and similar words shall mean approved by, acceptable or satisfactory to the Architect. The terms "necessary", "reasonable", "proper", "correct" and similar words shall mean necessary, reasonable, proper or correct in the judgment of the Architect.

H. "Piping" includes in addition to pipe or mains, all fittings, flanges, unions, valves, strainers, drains, hangers and other accessories relative to such piping.

I. "Concealed" means hidden from sight in chases, furred spaces, shafts, hung ceilings, embedded in construction or in crawl spaces.

J. "Exposed" means not installed underground or "concealed" as defined above.

K. "Invert Elevation" means the elevation of the inside bottom of the pipe.

L. "HVAC, Plumbing, and/or Fire Protection Contractor" shall refer to the Contractor or his Subcontractors responsible for furnishing and installation of all work indicated on the HVAC, Plumbing, and/or Fire Protection drawings and specifications, as applicable and or referenced to each Trade in the Architectural and/or Structural documents.

M. "Mechanical Contractor" shall refer to the Fire Protection, Plumbing, HVAC and ATC Contractors, as applicable.

N. "Architect" shall refer to the Architect “fdw A+U” and/or Engineer “DM Engineers” and/or Owner.

O. "Owner" shall refer to the designated representatives of the Project Owner.

P. "General Contractor" shall refer to the Contractor(s) performing work under other sections of the Contract Specifications.

Q. “Commissioning Agent (CA)” shall refer to the party employed by the Owner to witness the demonstration of all systems according to the commissioning plan.

1.3 CODES, STANDARDS AND REFERENCES

A. All materials and workmanship shall comply with all applicable Codes, Specifications, Local and State Ordinances, Industry Standards and Utility Company Regulations, latest editions.

B. In case of difference between Building Codes, State Laws, Local Ordinances, Industry Standards and Utility Company Regulations and the Contract Documents, the Mechanical Contractor, as applicable, shall promptly notify the Architect in writing of any such difference.

C. In case of conflict between the Contract Documents and the requirements of any Code or Authorities having jurisdiction, the most stringent requirements of the aforementioned shall govern for budgetary purposes. However, no work will proceed until the Architect determines the correct method of installation.

D. Should any Contractor, as applicable, perform any work that does not comply with the requirements of the applicable Building Codes, State Laws, Local Ordinances, Industry

Standards and Utility Company Regulations, he shall bear all costs arising in correcting the deficiencies, as approved by the Architect.

E. Applicable Codes and Standards shall include all State Laws, Local Ordinances, Utility Company Regulations and the applicable requirements of the following accepted Codes and Standards, without limiting the number, as follows:

1. National Electrical Code (NEC)

2. Environmental Protection Agency (EPA)

3. New York City - Environmental protection

4. 2020 New York City Energy Code

5. 2022 New York City Construction Codes

6. Local Ordinances, Regulations of the Local Building Department and Fire Department

7. Guidelines for Construction and Equipment of hospital and Medical Facilities, as published by A.I.A. Press, ISBN 1-57165-002-4, U.S. Dept. of Health and Human Services

8. Recommendations of the National Fire Protection Association (NFPA), latest applicable edition adopted, in general and in particular:

   a. Life Safety, NFPA 101

   b. HVAC, NFPA 90A, 90B

   c. Removal of Smoke and Grease Laden Vapors from Commercial Cooking Equipment, NFPA 96

   d. Hospitals, NFPA 99

9. Recommendations of ASHRAE (American Society of Heating, Refrigeration and Air Conditioning Engineers), including:

   a. ASHRAE 90.1

   b. ANSI/ASHRAE 62-Ventilation for Acceptable Indoor Air Quality

   c. ANSI/ASHRAE 15-Safety Code for Mechanical Refrigeration

   d. ANSI/ASHRAE 110-Method of Testing Performance of Laboratory Fume Hoods

   e. ANSI/ASHRAE 55-Thermal Environmental Conditions for Human Occupancy

F. In these specifications, references made to the following Industry Standards and Code Bodies are intended to indicate the accepted volume or publication of the Standard. All equipment, materials and details of installation shall comply with the requirements and latest revisions of the following Bodies, as applicable:

1.	AMCA	Air Moving and Conditioning Association
2.	ANSI	American National Standards Institute
3.	ARI	American Refrigeration Institute
4.	ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers
5.	ASME	American Society of Mechanical Engineers
6.	ASTM	American Society of Testing Materials
7.	AWS	American Welding Society
8.	CS	Commercial Standards, U.S. Department of Commerce
9.	FMG	Factory Mutual Global
10.	FS	Federal Specification, U.S. Government
11.	MSS	Manufacturers Standardization Society of the Valve and Fittings Industry
12.	NEMA	National Electrical Manufacturers Association
13.	SMACNA	Sheet Metal and Air Conditioning Contractors' National Association
14.	UL	Underwriters Laboratories, Inc.

G. Each Contractor for the work under his charge, shall give all necessary notices, obtain and pay for all permits, pay all governmental taxes, fees and other costs in connection with his work; file for necessary approvals with the jurisdiction under which the work is to be performed. Each Contractor shall obtain all required Certificates of Inspection for his work and deliver same to the Architect before request for acceptance of his portion of work and before final payment is made.

H. All equipment shall be installed per manufacturer's recommendations and requirements. The Contractor shall notify the Engineer in writing when they intend to deviate from manufacturer's installation guidelines. The Engineer shall advise if the installation is acceptable prior to installation.

1.4 SUBMITTALS

A. Submit detailed shop drawings or brochures for approval of equipment and material proposed to be used on this project. Furnish the number of copies required by General Conditions.

B. Documents submitted shall show the following:

1. Principal dimensions and details of construction.

2. Operating and maintenance clearances.

3. Weights of principal parts and total weights with information required for the design of supports and foundations.

4. Sizes and location of piping and connections.

5. Performance data, including pump and fan curves; sound data including sound power dB levels in 1/3 octave bands.

6. Data on electric motors, including brake horsepower of driven equipment, nameplate ratings and classes, sound data, starting and running full load currents, required starter size and recommended overload heater ratings.

7. Approval stamp of Underwriters' and other authorities having jurisdiction of Contract Drawings requiring such approval.

8. Certified performance guarantees.

9. Calculations and details for refrigeration for field assembled systems including description of specialties and pressure drops, layout of piping with lengths fittings, and refrigerant specialties, and capacity curves for evaporator and compressor showing balance points.

10. Minimum scale for sheet metal plans and piping plans shall be ¼ inch equal 1 foot.

C. Submit brochures that contain only that information which is relative to the particular equipment or materials to be furnished. Do not submit catalogs that describe several different items other than those items to be used unless irrelevant information is marked out and relevant material is clearly marked.

D. Specifications Compliance Statement

1. The manufacturer shall submit a point by point statement of compliance with the specifications.

2. The statement of compliance shall consist of a complete copy of the project specifications with a line by line compliance statement.

3. Where the proposed system complies fully, such shall be indicated by placing the word "comply" opposite the line or paragraph number.

4. Where the proposed system does not comply, or accomplishes the stated function in a manner different from that described, a full description of the deviation shall be provided.

5. Where a full description of a deviation is not provided, it shall be assumed that the proposed system does not comply with the paragraph in question.

6. Submissions which do not include a point by point statement of compliance as specified shall be disqualified.

1.5 GUARANTEE

A. Attention is directed to provisions of the General Conditions and Supplementary General Conditions regarding guarantees and warranties for work under this Contract.

B. Manufacturers shall provide their standard guarantees for work under this Contract, unless specified otherwise. However, such guarantees shall be in addition to and not in lieu of all other liabilities which the manufacturer and GC / CM may have by Law or by other provisions of the Contract Documents. In any case, such guarantees and warranties shall commence when the Owner accepts the various systems, as applicable and as determined by the Architect. The guarantees and warranties will remain in effect for a minimum period of (1) year thereafter except where longer periods are specifically stated and specified.

C. All materials, items of equipment and workmanship furnished under HVAC, shall carry the warranty against all defects in material and workmanship. Any fault due to defective or improper material, equipment, workmanship or design which may develop shall be made good, forthwith, by and at the expense of the Contractor responsible, including all other damage done to areas, materials and other systems resulting from this failure.

D. Each Contractor shall guarantee that all elements of the systems provided under his Contract, are of sufficient capacity to meet the specified performance requirements as set forth herein or as indicated on the drawings.

E. Upon receipt of notice from the Owner of failure of any part of the systems or equipment during the guarantee period, the affected part or parts shall be replaced by the responsible Contractor.

F. Each Contractor shall furnish, before the final payment is made, a written guarantee covering the above requirements.

1.6 COMMISSIONING

A. The TBA Contractor must also include sufficient man-hours within their bids, for their participation with the Commissioning Team and the rebalancing/readjusting/resetting all device setpoints, as required.

1.7 THE CONTRACTOR

A. Each Contractor shall base his bid on site examinations performed by him. This requirement is mandatory. Each Contractor shall visit the proposed site where work is scheduled to be performed and ascertain the amount of work required to fulfill the intent of his Contract and the complexity of the installation. Each Contractor shall not hold the Architect, his Consultants, agents or employees responsible for or bound by, any schedule, estimate or for any plan thereof. Each Contractor shall study all Contract Documents (HVAC, Plumbing, Fire Protection, Electrical, Communications, Architectural, Structural), etc., included under each Contract, to determine exactly the extent of work to be provided under each Section, and in installing new equipment and systems and coordinating the work with the other Trades and existing conditions.

B. Each Contractor shall faithfully execute his work according to the terms and conditions of the Contract and specifications and shall take all responsibility for and bear all losses resulting to him in the execution of his work.

C. Each Contractor shall be responsible for the location and performance of work provided under his Contract as indicated on the Contract Documents. All parties employed directly or indirectly by each Contractor shall perform their work according to all the conditions as set forth in these specifications.

D. Each Contractor shall furnish all materials and perform all work in accordance with the project specifications and any supplementary documents provided by the Architect. The work shall include every item shown on the drawings and/or required by the specifications as interpreted by the Architect. All work and materials furnished and installed shall be new and of the best quality and workmanship. Each Contractor shall cooperate with the Architect so that no error or discrepancy in the Contract Documents shall cause defective materials to be used or poor workmanship to be performed.

1.8 COORDINATION OF WORK

A. Each Contractor shall compare his drawings and specifications with those of other Trades and report any discrepancies between them to the Architect and obtain from the Architect written instructions for changes necessary in the mechanical or electrical work, to ensure that all work is installed in coordination and cooperation with other Trades installing interrelated work. Before installation, each Contractor shall make proper provisions to avoid interferences in a manner approved by the Architect. All changes required in the work of each Contractor caused by his negligence, shall be corrected by him at his own expense, to the Architect's satisfaction.

B. Locations of piping, ductwork, conduits and equipment shall be adjusted to accommodate the new work with interferences anticipated and encountered during installation. Each Contractor shall determine the exact routing and location of his systems prior to fabrication or installation of any system component. Accurate measurements and coordination drawings will have to be completed to verify dimensions and characteristics of the various systems' installations.

C. Lines which pitch shall have the right-of-wayover those which do not pitch. For example, waste piping shall normally have the right-of-way. Lines whose elevations cannot be changed shall have the right-of-way over lines whose elevations can be changed.

D. Offsets, transitions and changes of direction in all systems shall be made as required to maintain proper headroom and pitch of sloping lines whether or not indicated on the drawings. Each Contractor shall provide manual air vents and drains as required for his work to affect these offsets, transitions and changes in direction, as applicable.

E. All work shall be installed in a way to permit removal (without damage to other parts) of coils, filters, control appurtenances, fan shafts and wheels, filters, belt guards, sheaves and drives and all other system components provided under this Contract requiring periodic replacement or maintenance. All piping shall be arranged in a manner to clear the openings of swinging overhead access doors, ceiling tiles and cleaning access doors in ductwork.

1. Access to any and all components requiring servicing, adjustment, calibration, maintenance or periodic replacement shall be provided so that the Owner's operations personnel can freely gain access without removal of any materials other than the access panel or ceiling tile. Access shall be understood to mean free, clear and unobstructed from the floor up to the device and/or component being serviced. Access panels for VAV/CV boxes shall be 24" x 24" minimum.

2. Fire rated access doors with closers shall be provided for all rated assemblies.

F. The Contract Drawings are diagrammatic only intending to show general runs and locations of piping, ductwork, equipment, terminals and specialties and not necessarily showing all required offsets, details and accessories and equipment to be connected. All work shall be accurately laid out with other Trades to avoid conflicts and to obtain a neat and workmanlike installation which will afford maximum accessibility for operation, maintenance and headroom.

G. Where discrepancies in scope of work as to what Trade provides items, such as starters,

disconnects, flow switches, electric control components, etc., exist, such conflicts shall be reported to the Architect prior to signing of the Contract. If such action is not taken, each Contractor, as applicable, shall furnish such items as part of his work, for complete and operable systems and equipment, as determined by the Architect.

H. Where drawing details, plans and/or specification requirements are in conflict and where pipe or duct sizes of same pipe or duct run are shown to be different between plans and/or between plans and sections or details, the most stringent requirement will be included in the Contract. HVAC systems and equipment called for in the specification and/or shown on the drawings shall be provided under this Contract as if it were required by both the drawings and specifications. However, prior to ordering or installation of any portion of work which appears to be in conflict, such work shall be brought to Architect's attention for direction as to what is to be provided.

I. Final location of all air distribution devices, thermostats, heaters, control devices, sprinkler heads, etc., shall be coordinated with the Architectural reflected ceiling plans and/or other Architectural details, as applicable. (**Note**: Sprinkler head locations shall provide the specified coverage rating and water flow density, and shall be in accordance with all applicable Codes and in full compliance with the requirements of the Owner's insurance carrier.) Offsets of ductwork, added sheet metal, fittings, elbows, flexible connections, etc., shall be provided as required to comply with the Architectural reflected ceiling plans and/or installation details. Obtain approval of locations of all devices from Architect in the field, prior to installation.

Any other type of equipment shown on the Plumbing, Fire Protection, HVAC and/or Architectural drawings to be provided with services, such as exhaust ductwork, piping, traps, drains, valves, etc., shall be included under this Contract as applicable, including all piping or ductwork connections to systems, to make equipment completely operable. Additional sheet metal, flexible fittings, etc., shall be provided to accomplish the above requirement, as required, all as part of this Contract at no additional cost to the Owner.

1.9 COORDINATION DRAWINGS

A. Before materials are purchased, fabricated or work is begun, each Contractor shall prepare coordination drawings for all floors/areas, including buried systems/services (all-Trade-composite at 3/8" scale), showing the size and location of his equipment and lines, in the manner described herein under General Requirements.

B. Coordination drawings are for the GC / CM and Architect's use during construction and shall not be construed as shop drawings or as replacing any shop drawings. The coordination drawings, when corrected for actual "as-built" conditions, will be reviewed by the Architect, corrected and become the Record Drawings to be submitted to the Owner for his use.

C. The cost of producing and reproducing the drawings will be included under the Contract of each Trade, including the cost or preparation of the Architectural building outlines. This process may include multiple revisions to these drawings which will be included in the cost. The intent is to provide a fully coordinated set of documents between trades no matter how many times they may have to be redone. The HVAC Contractor shall take the lead to produce the Architectural backgrounds, show all ductwork, piping, etc., and circulate the drawings to any of his Subcontractors and the other Trades (Plumbing, Fire Protection, Electrical), so that they can indicate all their work as directed by the GC / CM and Architect as required, to result in a fully coordinated installation.

D. In addition to the regular coordination drawing review, the mechanical work will also be reviewed by the Architect/Engineer to ensure that the system and equipment arrangements are suitable to provide maintenance access and service as follows:

1. Valves and instrumentation should be grouped where possible and positioned in accessible locations.

2. Valves on pipes of 6" and larger, positioned above 7'-0" in height from the operating level, will be provided with chain operated valve wheels and be located where chains will not interfere with primary access through the mechanical room.

3. Location of control/diagnostic panels shall be shown and identified on the mechanical room coordination drawings.

E. Prepare a complete set of computer based drawings:

1. Format shall be:

a. AutoCAD (Latest Version)

b. REVIT (Latest Version)

2. Scale not less than 3/8" scale equals 1'-0", showing basic layout for the structure and other information as needed for preparation of Coordination Drawings.

3. The drawings shall indicate the layout of all specialty trade work as indicated herein and shall be designated as Coordination Drawings.

4. Any drawing provided to assist the contractor will require:

a. A signed liability release form will be required from the Contractor prior to the release of the disk from the Engineer.

F. Highlight all fire rated partitions on the Coordination Drawings for appropriate coordination.

G. The main paths for the installation or removal of equipment from mechanical and electrical rooms shall be clearly indicated on the Coordination Drawings.

H. Each of the specialty trades shall add its work to the base drawings with appropriate elevations and grid dimensions. Specialty trade information shall be required for fan rooms and mechanical rooms, horizontal exits from duct shafts, crossovers and for spaces in the above ceilings where congestion of work may occur such as corridors and, where required, entire floors. Drawings shall indicate horizontal and vertical dimensions to avoid interference with structural framing, ceilings, partitions and other services. Indicate elevations relative to finish floor for bottom of ductwork and piping and conduit 6" greater in diameter.

1. Specialty Trade shall include:

a. Plumbing system.
b. HVAC piping and associated control systems.
c. Electrical.
d. Sheet Metal Work.
e. Fire Protection system.
f. Automatic Temperature Control
g. Fire Alarm
h. Security
i. Telecommunications
j. Pneumatic Tube
k. Commissioning

I. Upon completing their portion of the Coordination Drawings, each specialty trade shall sign, date and return Coordination Drawings to the Contractor.

J. Where conflicts occur with placement of materials of various trades, the General Contractor shall be responsible to coordinate the available space to accommodate all trades. Any resulting adjustments shall be initialed and dated by the affected specialty trade Subcontractor. The General Contractor shall then final date and sign each drawing.

K. Fabrication shall not start until Coordination Drawings have been distributed to all parties as indicated herein.

L. Distribution of Coordination Drawings:

1. The General Contractor shall provide one print of each Coordination Drawing to:

a. Each specialty trade Subcontractor.
b. Owner.
c. General Contractor.
d. Architect (for record purposes).

M. After distribution:

1. Resolve all interferences not previously identified.

N. Coordination Drawings include but are not necessarily limited to:

1. Structure.
2. Partition/room layout, including indication of smoke and fire resistance rated partitions.
3. Ceiling layout and heights.
4. Light fixtures.
5. Access panels.
6. Sheet metal, heating coils, heat pumps, grilles, diffusers, etc.
7. All heating piping and valves.
8. Smoke and fire dampers.
9. Soil, waste and vent piping.
10. Major water and gases.
11. Major electrical conduit runs, panelboards, feeder conduit and racks of branch conduit. Motor control centers, starters and disconnects.
12. Sprinkler piping and heads.
13. All equipment, including items in the Contract as well as O.F.C.I. and O.F.I. items.
14. Equipment located above finished ceiling requiring access for maintenance and service. In locations where acoustical lay-in ceilings occur indicate areas in which the required access area may be greater than the suspected grid systems.
15. Rainwater Piping.
16. Existing conditions, including, but not limited to, Mechanical, Plumbing, Fire Protection and Electrical items.
17. ATC panels.

O. The Architect’s response to all requests for information (RFI’s) generated by the trade contractors shall be distributed to all other affected trades as if this information was contained in the original contract documents. In other words, the party that issues an RFI is responsible for distributing the information to all affected parties.

1.10 RECORD DRAWINGS

A. Each Contractor shall maintain, current at the site, a set of Contract Drawings for his portion of

the work on which he shall accurately show the actual installation of all work provided under his Contract indicating any variation from the Contract Drawings, in accordance with the General Conditions and Supplementary General Conditions. Changes whether resulting from formal change orders, requests for information, or other instructions issued by the Architect shall be recorded. Include changes in sizes, location and dimensions of piping, ducts, equipment, etc.

B. Each Contractor shall indicate progress by coloring-in various pipes, ducts and associated appurtenances exactly as they are erected. This process shall incorporate both the changes noted above and all other deviations from the original drawings whether resulting from job conditions encountered or from any other causes.

C. The marked-up and colored-up prints will be used as a guide for determining the progress of the work installed. They shall be inspected periodically by the Architect and Owner's representatives and they shall be corrected if found either inaccurate or incomplete. This procedure is mandatory. Marked up drawings shall include all flow diagrams, schedules, details and control diagrams.

D. Each Contractor shall meet at a minimum on a monthly basis, with the Owner's representative to transfer the information from his HVAC, Plumbing, Fire Protection, etc., marked-up and colored-up prints to a set which will become the basis for preparation of as-built drawings.

E. Upon completion of the project, each Contractor shall submit his marked-up drawings to the Architect for review and comment. After the Architect reviews and comments on this set of documents, each Contractor shall prepare as-built drawings on CAD using the format specified for coordination drawings. When the work is completed, each Contractor shall provide 2 hard copies to the Architect for submittal to the Owner and disks with all documentation and a set of reproducible drawing plots marked "As-Built" drawings. The Contractor shall bear all costs of producing the CAD "As-Built" drawings, providing all necessary drawing changes and printing the reproducible drawings for the work under his charge.

1.11 GIVING INFORMATION

A. Each Contractor shall keep himself fully informed as to the shape, size and position of all openings required for his apparatus and shall give information to the Architect and other Contractors **[or Subcontractors]** sufficiently in advance of the work so that all openings may be built in advance.

B. The manufacturers listed within this specification have been preselected for use on this project. No submittal will be accepted from a manufacturer other than those specified. Should any Contractor wish to propose a substitution during the bid period, such request shall be made in writing to the Architect, at least (15) working days, prior to bid date. If substitutions are deemed acceptable, such items shall be issued as an Addendum, prior to bid due date. The above requirement is mandatory.

1.12 EQUIPMENT AND MATERIALS

A. Equipment and materials shall be delivered to the site and stored in original sealed containers, suitably sheltered from the elements, but readily accessible for inspection by the Architect until installed. All items subject to moisture damage such as controls, filters, etc., shall be stored in dry, heated spaces.

B. Each Contractor shall have his equipment tightly covered and protected against dirt, water and chemical or mechanical injury and theft. At the completion of the work, equipment and materials shall be cleaned, polished thoroughly and turned over the Owner in a condition satisfactory to

the Architect. Damage or defects developing before acceptance of the work shall be made good at each Contractor's **[or Subcontractor's]** expense as applicable.

C. Each Contractor shall make necessary field measurements to ascertain space requirements, for equipment and connections to be provided under his Trade and shall furnish and install such sizes and shapes of equipment to allow for the final installation to conform to the drawings and specifications.

D. Manufacturers' directions shall be followed completely in the delivery, storage, protection and installation of any equipment. Promptly notify the Architect in writing of any conflict between any requirements of the Contract Documents and the manufacturer's directions and obtain the Architect's written instructions before proceeding with the work. Should any Contractor perform any work that does not comply with the manufacturer's directions or written instructions from the Architect, he shall bear all costs arising in correcting any deficiencies that should arise.

E. Each Contractor shall furnish and install all equipment, accessories, connections and incidental items necessary to fully complete the work under his Contract for use, occupancy and operation by the Owner.

F. Where equipment of the acceptable manufacturers requires different arrangement or connections from those shown, it shall be the responsibility of each Contractor to install the equipment to operate properly and in harmony with the original intent of the drawings and specifications. When directed by the Architect, each Contractor shall submit drawings showing the proposed installation. If the proposed installation is approved, each Contractor shall make all necessary changes in all effected related work provided under other Sections including location of roughing-in connections by other Trades, electrical requirements, piping, supports, insulation, etc. All changes shall be made at no increase in the Contract amount or additional cost to the other Trades and/or Owner.

G. Testing Agency Labeling Requirements

1. All equipment and materials required for installation under these specifications shall be new and without blemish or defect.

2. All equipment shall meet OSHA standards.

3. Equipment and materials shall be products which will meet with the acceptance of the Authorities Having Jurisdiction (AHJ) over the work and as specified hereinbefore and below.

a. Where such acceptance by the AHJ of any given product is contingent upon having the FM Global, it shall be provided with an FM Global label and constructed in compliance with FM Global’s standards and guidelines.

b. All products shall be listed and labeled by UL or other national testing laboratories such as ETL and the products shall be so labeled.

1) Label of Underwriters Laboratories, ETL or other nationally recognized testing agency acceptable to the Authorities Having Jurisdiction.

2) This Labeling shall include not just the control panel and/or motor but all wiring and devices included in the package as a complete package. Note: Providing a series of individually labeled electrical devices that are then assembled into a package does not meet this requirement, the whole assembly must be labeled as an assembly. The manufacturers have the

option of having the equipment inspected and Labeled at the factory or at the site after installation. This requirement shall supersede any other specification language hereinbefore or hereinafter that requires only portions of the equipment to be labeled.

3) Some examples of packaged equipment requiring Labeling:

a) Sump pumpsets
b) Ejector pumpsets
c) Laboratory waste ejector pumpsets
d) Fuel oil transfer pump skids
e) Steam condensate pumpsets
f) Duplex air compressor system
g) Air handling units (packaged and custom built-up)
h) Cooling towers
i) Chillers
j) Boilers
k) Feed water equipment
l) pH Neutralization system skids
m) High purity water system skids (such as RODI units)
n) Laboratory and/or Medical Air compressor skids
o) Vacuum pumpsets
p) Water pressure booster systems
q) Animal watering system skids
r) Cooling tower water filtration system
s) Cooling coil condensate water collection and discharge systems

H. All equipment of one type (such as valves, fans, air handling units [custom built], air terminals, heat pumps, plumbing fixtures, etc.), shall be the product of one manufacturer.

I. Equipment pre-purchased on behalf of the Owner or by the Owner himself, if assigned to any of the Contractors, shall be received, inspected, installed, etc., as if it was purchased by the Contractors as applicable. All guarantees, service contracts, etc., shall be the same as for all other equipment provided under this Contract.

1.13 CUTTING AND PATCHING

A. Each Contractor shall be responsible for all core drilling, as required for work under his Contract, but in no case shall he cut into any structural elements without the written approval of the Architect.

B. All cutting, rough patching and finish patching, shall be provided under this Contract.

C. All concrete and masonry equipment bases shall be provided under this Contract.

1.14 USE OF PREMISES

A. Each Contractor shall confine all of his apparatus, storage of materials and construction to the limits indicated on the drawings and directed by the Architect and he shall not encumber the premises with his materials.

B. In storing materials within areas (structure or ground), or when used as a shop, each Contractor shall consult with the General Contractor/Construction Manager and shall restrict his storage to space designated for such purposes. Each Contractor will be held responsible for repairs,

patching or cleaning arising from any unauthorized use of premises.

C. Notwithstanding any approvals or instructions which must be obtained by each Contractor from the Architect in connection with use of premises, the responsibility for the safe working conditions at the site shall remain each Contractor's. The Architect or Owner shall not be deemed to have any responsibility or liability in connection therewith.

D. Air handling unit or cooling tower sections shall not be used for storage of materials. The HVAC Contractor will be responsible for securing, and maintaining the equipment clean. The above requirement is mandatory.

1.15 PROTECTION/CLEANLINESS

A. All materials such as valves, fittings, piping, ductwork, plenums, grilles, registers, diffusers, etc., shall be properly protected from the accumulation of dirt, dust, debris or any other contaminants. All ductwork and piping openings shall be temporarily closed by each Contractor **[or Subcontractor]** installing same, so to prevent obstruction and damage, as a minimum at the end of each working day or more often if required by job conditions. Each Contractor shall take precautions to protect his materials from damage and theft.

B. Each Contractor shall furnish, place and maintain proper safety guards for the prevention of accidents that might be caused by the workmanship, materials, equipment or electrical systems provided under his Contract.

1.16 DAMAGE CORRECTION AND EXTRA WORK

A. Each Contractor shall be held responsible and shall pay for all damages caused by his work to the new and existing building structures and new and existing equipment, piping, duct systems, etc., and all work and finishes installed under this Contract in the new or in existing building. Repair of such damage shall be done as herein before specified, at the expense of each Contractor and to the Architect's satisfaction.

B. Each Contractor shall promptly correct all work provided under his Contract and rejected by the Architect as defective or as failing to conform to the Contract Documents whether observed before or after completion of work and whether or not fabricated, installed or completed. Each Contractor shall bear all costs of correcting such rejected work.

C. No claim for extra work will be allowed unless it is authorized by the Architect in writing before commencement of the extra said work.

1.17 TOUCH-UP PAINTING

A. Each Contractor shall thoroughly clean all equipment and systems provided under this Contract from rust, splatters and other foreign matter or discoloration, leaving every part of each system in an acceptable prime condition. Each Contractor, for the work under his Contract, shall refinish and restore to the original condition all equipment and piping which has sustained damage to the manufacturer's prime and finish coats of paint and/or enamel.

1.18 HOUSEKEEPING PADS (NOT USED)

1.19 DUCT AND PIPE SLEEVES, PLATES AND ESCUTCHEONS, FIRESTOPPING AND SMOKEPROOFING

A. Where piping and/or ductwork pass through masonry or concrete walls or drywall partitions or

floors, each Contractor shall provide and set individual sleeves for each pipe or duct and all other work under his charge, as necessary for passage of all pipes and/or ducts. Sleeves shall be of sufficient size to provide 1/2" air space around the pipe or duct passing through (including insulation where pipes or ducts are internally/externally insulated). All openings shall be sealed, smokeproofed and made tight. Each Contractor shall be responsible for the exact location of sleeves provided under his Contract and shall coordinate all requirements for piping and ductwork sleeves.

B. Each Contractor, for work under his charge, shall determine the required inside diameter of each individual wall opening or sleeve before ordering, fabrication or installation.

C. Sleeves and inserts shall not be used in any portions of the building, where their use would impair the strength or construction features of the building. Elimination of sleeves must be approved by the Architect.

D. Provide chrome plated brass escutcheons with set screw for exposed piping, in all areas except in mechanical rooms. In this area use plain brass or cast iron escutcheons suitable for painting. All escutcheons shall be sized to fit the bare pipe or insulation in a snug and neat manner. They shall be of sufficient size to cover sleeved openings for the pipes and of sufficient depth to cover sleeves projecting above floors. Escutcheons shall be as manufactured by Beaton & Caldwell, Dearborn Brass, or Grinnell.

E. Pipe or duct sleeves shall be made of Schedule 40 pipe, 20 gauge galvanized steel or 16 gauge steel as follows:

1. Sleeves on pipes passing through masonry or concrete construction shall be Schedule 40 pipe.

2. Sleeves on ducts passing through concrete construction shall be 20 gauge steel unless required otherwise by item 4 below.

3. Sleeves on pipes or ducts passing through fire rated partitions shall be 16 gauge steel.

4. Sleeves on pipes or ducts passing through non-rated drywall construction shall be 20 gauge galvanized steel.

F. Pipe or duct sleeves shall be set as follows:

1. Set sleeves 1" above finish floor, (except set sleeves, 6" above finish floor at penthouses or mechanical rooms and 6” above finished roof) and flush on each side of walls. Coordinate roof penetrations with roof Subcontractor.

2. Sleeves shall be set securely in place before concrete is poured when placed in concrete construction.

3. Provide sheet metal sleeves for all duct penetrations and cover with sheet metal plates all penetrations after ductwork has been installed through walls/floors.

G. Each Contractor shall fire stop, smoke stop, and/or acoustically seal the space between the sleeves provided under his Contract and piping or ductwork as applicable, as follows:

1. See Specification Section 230584 Through Penetration Firestopping System

H. Except as otherwise specified, underground piping passing through exterior walls or foundation slabs

on grade, shall have penetration closures of the modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and wall opening. Links shall be loosely assembled with bolts to form a continuous belt around the pipe and with a pressure plate under each bolt head and nut. After the seal assembly is positioned in the sleeve, tightening of the bolts shall cause the rubber sealing elements to expand and provide an absolutely watertight seal between the pipe and wall, reducing chances of cathodic reaction between these members. Each Contractor for work under his charge shall determine the required inside diameter of each individual wall opening or sleeve before ordering, fabrication or installation. The inside diameter of the wall opening shall be sized to fit the pipe and ensure a watertight joint. Where applicable, when installing seals, take into account the pipe O.D. if non-standard due to coating or jacketing

1.20 MISCELLANEOUS IRON AND STEEL

A. Each trade shall provide all primary and secondary steel supports and hangers as shown on the drawings and/or as required to support equipment, ductwork, piping, exhaust fans, or any other materials provided under the work of this Section.

B. The work of this Section of designing, furnishing and installing all miscellaneous metal work associated with the system, and related items as indicated on the drawings and/or as specified herein, and includes, but is not limited to the items listed herein below.

C. The scope of work shall include:

1. Exhaust fan support platforms including ship ladders, steel grating for decking, cross-bracing and floor stands.

2. Intermediate beams to hang ductwork and piping from the roof. All piping and ductwork must be hung from beam or supported from the floor. Provide supplemental steel for support of equipment.

3. Support of ductwork and piping in shafts in addition to support provided by structure.

4. Support of ductwork via floor stands as required.

5. Heat exchanger support racks.

6. Piping support in underground concrete trench and manholes.

7. Pipe anchors in the building.

8. Hangers, brackets, angle irons or rods required for the support and protection of HVAC, plumbing and fire protection equipment.

9. Field prime painting of galvanized steel and field finish painting.

D. Shop Drawings for General Miscellaneous Items

1. Submit Shop Drawings of all miscellaneous metal items to Architect for approval, showing sizes and thickness of all members, types of materials, methods of connection and assembly, complete dimensions, clearances, anchorage, relationship to surrounding work by other Trades, shop paint, and other pertinent details of fabrication and installation.

E. The Subcontractor shall engage the services of a Professional Engineer registered within the

state wherein the project is located to prepare complete Design Drawings and structural design computations based on, and closely following, the design and details on the Drawings. The Design Drawings and structural design computations, with the Engineer's seal affixed thereto, shall be submitted to the Architect for review. The structural design computations shall provide a complete structural analysis, including anchors and fastening devices, and shall certify as to conformation to governing laws and codes. These submittals, upon review, must be sufficient, when taken in conjunction with this Specification to provide the complete basis of the fabrication and erection.

F. Samples

1. Submit duplicate samples of all materials to be furnished under this Section if, and in size and form, requested by Architect.

G. Do not order materials or begin fabrication until Architect's approval of submittals has been obtained.

H. In addition to the governing laws and codes, the following Specifications and Codes form a part of this Specification:

1. American Iron and Steel Institute applicable standards.

2. American Institute of Steel Construction "Code of Standard Practice for Steel Buildings and Bridges" and "Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings".

3. American Welding Society Code: Standard Code for Arc and Gas Welding in Building Construction.

I. All materials shall be new stock, free from defects impairing strength, durability or appearance and of best commercial quality for each intended purpose.

1. Unless other wise specifically called for, work of this Section shall be fabricated of structural steel conforming to ASTM Specification A36.

2. Steel pipe shall be seamless steel pipe conforming to ASTM Specification A53, Schedule 40.

3. Steel tubing shall be seamless steel tubing conforming to ASTM Specifications A500 to A501.

4. Construction specialties such as slotted inserts, wedge inserts, etc., shall be as manufactured by Hohmann and Barnard, Gateway Erectors, Inc., Richmond Screw Anchor Co. or equal approved by Architect.

5. Non-ferrous metals shall be as specified under descriptions of specific items, herein below.

J. Provide all anchors, bolts, sockets, sleeves, and other parts required for securing each item of work of this Section to the construction, including furnishing to concrete workers all required insets and sleeves for use at concrete.

1. All exposed fastenings shall be of the same material and finish as the metal to which applied, unless otherwise noted.

2. Welding rods shall conform to AWS Standards and the recommendation of the welding rod manufacturer.

3. Shop primer for other ferrous surfaces shall be a high-quality, lead-free, rust-inhibitive primer, Tnemec No. 10-99 Metal Primer or equivalent by Devoe and Raynolds Co., Carboline or equal.

K. Metal surfaces shall be clean and free from mill scale, flake, rust and rust pitting. Metal work shall be well formed and finished to required shape and size, true to details, with straight, sharp lines and angles and smooth surfaces. Curved work shall be true radii. Exposed sheared edges shall be eased.

L. Weld all permanent connections. Welds shall be continuous on all exposed surfaces and where required for strength on concealed surfaces. Exposed welds shall be ground flush and smooth, with voids filled with metallic filling compound (metallic filling compound not permitted on surfaces to receive hot-dip galvanizing). Tack-welding will not be permitted unless specifically called for. Do not use screws or bolts where they can be avoided. Where used, heads shall be countersunk, screwed up tight, and threads nicked to prevent loosening.

M. Fastenings shall be concealed where practicable. Thickness of metal and details of assembly and supports shall give ample strength and stiffness. Joints exposed to weather shall be formed to exclude water.

N. Do all cutting, punching, drilling and tapping required for attachment of anchor bolts and other hardware and for attachment of work by other Trades. All such cutting, punching, drilling, etc., shall be done prior to hot-dip galvanizing of the various components.

O. Live loads shall be not less than the minimum required by law. Where specific live load are not set forth in the laws and codes applicable to this work, and are not given on the Drawings or in this Specification, designs shall be such as to support the live loads which may normally be imposed without failure, without deflection of more than 1/360 of length of any member, and without permanent deformation, all with a factor of safety of not less than 2 1/2 to 1.

P. Shop Painting

1. All ungalvanized ferrous metals under this Section shall be given a shop coat of rust inhibitive primer of type specified above.

a. Immediately before shop painting, remove all rust, loose mill scale, dirt, weld flux, weld spatter, and other foreign material with wire brushes and/or steel scrapers. Power tool clean in accordance with SSPC SP-3 (Power Tool Cleaning). Remove all grease with oil by use of solvent recommended by paint manufacturer. Sandpaper exposed surfaces as required to produce smooth, even finishes.

b. Apply paint by spray process in strict accordance with manufacturer's printed instructions to uniform thickness(es) recommended by manufacturer. Apply thoroughly and evenly and work well into corners and joints taking care to avoid sags and runs.

c. Do not paint surfaces to be embedded in concrete, or to be welded in the field. After field welds are complete, grind smooth and flush, thoroughly clean and then apply specified primer over all unprimed in the field by brush roller.

d. After erection, sand smooth and retouch all portions of the shop coats chipped or damaged during erection, and coat all field welds and connections with primer equivalent to that used for the shop coat.

Q. Installation

1. All materials shall be carefully handled and stored under cover in manner to prevent deformation and damage to the materials and to shop finishes, and to prevent rusting and the accumulation of foreign matter on the metal work. All such work shall be repaired and cleaned prior to erection.

2. Work shall be erected square, plumb and true, accurately fitted, and with the tight joints and intersections. All anchors, inserts and other members to be set in concrete or masonry shall be furnished loose by this Trade to be built-into concrete and masonry and by those Trades as the work progresses. Later cutting or drilling shall be avoided wherever possible.

3. All metal work shall be rigidly braced and secured to surrounding construction, and shall be tight and free of rattle, vibration, or noticeable deflection after installed.

4. Where members, other than expansion bolts or inserts, are fastened into concrete, set such members in holes formed as specified below, and secure permanently in place by installation of proprietary-type expanding grout manufactured specifically for such purpose, used strictly in accordance with manufacturer's directions. Holes to receive members shall be formed with galvanized sheetmetal sleeves, expanded polystyrene foam, or other approved method to provide at least 1/2 inch clearance around entire perimeter. At exposed applications, hold expanding grout back 1/2 inch from finish surface and fill voids with Portland cement grout to match color and texture of surrounding concrete surface.

5. Electrolytic Isolation

a. Where dissimilar metals are to come into contact with one another, isolate by application of a heavy coating of bituminous paint on contact surfaces in addition to shop coat specified above. Do not permit the bituminous paint in any way to remain on surfaces to be exposed or to receive sealant.

R. Description of Major Items

1. The items described below constitute the major part of the work of this Section, but are not intended or implied to cover each and every item that may be required to properly complete the work. Carefully review the Drawings to determine the full extent of the miscellaneous metal work required.

S. Steel Ladders/Platforms

1. Fabricate and install interior steel ladder at fans, air handling units, filter racks and all equipment requiring service. Ladders shall have a safety cage as required by OSHA regulations.

2. Except as may be otherwise indicated on the Drawings, ladder shall be minimum 16 inches wide, fabricated of minimum 3/8 inch by 2 1/2 inches hot rolled steel rails and minimum 3/4 inches outside diameter steel pipe rungs. Rungs shall be spaced 12 inches on center and shall be continuously welded to the rails. Provide a pair of steel clip angles

or wall brackets at bottom and steel anchor plates or wall brackets at top, welded to the rails, as indicated.

3. Exterior steel ladders shall be hot dip galvanized after fabrication as specified hereinbefore. Rungs are to have non-slip surfaces.

4. All shall be OSHA and ANSI compliant.

T. Gratings and Frames

1. Fabricated and install steel gratings and frames at fan platforms.

2. Steel grating frames shall consist of a steel angle perimeter frame constructed of steel angles, at least 4 inches by 4 inches by 3/8 inches carried around perimeter with coped or mitered, full-welded corners. Perimeter frames shall be anchored with 7/16 inch minimum diameter expansion bolts or other suitable devices of adequate capacity, at corners, two (2) per beam end and spaced not more than 2 feet on center around full perimeter.

3. Steel Gratings shall be pressure-locked type, with bearing bars spaced 1 3/16 inch on center and cross-bars spaced 4 inches on center. Sizes of bars shall be as required by manufacturer's loading tables to limit deflection of any member across any span to 1/240th of the span at live load of 100 pounds per square foot. Gratings shall be as manufactured by Borden Metal Products, Co., Irving Subway Grating Co., Reliance Steel Products Co., approved by Architect.

4. All (gratings and) frames shall be hot-dip galvanized after fabrication as specified hereinbefore (aluminum, FRP).

U. Miscellaneous Items

1. Carefully review all Drawings for miscellaneous metal items required but not specifically listed above, such as miscellaneous steel clip angles, miscellaneous steel bracketing, and other miscellaneous metal items as indicated on the Drawings, reasonably implied therefrom, or reasonably necessary for the thorough completion of the work.

2. Provide rigid and secure anchorage of all components whether or not specifically described in complete detail on the Drawings.

V. Piping supports shall be coordinated with the building structure and shall span between roof beams as required.

1.21 WATERPROOFING, FLASHING AND COUNTERFLASHING

A. Unless specifically indicated otherwise on the drawings, each Contractor shall provide all counterflashing and waterproofing of all piping, ductwork and equipment provided by him, which pierce roofs, walls and other weatherbarrier surfaces. All work under this paragraph shall be coordinated with the GC / CM.

B. All work shall be performed in a workmanlike manner to ensure weatherproof installation. Any leaks developed due to each Contractor's work shall be repaired at his expense, to the Architect's satisfaction.

C. Pipes passing through slabs shall have the sleeve extended above floors as hereinbefore specified to retain any water and the space between the pipe and sleeve caulked waterproof fire stopping. The top and the bottom shall be sealed with monolastic caulking compound.

D. All flashing required for ductwork and piping penetrations shall be provided by the GC / CM.

1.22 ELECTRICAL WORK, MOTORS, MOTOR CONTROLLERS

A. See Section 230513 MOTORS AND CONTROLLERS.

B. See Divisions 26 and 28 for Electrical.

1.23 IDENTIFICATION OF MATERIALS

A. See Section 230553.

1.24 VALVE TAGS, NAMEPLATES AND CHARTS

A. See Section 230553.

1.25 PARTS LIST AND INSTRUCTIONS FOR OPERATION AND MAINTENANCE

A. Each Contractor shall thoroughly instruct the representative(s) of the Owner, to the complete satisfaction of the Architect, in the proper operation of all systems and equipment provided by him. Each Contractor shall make arrangements, via the GC / CM as to whom the instructions are to be given in the operation of the basic and auxiliary systems and the periods of time in which they are to be given. The Architect shall be completely satisfied that the representative of the Owner has been thoroughly and completely instructed in the proper operation of all systems and equipment before final payment is made. If the Architect determines that complete and thorough instructions have not been given by each Contractor to the Owner's representative, then each Contractor shall be directed by the Architect to provide whatever instructions are necessary until the intent of this paragraph of the specification has been complied with. All time required for Owner's instruction to satisfy the above requirements shall be included in this Contract. No extra compensation for such instructions will be allowed.

B. Each Contractor, including but not limited to, the HVAC Contractor, shall submit to the Architect for approval, a total of (6) typed sets, bound neatly in loose-leaf binders, of all maintenance and operating instructions for the installation, operation, care and maintenance of all equipment and systems. All data and literature furnished shall be specific for the make and model of the equipment furnished. General non-specific catalog data will not be acceptable. Information shall indicate possible problems with equipment and suggested corrective action. The manuals shall be indexed for each type of equipment. Each section such as fans, valves, plumbing fixtures, hot water heaters, boilers, air handling units, etc., shall be clearly divided from the other sections. A sub-index for each section shall also be provided. The methodology of setting-up the manuals shall be submitted to the Architect and Owner through the General Contractor for approval prior to final submission of manuals.

C. The instructions shall contain information deemed necessary by the Architect and shall include, but not be limited to, the following:

1. Instructional classes on equipment and systems operation for Owner's representative and maintenance personnel, by engineering staff of each Contractor. Minimum of 48 hours of instruction for minimum of (6) people. Instruction shall include:

a. Explanation of manual and its use.
b. Summary description of the HVAC systems.
c. Purpose of systems.

2. System

a. Detailed description of all systems.
b. Illustrations, schematics, block diagrams, catalog cuts and other exhibits.

3. Operations

a. Complete detailed, step-by-step, sequential description of all phases of operation for all portions of the systems, including start-up, shutdown, adjusting and balancing. Include all posted instruction charts.

4. Maintenance

a. Parts list and part numbers.

b. Maintenance, lubrication and replacement charts and manufacturer's recommendations for preventive maintenance, as applicable to his work.

c. Troubleshooting charts for systems and components.

d. Instructions for testing each type of part.

e. Recommended list of on-hand spare parts.

f. Complete calibration instructions for all parts and entire systems.

g. Instruction for charging, filling, draining and purging, as applicable.

h. General or miscellaneous maintenance notes.

5. Manufacturer's Literature

a. Furnish complete listing for all parts required for models actually furnished.

b. Names, addresses and telephone numbers of manufacturers and suppliers.

c. Describe and operation of all models actually furnished.

d. Furnish all and only pertinent brochures, illustrations, drawings, cuts, bulletins, technical data, certified performance charts and other literature with the model actually furnished to be clearly and conspicuously identified.

e. Internal wiring diagrams and engineering data sheets for all items and/or equipment furnished under each Contract.

f. Guarantee and warranty data.

6. Each Contractor shall furnish instructions for lubricating each piece of equipment installed by him. Instructions shall state type of lubricant, where and how frequently lubrication is required. Frame instructions under glass and hang in a location as directed by Architect.

1.26 MANUFACTURER'S REPRESENTATIVE AND COMMISSIONING OF SYSTEMS

A. Each Contractor shall provide, at appropriate time or as directed by the Architect, the on-site services of a competent factory trained Engineer or authorized representative of particular manufacturer of equipment provided under his Contract, such as for the air handling units, automatic temperature controls, building automation system (BAS), etc., provided under this Contract, to instruct the Owner, inspect, adjust and place in proper operating condition any item provided by him, as applicable.

B. The HVAC Contractor, as applicable, shall commission and set in operating condition all major equipment and systems, such as the condenser water, hot water and all air handling systems, etc., in the presence of the applicable equipment manufacturer's representatives, and the Owner and Architect's representatives. In no case will major systems and equipment be commissioned by any of the Contractor's forces alone, without the assistance or presence of the equipment manufacturers.

C. A written report shall be issued by the particular equipment manufacturer and the Mechanical Contractor summarizing the results of the commissioning and performance of each system for the Architect's record. No additional compensation will be allowed for any Contractor for such services.

D. The Contractor shall prepare and submit to the Architect for acceptance, a schedule of anticipated system commissioning. No system shall be commissioned without prior acceptance of the schedule by the Architect and Owner. No systems shall be commissioned prior to submittal and acceptance of Operation and Maintenance Manuals.

1.27 CONNECTIONS TO EQUIPMENT

A. Each Contractor shall provide all duct and/or pipe connections, condensate traps, drains, overflows, relief valves and vents, power connections, etc., to make equipment operable, as provided under other Sections of the specifications, as shown on the Architectural and/or each Trade's drawings and herein specified, including final connections to equipment to result in a complete system, fully operational. Coordinate location of all equipment with Architect. Obtain installation diagrams and methods of installation of all equipment from manufacturers. Follow instructions strictly. If additional information is required, obtain same from Architect. If equipment is indicated on the Architectural drawings, it shall also be construed and understood by the Mechanical Contractor to be constructed as shown on the HVAC drawings and shall be fully serviced and connected at no extra cost to the Owner.

1.28 SMOKE DETECTION AND FIRE SAFETY SYSTEMS

A. All duct or unit mounted smoke detectors shall be furnished and wired to the building fire alarm system by the Electrical Contractor. All smoke detectors required in units and ducts and for smoke barrier dampers shall be installed in the field by the HVAC Contractor. Refer to the Contractor Coordination Matrix contained under item **1.34** of this section.

B. All smoke dampers, except in built-up air handling units, shall be furnished by the ATC Contractor with electric actuators field wired by the ATC Contractor. Dampers shall be field installed by the HVAC Contractor, except dampers in the air handling units.

C. The Electrical Contractor, when providing smoke detectors, shall include additional contacts, as required and coordinated with the ATC Contractor, to allow for other control functions, as specified hereinafter. Close coordination must be exercised to allow for the provision of contacts.

D. All smoke detectors shall be installed as recommended by the smoke detection system manufacturer in sheet metal ducts or plenums to ensure that the sensing elements are effective and shall coordinate installation of smoke detectors with the Electrical Contractor and detector manufacturer.

E. The HVAC Contractor shall provide access doors to make all such detection heads accessible, and shall provide bracing for smoke detection sampling tubes, as recommended by the detector manufacturer, to properly and securely support such tubes.

F. If duct smoke detectors are required to be installed in ducts that are exposed to outside ambient conditions, they shall be installed in ventilated accessible weatherproof enclosures. See details on HVAC Drawings.

1.29 ELECTRICAL ROOM REQUIREMENTS

A. The HVAC Contractor [or Subcontractors] shall not install any piping, ductwork or equipment in or through electrical rooms, transformer rooms, electrical closets, telephone rooms or elevator machine rooms, unless piping, ductwork or equipment is intended to serve these rooms. If any Contractor violates this requirement, he shall remove and/or relocate all items as required at his expense and to the satisfaction of the Architect.

1.30 HOISTING EQUIPMENT AND MACHINERY

A. All hoisting equipment and machinery required for the proper and expeditious prosecution and progress of the work under this Contract shall be furnished, installed, operated and maintained in safe condition by each Contractor for his material and/or equipment delivered to the designated hoisting area. All costs for hoisting operating services shall be borne by the Mechanical Contractor for all equipment and work under his charge.

1.31 STAGING

A. All staging, exterior and interior, required to be over 8'-0" in height, shall be furnished and erected by each Contractor for work under his charge and maintained in safe condition by him for proper execution of his work.

1.32 PHASING, DEMOLITION AND MAINTAINING EXISTING SERVICES

A. During the execution of the work, required relocation of existing equipment and systems in the existing areas where new work and connections are scheduled to be made shall be performed by each Contractor as indicated on the drawings, as required by the job conditions and as determined by the GC / CM in close cooperation with the Architect and Owner's designated representative to facilitate the installation of the new systems and completion of this Contract. The Owner will require the continuous operation of all existing systems, while demolition, relocation work of new tie-ins are being performed. Outages required for construction purposes shall be scheduled for the shortest practical periods of time, in coordination with the Owner's designated representative for specific, mutually agreeable periods of time after each of which the interruption shall cease and service shall be restored. This procedure shall be repeated to suit the Owner's working schedule as many times as required until all work is completed.

B. Prior to any deactivation and relocation, capping, valving, tie-in or demolition work, consult the drawings and arrange a conference with the Architect and the Owner's representative in the field to inspect each of the items to be deactivated, removed or relocated. Care shall be taken to protect all equipment designated to be relocated and reused. Give notice to all parties, with a minimum of (5) working days in advance.

C. All draining of existing systems, filling and venting required to remove and relocate existing piping systems shall be included and provided under this Contract as required to perform the various equipment or piping relocations or new tie-ins.

D. Except as otherwise noted, all deactivation, safe capping, valving, etc., of systems designated to be demolished shall be provided by each Trade, as applicable, and all demolition, removal and disposal of demolished materials shall be performed by the GC / CM. All equipment scheduled to be removed shall be inspected by the Owner, and, if he decides that such equipment is to be salvaged, each Contractor shall deliver said equipment to an area within the site boundaries as determined by the Owner and Architect.

E. The phasing of the work shall be performed in strict accordance with the GC / CM construction schedule. The new systems will be installed and completely commissioned prior to occupancy. Coordinate requirements for temporary heat or rerouting of existing services as required to accomplish the construction schedule.

1.33 CONTROL WIRING

A. The ATC Contractor shall provide all control and interlock wiring for all systems provided under the HVAC, plumbing and ATC Contracts.

B. All control wiring shall be installed in conduit and in accordance with the respective equipment manufacturer's requirements, and all connections shall be provided by the Mechanical and/or the ATC Contractor. All conduit and wiring provided by these Contractors shall be installed in accordance with the requirements of Section 26 of the specifications.

PART 2 – PRODUCTS

2.1 NOT USED

PART 3 – EXECUTION

3.1 NOT USED

END OF SECTION 230500

SECTION 230513 – MOTORS AND CONTROLLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Section 230500 and Divisions 26 & 28, apply to this Section.

1.2 WORK INCLUDED

A. Furnish and install all motors required for all mechanical equipment specified under this Division.

B. Furnish and install all individual motor controllers, starters and disconnect switches not provided under Divisions 26 and 28 – Electrical Work.

C. All motors shall be premium efficiencysuitable for the duty and voltage service available and as indicated on the contract drawings.

D. Provide all necessary control transformers so all motors, starters, disconnect switches, etc. are compatible with the control and operating sequences specified.

1.3 RELATED SECTIONS

A. Examine all drawings and criteria sheets and all other Sections of the Specifications for requirements which affect work under this Section whether or not such work is specifically mentioned in this Section.

1.4 REFERENCES

A. Applicable provisions of the following Codes and Trade Standard Publications shall apply to the work of this Section, and are hereby incorporated into, and made a part of the Contract Documents.

B. Material standards shall be as specified or detailed hereinafter and as follows:

1. AFBMA: Anti-Friction Bearing Manufacturers Association.

a. 1-84 – Terminology for Anti Friction Ball and Roller Bearings and Parts.

b. 9-84 – Load Ratings and Fatigue Life for Ball Bearings.

c. 11-78 – Load Ratings and Fatigue Life for Roller Bearings.

d. 20-77 – Metric Ball and Roller Bearings Conforming to Basic Boundary Plans

2. ANSI: American National Standards Institute.

a. 50-84 – Mechanical Vibration of Rotating and Reciprocating Machinery.

3. ASTM: American Society for Testing and Materials.

a. A48-83 – Gray Iron Castings.

b. B117-85 – Method of Salt Spray (Fog) Testing.

4. IEEE: Institute of Electrical and Electronic Engineers.

a. 1-86 – General Principals for Temperature Limits in the Rating of Electrical Equipment.

b. 85-73 – Test Procedures for Airborne Sound Measurements on Rotating Electric Machinery.

c. 112-84 – Standard Test Procedures for Polyphase Induction Motors and Generators.

d. 114-82 – Test Procedures for Single-Phase Induction Motors.

e. 117-74 – Test Procedures for Evaluation of Systems of Insulating Materials for Random-Wound AC Electric Machinery. Single-Phase Induction Motors.

5. NEMA: National Electrical Manufacturer's Association.

a. MG 1-78 – Motors and Generators.

6. NFPA: National Fire Protection Association.

7. National Electrical Code.

8. SAE: Society of Automotive Engineers.

9. SAE Grade 5.

1.5 SYSTEM DESCRIPTION

A. Furnish and install all premium efficiency motors for all systems and equipment.

B. Motor Controllers: Provide individual motor controllers not provided under Division 26. Coordinate with the Division 26 Contractor to determine the location, size and number of individual motor controllers to be provided under this Division.

C. Mounting and installing of motors and drives.

D. Installation of motor controllers supplied under this Division.

E. Work shall be done in accordance with requirements of Division 26 "Electrical Work". Wiring shall be done under Divisions 26 and 28.

F. Disconnect switches; Provide combination motor controller and disconnect switch where required under Division 23 as specified in Division 26. If not specified under individual product sections, then disconnect switches shall be furnished and installed under Division 26.

1.6 SUBMITTALS

A. See Section 230500 and General Conditions for additional requirements.

B. Product Data: Provide product description and list of materials including all motor efficiency ratings.

C. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.7 QUALITY ASSURANCE

A. Manufacturer regularly engaged in the design, testing and manufacturing of specified products and issuing complete catalog data on such products.

B. Manufacturers must prove expertise in the design, testing and production of specified or similar to specified products for at least ten (10) years prior to date of bid.

C. Manufacturer must provide written certification that the products provided meet or exceed the specification requirements. An executive officer of the company must sign the written certification.

1.8 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery of materials shall be made to the project by the materials supplier in accordance with the instructions of the Contractor.

B. The Contractor shall provide adequate storage space for the materials, shall be responsible for all items of materials after receipt from the supplier, and shall replace all materials lost or damaged after delivery and receipt.

C. The Contractor shall furnish the materials supplier with receipts for all materials and accessory items received, and shall send copies of these receipts to the Architect.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURER CONTINGENT ON COMPLIANCE WITH SPECIFICATIONS

A. Motors:

1. Toshiba
2. General Electric Company
3. Reliance Electric Company
4. US motor
5. Baldor
6. WEG Electric

B. Motor controllers:

1. General Electric
2. Square D.

3. Allen Bradley

4. Westinghouse/Cutler-Hammer

5. Cerus

6. WEG Electric

2.2 GENERAL

A. All control wiring shall be installed in conduits and in accordance with the respective equipment manufacturer requirements. All connections shall be provided by the HVAC Contractor. All conduit and wiring provided by the Mechanical Contractor shall be installed in accordance with the requirements of Division 26 of these Specifications.

B. Motors shall be built in accordance with latest Standards of NEMA and as specified. Motors shall be specifically and expressly wound for voltage required.

C. Motors shall be tested in accordance with ANSI 50 and conform thereto for insulation resistance and dielectric strength.

D. Motors shall be provided with adequate starting and protective equipment as specified or required and with conduit terminal box of size adequate to accommodate conduits and wires.

E. Capacity shall be sufficient to operate motors under job conditions of operation and load, without overload and shall be at least the horsepower size indicated or specified.

F. All motors shall be suitable for continuous duty at rated horsepower, with temperature rise not to exceed 90°C above a 40º (with a 1.15 SF (before rise). All motors shall be capable of 15% overload without overheating. All motors shall be rated and certified for use with VFDs per NEMA MG1 Section 31.

G. All motors shall be properly grounded.

H. Motors Powered through Variable Frequency Drives

1. 3/4 to 75 MHP shall be provided with one of the following:

a. Shaft grounding rings (drive end)

b. Insulated sleeve bearings (Both ends)

c. Insulated bearings (Both ends).

2. 100 MHP and larger shall be provided with shaft grounding rings and one of the following:

a. Insulated sleeve bearings both ends.

b. Insulated bearings both ends.

I. All motors shall be rated and certified for inverter duty, and stamped as such.

1. All motors shall have Class F insulation or higher temperatures.

2. Manufactured to maximize Corona Inception Voltage (CIV) rating.
   a. The minimum acceptable shall be 2500 Volts at 155°C.

3. Windings shall be in-slot wound type.

J. Direct connected motors shall be furnished with adjustable base. Motors connected to driven equipment by belt or shaft shall be furnished with adjustable sliding bases, except for fractional motors which shall be furnished with slotted mounting holes.

K. Motors shall have nameplates giving manufacturer's name, serial number, horsepower, speed and current characteristics.

L. Motors smaller than 1/2 HP shall be capacitor, starter or split-phase type. Motors 1/2 HP and larger shall be squirrel cage, induction type. Motors 1 HP and larger shall have grease lubricated ball bearings and approved grease fittings. Motors provided shall have voltage, phase and hertz characteristics, as scheduled on the drawings.

M. Except for electrical apparatus specifically called for to be provided under this Contract, all motor starters, disconnect switches, controllers and other electrical appurtenances required under the HVAC, Plumbing, Fire Protection, etc. work, shall be provided under Division 26. Study the Electrical drawings and coordinate requirements and quantities with the Electrical Contractor.

N. All electrical apparatus and controls furnished as a part of the HVAC, Plumbing, Fire Protection, etc. work shall conform to applicable requirements under Electrical Section.

O. Each Contractor shall provide the Electrical Contractor with all motor size and wiring requirements within (30) days from date of Contract to allow proper coordination of Trades by the General Contractor.

P. Each Contractor shall verify with the Electrical Contractor available electrical characteristics before ordering any equipment or motors.

Q. Equipment which includes a number of correlated electrical control devices mounted in a single enclosure or on a common base with equipment, shall be supplied for installation completely wired internally with terminal strip ready for external wiring. Unless specifically directed otherwise in the Contract Documents, if these control devices are separately mounted they shall be furnished by the HVAC Contractor and wired by ATC Contractor or Electrical Contractor in accordance with the manufacturer's wiring diagram, as shown on the drawings and as specified hereinafter.

R. All motors shall meet NEMA vibration requirements and shall be less than 0.15 in./sec.

2.3 SHAFT GROUNDING RINGS

A. Shall be maintenance-free, circumferential, conductive micro fiber shaft grounding ring

B. Shall be installed on the AC motor to discharge shaft currents to ground.

C. Similar to AEGIS shaft grounding rings (SGRs).

2.4 MOTORS

A. In accordance with NEMA, IEEE and ANSI 50 Standards.

B. Capacity: Minimum of indicated horsepower and to operate driven devices under all conditions without overload.

C. Provide all of the same manufacturer, except those provided integrally with equipment.

D. Motor type and application (1/2 hp and above):

1. Conditioned areas and heated ventilated areas protected from weather:

a. Squirrel-cage induction type, open drip-proof, NEMA B design, rated for 90 degree C rise over 40 degree C ambient, Class B insulation up to 1 hp and class f insulation above 1 hp, 1.15 service factor, continuous rating per NEMA MG1-1.40.

b. Unless otherwise noted on the mechanical contract drawings or specified.

2. Motors installed outdoors, on roofs and out of building airstreams:

a. Squirrel-cage induction type, totally enclosed fan cooled, NEMA B design, class B insulation, up to 1 hp and Class F insulation above 1 hp 1.15 service factor, continuous duty unless otherwise noted on the contract drawings or specified.

E. Motor shall be 1800 rpm single speed motors unless otherwise noted on the contract drawings.

F. Motor type and application (less than ½ hp).

1. Built in overload protection.

2. Rewinding tap, permanent split capacitor type, unless otherwise noted on the contract drawings or specified.

3. Suitable for service and location.

4. Motor shall be 1800 rpm single speed motors, unless otherwise noted on the contract drawings.

G. Motor voltages:

1. Motors less than ½ hp: Single phase, 60 hertz, 120 volt, AC, unless otherwise indicated on the contract drawings.

2. Motors ½ hp and up. Suitable for 3 phase, 60 hertz, 480 volt, AC power source, unless otherwise indicated on the contract drawings.

H. Motor Efficiency Ratings And Construction

1. Motors 1.0 hp up to 250 hp: Suitable for 3 phase, 60 hertz, 480 volt, AC power source, premium-efficient type, unless otherwise noted on the contract drawings as specified.

2. Guaranteed minimum power factor at full load and rated voltage and guaranteed minimum efficiency at full load and rated voltage when tested in accordance with IEEE Test Procedure 112A, Method B.

3. Premium-efficient type motors shall conform to the following efficiencies:

Nominal Efficiencies For NEMA Premium Efficiency

Motors Rated at 600 Volts or Less

	Open Drip Proof			Totally Enclosed Fan-cooled		
HP	6 pole	4 pole	2 pole	6 pole	4 pole	2 pole
1	82.5	85.5	77.0	82.5	85.5	77.0
1.5	86.5	86.5	84.0	87.5	86.5	84.0
2	87.5	86.5	85.5	88.5	86.5	85.5
3	88.5	89.5	85.5	89.5	89.5	86.5
5	89.5	89.5	86.5	89.5	89.5	88.5
7.5	90.2	91.0	88.5	91.0	91.7	89.5
10	91.7	91.7	89.5	91.0	91.7	90.2
15	91.7	93.0	90.2	91.7	92.4	91.0
20	92.4	93.0	91.0	91.7	93.0	91.0
25	93.0	93.6	91.7	93.0	93.6	91.7
30	93.6	94.1	91.7	93.0	93.6	91.7
40	94.1	94.1	92.4	94.1	94.1	92.4
50	94.1	94.5	93.0	94.1	94.5	93.0
60	94.5	95.0	93.6	94.5	95.0	93.6
75	94.5	95.0	93.6	94.5	95.4	93.6
100	95.0	95.4	93.6	95.0	95.4	94.1
125	95.0	95.4	94.1	95.0	95.4	95.0
150	95.4	95.8	94.1	95.8	95.8	95.0
200	95.4	95.8	95.0	95.8	96.2	95.4
250	95.4	95.8	95.0	95.8	96.2	95.8
300	95.4	95.8	95.4	95.8	96.2	95.8
350	95.4	95.8	95.4	95.8	96.2	95.8
400	95.8	95.8	95.8	95.8	96.2	95.8
450	96.2	96.2	95.8	95.8	96.2	95.8
500	96.2	96.2	95.8	95.8	96.2	95.8

Nominal Efficiencies For NEMA Premium Efficiency
Motors Rated at 5kV or Less

	Open Drip Proof			Totally Enclosed Fan cooled		
HP	6 pole	4 pole	2 pole	6 pole	4 pole	2 pole
250	95.0	95.0	94.5	95.0	95.0	95.0
300	95.0	95.0	94.5	95.0	95.0	95.0
350	95.0	95.0	94.5	95.0	95.0	95.0
400	95.0	95.0	94.5	95.0	95.0	95.0
450	95.0	95.0	94.5	95.0	95.0	95.0
500	95.0	95.0	94.5	95.0	95.0	95.0

4. Motors less than 1 hp shall be manufacturer’s standard premium efficiency design.

5. Motor nameplate shall be specially marked “energy efficient motor” or similar nomenclature.

6. Motors built in accordance with current NEMA Standard MG-1 except as noted.

    a. Motors NEMA Design B, NEMA T-frame sizes.

    b. Insulation tested by manufacturer, Class F or better. Test per NEMA MG1-12.03.

    c. Temperature rise limits in accordance with NEMA limits for insulation class, service factor and enclosure specified.

I. Materials and Construction:

1. Motors up to 5 hp

a. Steel motor frames, cast aluminum end brackets, steel terminal box, copper windings.

2. Motors 5 hp and larger:

a. Cast iron motor frames, cast iron end brackets, cast iron terminal box, copper windings.

3. TEFC Motors

a. Cast iron motor frames, cast iron end brackets, cast iron terminal box, copper windings, corrosion resistant fan internals, epoxy varnish coated for corrosion protection, cadmium plated hardware.

b. Severe duty motors:

1) Cast iron construction (frame, end brackets and terminal box). External hardware, fan and fan cover coated or plated to prevent corrosion or corrosion-resistant material. Air gap surfaces coated with epoxy or zinc chromate. Shafts with rotating shaft mounted slingers or seals to prevent entry of contaminants at each end. Epoxy insulation system where used in high-moisture and corrosive atmospheres.

4. Explosion proof motors:

a. UL listed for application or duty.

b. Motors shall conform to requirements defined in Article 500, 501, 502, 503 of the National Electric Code.

c. Motor nameplate shall be specifically marked “explosion proof” or similar such nomenclature.

5. Sound-power levels no greater than recommendations of NEMA (MG1-12-49).

J. Motors 1/2 hp and above, conform to following:

1. Bearings: Antifriction type with bearing housings equipped with easily accessible plugged provisions for relubrication. Minimum L-10 life of 100,000 hours based on direct drive equipment. Bearing housings shall be equipped with grease openings for simultaneously adding new grease and purging the old grease. Provide corrosion resistant plugs or caps on grease openings.

2. Belt-connected motors: NEMA foundation slide base and shaft as required for aligning pulleys. Minimum L-10 life based on belt drive shall be 40,000 hrs.

3. Motor enclosure: Suitable for service and location.

2.5 MOTOR DISCONNECT

A. Provide only devices of Specification Grade, UL listed and labeled, manufacturer’s certification

to meet applicable Federal Specifications, and to meet NEMA performance standards.

B. Disconnects shall be “Heavy Duty Type”. Single phase disconnect switches: Two pole toggle operated AC manual motor starting switch without overload protection for single phase motors.

C. Three phase disconnect switches: 3 pole fusible or unfusible as required; 250 or 600 volt as required in NEMA 4 enclosures.

D. The operating handle for three phase disconnect switches shall be of the box-mounted type that directly drives the switch mechanism.

E. Three phase disconnect switches shall have a defeatable, front accessible, interlock to prevent the opening of the cover when the switch is in the “ON” position and prevent turning the switch “ON” when the door is open.

F. Solid neutral: Provide as required.

G. Provide ground lug for ground wire termination.

H. All disconnects shall be lockable.

I. Operating handle: Lockable in either open or closed position.

J. All motor disconnects shall be horsepower rated.

K. Feed through or double lugged: UL approved for the purpose.

L. Installation:

1. All switches shall have a nameplate indicating the circuit number feeding the switch. Nameplate shall be laminated black with white letters engraved.

2. Install a motor disconnect switch with every motor unless noted otherwise on mechanical equipment schedules.

2.6 MOTOR CONTROLLERS

A. Manual motor controller:

1. For single phase motors, provide H-O-A switches with thermal overload.

2. 2-speed: Fast-slow-off selector switch with overload protection for each speed, with pilot lights for slow and fast speed.

B. Magnetic motor controller:

1. Provide magnetic contactors with three overload relays, for motor running overload protection, per NEC.
2. 120 Volt holding coil.
3. Provide status pilot light in cover, red for energized. Pilot light shall be operated by an extra interlock (not placed across holding coil). Pilot light shall be long life (130 volt) type 6S6 incandescent lamps.

4. Provide reset button, and Hand-Off-Automatic switch in cover, field convertible to Off-Auto or Start/Stop pushbutton.

5. Provide one set of convertible auxiliary contacts in addition to standard auxiliary holding contacts supplied with each contactor.

6. Provide control transformer 120 volt secondary of sufficient capacity to handle operating coil and associated controls plus 75 volt amps.

7. Provide surface mounted starters in NEMA Type 1 enclosure for indoor applications and NEMA Type 4 enclosure for outdoor applications.

8. Contacts shall be solid-silver cadmium oxide alloy which will not require any filing, dressing or cleaning throughout the life of the control equipment. Bare copper or silver flashed contacts shall not be permitted.

9. Operating coils shall be pressure molded. When a coil fails under over-voltage condition, the motor controller shall drop out.

10. Overload relays shall be of the hand-reset, trip-free variety so that blocking the reset mechanism in the reset position will not prevent the starter from dropping out if the motor is overloaded. This specifically excludes those overload relays which change to automatic reset from hand-reset when the reset mechanism is blocked unless the automatic reset feature can be removed or voided. Accidentally depressing the reset button or mechanism shall not shut off the motor. Overload relays shall not be field convertible from hand to automatic reset type.

11. Disconnect switch shall be provided under Division 26 unless otherwise noted.

12. Where specified, motor hp rated disconnect switches shall be provided in NEMA 1 enclosure for indoor applications and NEMA 4 enclosures for outdoor applications.

13. Provide full coordination between settings or ratings of protective devices in accordance with the NEC.

C. Combination motor controller (only where indicated on the contract drawings or specified).

1. Provide molded case circuit breakers with rotary operating handle and lock-off facility.

2. Restrict opening of switch enclosure by the use of a defeater screw unless switch is in the OFF position.

3. Provide contactors with three overlay relays.

   a. 120 Volt holding coil.

   b. Provide status pilot light in cover, red for energized. Pilot light shall be operated by an extra interlock (not placed across holding coil) Pilot lights shall be long life (130 volt) type 6S6 incandescent lamps.

4. Provide reset button, and Hand-Off-Automatic switch in cover, field convertible to Off/Auto or Start/Stop pushbutton.

5. Provide one set of auxiliary contacts in addition to standard auxiliary hold contacts

supplied with each contactor.

6. Provide control transformer 120 volt secondary of sufficient capacity to handle operating coil and associated controls plus additional 75 volt amps.

7. Time-delay relays shall be adjustable, pneumatic type, 2 to 60 seconds and operate on 120 volts, 60 hertz. They shall have at least one normally open and one normally closed timed contact. The type of operation is as indicated or required.

PART 3 – INSTALLATION

3.1 MOTORS

A. Coordinate with appropriate trades.

1. Motor and base mounting requirements.

2. Motor electrical requirements.

B. Motors shall be installed in accordance with manufacturer's installation instructions.

C. Motors shall be installed in accordance with all applicable codes.

D. Mechanical Contractor shall assist the ATC Contractor in the calibration process of all motor current transformers as detailed in Division 25.

3.2 CONTROLLER

A. Provide all controllers not indicated on Electrical drawings.

END OF SECTION 230513

SECTION 230529 – HANGERS AND SUPPORTS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Section 230500, apply to this Section.

1.2 WORK INCLUDED

A. Furnish and install all hangers, supports and assemblies for all parts of the mechanical systems. This shall include all piping, ducts and equipment specified in this Division and as shown on the drawings

B. All materials shall be new and manufactured for the specific purpose of supporting systems, equipment, pipes, ducts, conduits and accessories.

C. All system components shall be installed in accordance with local codes including seismic isolation as required and specified under Section 230548.

D. Refer to Section 230516 Pipe Expansion and closely coordinate with this work.

E. Secure all permits and local/state approval for the components as specified and included under this Section.

1.3 RELATED SECTIONS

A. Examine all drawings and criteria sheets and all other Sections of the Specifications for requirements which affect work under this Section whether or not such work is specifically mentioned in this Section.

B. Section 230548 – Mechanical Vibration Controls and Seismic Restraints.

C. Section 232000 – HVAC Piping and Joints.

1.4 REFERENCES

A. Applicable provisions of the following Codes and Trade Standard Publications shall apply to the work of this Section, and are hereby incorporated into, and made a part of the Contract Documents.

1. Material standards shall be as specified or detailed hereinafter and as following:

a. ASME B31.9 – Building Services Piping, The American Society of Mechanical Engineers.

b. ASME B31.1 – power piping.

c. ASHRAE Systems and Equipment Handbook.

d. ASTM F 708 – Standard Practice for Design and Installation of Rigid Pipe Hangers.

e. MSS SP-58 – Pipe Hangers and Supports – Materials, Design and Manufacture; Manufacturers Standardization Society of the Valve and Fittings Industry.

f. MSS SP-69 – Pipe Hangers and Supports – Selection and Application; Manufacturers Standardization Society of the Valve Fittings Industry.

g. MSS SP-89 – Pipe Hangers and Supports – Fabrication and Installation Practices; Manufacturers Standardization Society of the Valve and Fittings Industry.

h. NFPA-13 – Installation of Sprinkler Systems

i. MSS-SP-127-2001 – Bracing for Piping Systems.

1.5 SYSTEM DESCRIPTION

A. In addition to special hangers and supports specified elsewhere in this Section and shown on the drawings for ducts, piping and equipment, furnish and install safe and substantial means of support for all parts of the mechanical systems. Shop drawings shall be submitted for review and approval for all supports. All piping, ductwork, exhaust pipe and breeching hangers and supports in all mechanical rooms, penthouses and energy plant shall be installed with vibration isolators and Seismic restraints. This requirement is mandatory and shall be strictly enforced.

B. All piping shall be hung to true alignment, using appropriate and substantial hanger arrangements. Wire and strap hangers will not be permitted. Hangers shall be located so that piping and hangers will be clear of other piping, hangers, conduits, lighting and other obstructions.

C. The hanging and supporting of piping and equipment shall conform to recommendations of the manufacturers of same and American National Standard, ANSI/MSS SP-58 and SP-69 latest edition, except where requirements of this specification exceed the above referenced Standards.

1.6 SUBMITTALS

A. See Section 230500 and General Conditions for additional requirements.

B. All brackets and hangers shall be submitted for review. Include the method of hanging and supporting all piping, ductwork and equipment. Include upper attachment to building structure.

C. The Architect is to be notified when the first bracket is assembled so that the installation can be reviewed in the field.

D. Provide location of all inserts to be used for hanging ductwork, piping and equipment and the weight of all components (including water weight).

E. On piping plan submittal (reference Section 232000), provide index of hanger types and point loads on building structure.

1.7 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing products of the type specified in Part 2 – Products.

B. Installer: Company specializing in performing work of the type specified in this section, with documented experience.

C. Welders: Certify in accordance with ASME.

1.8 REGULATORY REQUIREMENTS

A. Conform to ASME B31.9 code for installation of piping system and supports.

B. Conform to ASME B31.1 code for power piping.

C. All applicable seismic codes.

D. ASTM F708 for design and installation of pipe hangers.

E. Welding Materials and Procedures: Conform to ASME (BPV IX) and applicable state labor regulations

1. Provide certificate of compliance from authority having jurisdiction, indicating approval of welders.

1.9 DELIVERY, STORAGE AND HANDLING

A. All hangers and supports shall be delivered in containers and shall be kept in a dry and protected area.

B. All exposed hangers, supports, etc. shall be given 2 coats of rust resistant paint of a color selected by the Architect prior to installation.

1.10 ENVIRONMENTAL

A. Do not paint or install inserts, hangers and/or supports when environmental conditions are outside the specific limitations of the referenced codes and manufacturer’s recommendations.

PART 2 – PRODUCTS

2.1 GENERAL

A. Pipe supports shall be of type and figure number as specified.

B. Acceptable manufacturers subject to compliance with the specifications shall be as follows:

1. Pipe Hangers

a. Carpenter & Patterson
b. B-Line
c. Grinnell

d. National Pipe Hanger Corp.

e. Piping Technology & Products Inc.
f. PHD Manufacturing, Inc.

2. Constant Force Hangers.

a. Anvill International, Inc.
b. Piping Technology & Products Inc.
c. Piping Accessories, Inc.
d. Rilco Manufacturing Co.
e. PHD Manufacturing, Inc.

3. Channel Support Systems

a. B-Line Systems, Inc.
b. Grinnell Corp. Power-Strut Unit
c. GS Metals Corp.
d. Michigan Hanger Co., Inc. O-Strut Div.
e. National Pipe Hanger Corp.
f. Thomas & Betts Corp.
g. Unistrut Corp.
h. Wesanco, Inc.

4. Thermal-Hanger Shield Inserts

a. Carpenter & Patterson, Inc.
b. Michigan Hanger Co., Inc.
c. PHS Industries, Inc.
d. Pipe Shields, Inc.
e. Rilco Manufacturing Co., Inc.
f. Value Engineered Products, Inc.

2.2 PIPE HANGERS

A. Bracket assemblies for supporting piping are to be fabricated by welding and all irregular surfaces are to be smoothed up by grinding. Shop drawings shall be submitted for review for each type bracket. The Architect is to be notified when the first bracket is assembled so that installation can be reviewed in the field. Exposed hangers, supports and brackets are to be given (2) coats of rust resistant paint of the color as selected by the Architect. Additionally, provide for Architect's review, the following:

1. Location of all inserts to be used for hanging ductwork and piping where applicable and the weight of such pipe or equipment to be hung, including the weight of water, valves and insulation.

2. Method of hanging and support of all piping, ducts and other equipment.

B. All pipe supports shall be of type and arrangement as hereinafter specified. They shall be so arranged as to prevent excessive bending stresses between supports.

C. All bracket clamp and rod sizes indicated in this specification are minimum sizes only. This Section shall be responsible for structural integrity of all supports. All structural hanging materials shall have a safety factor of (5) built in. Beam clamps shall be 2-sided steel clamps designed to firmly attach to the flange of the beam with the load directed downward on the centerline of the beam web. Beam clamps shall be similar to B-Line #B3055, or approved equal.

D. Other forms of hangers and supports shall be used to accommodate special or unusual job conditions or conditions not covered herein, subject to the approval of the Architect. When special conditions require the use of concrete inserts which are not "built in", such inserts may be used in locations approved by the Architect and shall be Phillips "Red Head" or approved equal. Explosive powder studs or detonator assisted studs or anchors will not be permitted.

E. All pipes shall be hung free of dependence on pipe sleeves for support.

F. All auxiliary steel required for pipe, duct and equipment supports shall be furnished and installed by the Mechanical Contractor.

G. Threaded pipe, chains, wire and perforated straps will not be accepted. No piping shall be supported from ductwork, conduit or other piping. All system components and equipment shall be independently supported. Distribute hangers on parallel piping to avoid overloading of structure.

H. Roller type supports shall be used for pipes subject to axial movement (all hot water steam, condensate and any emergency generator exhaust). They shall be braced so that movement occurs in roller rather than support rods. This requirement shall apply to piping 2 1/2" and up.

I. Constant force support hangers shall be provided for the emergency generator exhaust piping as determined by the stress and seismic analysis. Constant force hangers shall be similar to Anvil International, Inc. and they shall be pre-engineered to meet the loads and expansion for the vertical risers and off sets if any.

J. Hangers and supports used for systems exposed to weather shall be hot dipped galvanized in accordance with ASTM A153-73 or A123. Rods and nuts shall be electro-galvanized.

K. All horizontal water, drain, waste, vent and rainwater piping shall be hung with clevis steel hangers similar to B-Line #B3100. Groups of pipes in the same horizontal plane and with the same pitch may be supported on B-Line #3160 gang hangers. Wall brackets similar to shall be B-Line #B3066 and #B3077.

L. All pipes which are hung so that the centerline of the pipe is less than 10" below the point of suspension of the hanger rod and all hydronic hot water piping shall be supported on roller hangers similar to B-Line #B3110.

M. Unless otherwise noted, maximum hydronic pipe hanger spacing shall not exceed the recommendations of the pipe manufacturer of MSS-SP-58 and SP-69, and the following:

1. Steel Pipe

a.	For 1/2" – 1-1/4”:	7'-0"o.c.
b.	For 1-1/2” – 2” size:	8'-0"o.c.
c.	For pipe 2-1/2" to 8":	10'-0"o.c.
d.	For pipes 10" and up:	15'-0"o.c.

2. Copper Tubing

a.	1/4” – 3/4”:	5’-0”o.c.
b.	1” – 1-1/4”:	6’-0”o.c.
c.	1-1/2” – 2”:	8’-0”o.c.
d.	2-1/2” – 3”:	9’-0”o.c.
e.	4” – 6”:	12’-0”o.c.

3. In addition, hangers shall be installed within 2'-0" of each change in direction and on each side of valves 2-1/2” in size and up.

N. Hanger rods shall be of steel and not less in diameter than:

1.	For pipe 2" and under:	3/8"
2.	For pipe 2 1/2" and 3":	1/2"
3.	For pipe 4" and 5":	5/8"
4.	For pipe 6" and 8”:	3/4"
5.	For pipe 10" and 12":	7/8"
6.	For pipe 14", 16", 18”:	1"
7.	For pipe 20" and up:	Per MSS-SP-69

O. All vertical piping shall be supported vertically at the base of all risers and guided laterally at each floor. Vertical copper tube shall be laterally guided at a minimum of 10 ft. intervals. Refer also to Section 230548, Paragraph 3.2, Spring Riser Support System.

P. Insulated steel piping 2 1/2" and up, except chilled water, shall be fitted with steel pipe covering protection saddles similar to B-Line #B3163 and of the same depth as the specified insulation. Saddles shall be tack welded to the pipe and filled with loose insulation. Standard length saddles may be cut in (2) equal sections for attachment to pipes 6” diameter and under.

Q. Insulated piping 2" and under, except chilled water, shall be fitted with 16 gauge steel covering protectors at each hanger location similar to B-Line #B3151.

R. Chilled water piping shall be insulated with high density hydrous calcium silicate shields where hangers occur similar to #B3380CW. Special care shall be exercised to assure a continuous vapor barrier installation to protect the system and prevent sweating.

S. All vertical piping shall be supported with steel riser clamps similar to B-Line #B3773. Such clamps on copper tubing shall be applied over couplings only.

T. All pipes suspended at an elbow shall be hung using plate lugs similar to Grinnell #HS.53 with forged steel clevis similar to B-Line #B3201.

U. Spring hanger locations shall be provided as specified herein, under vibration isolation, and shall be Grinnell, pre-engineered to meet loads and movements in accordance with ANSI B.31.1.10, where applicable.

V. Drop rods for hangers may be used wherever possible and shall be installed prior to slabs being poured. Drop rod details shall be submitted to the Architect and Engineer for review.

2.3 DUCT HANGERS

A. See Specification 233100 Sheet Metal.

2.4 MISCELLANEOUS MATERIALS

A. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.

B. Structural Steel: ASTM A 36M, steel plates, shapes, and bars, black and galvanized.

C. Grout: ASTM C 1107, Grade B, factory-mixed and packaged, non-shrink and nonmetallic, dry, hydraulic-cement grout.

1. Characteristics: Post hardening and volume adjusting recommended for both interior and exterior applications.
2. Properties: Non-staining, non-corrosive and nongaseous
3. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 – EXECUTION

3.1 PREPARATION

A. All hangers, rod and supports shall receive two (2) coats of rust inhibitive paint.

B. Provide inserts for placement in concrete formwork.

C. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

D. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.

E. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

3.2 INSTALLATION

A. Pipe Hangers and Supports.

1. Install in accordance with ASME B31.9, ASTM F 708, or MSS SP-89 or NFPA-13.

2. Support piping, ductwork and equipment as specified under Part 2.

3. Install hangers to provide minimum ½ inch space between finished covering and adjacent work.

4. Place hangers with 24 inches of each horizontal elbow and on each side of valves 3” in size and up.

5. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.

6. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.

7. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

8. Provide copper plated hangers and supports for copper piping or between hanger support and piping.

9. Prime coat (2 coats rust inhibitive paint) exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

10. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.

B. Where pipe support members are welded to structural building framing, scrape, brush clean and apply two coats of zinc rich primer to welds.

3.3 INSERTS

A. Use inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

B. Set inserts in position in advance of concrete work. Provide reinforcement rod in concrete for inserts carrying pipe over 4 inch or ducts over 60 inches wide.

C. Finish inserts, flush with slab surface.

D. Inserts: Steel, slotted type, factory-painted.

1. Single rod: Similar to Grinnell Figure 281.
2. Multi-rod: Similar to Carpenter and Paterson 1480 Type 1.
3. Clip form nails flush with inserts.
4. Maximum load 75 percent of rating.

3.4 SUPPORTS FROM BUILDING CONSTRUCTION

A. Inserts, Beam Clamps, Steel Fishplates (in concrete fill only), Cantilever Brackets or Other Means.

B. Submit for Review.

C. Grouped Lines and Services

1. Trapeze Hangers fabricated of Bolted Angles or Channels.

D. Where Building Construction is Inadequate

1. Provide Additional Framing.

2. Submit for Review.

3.5 EXPANSION DEVICES

A. Expansion anchors: Similar to Hilti "Drop-In Anchor HDI" flush type.

B. Drill concrete to receive required expansion cases on concrete fasteners.

C. Install in shear only, not in tension.

3.6 EQUIPMENT BASES AND SUPPORTS

A. Provide rigid anchors for ducts and pipes immediately after vibration connections to equipment.

B. Refer to Specification Sections 230500 and 230548 for additional information.

C. Fabricate structural-steel stands to suspend equipment from structure above or to support equipment above floor.

D. Grouting: Place grout under supports for equipment and make smooth bearing surface.

3.7 METAL FABRICATION

A. Cut, drill, and fit miscellaneous metal fabrications for heavy-duty steel trapezes and equipment supports.

B. Fit exposed connections together to form hairline joints. Field-weld connections that cannot be shop-welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding appearance and quality of welds, and methods used in correcting welding work, and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base-metals.

2. Obtain fusion without undercut or overlap.

3. Remove welding flux immediately.

4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.8 ADJUSTING

A. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

3.9 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

B. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 230529

SECTION 230548 – MECHANICAL VIBRATION CONTROLS AND SEISMIC RESTRAINTS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Section 230500, apply to this Section.

1.2 WORK INCLUDED

A. Furnish and install all necessary vibration isolation materials to eliminate excessive noise and vibration from all building mechanical systems.

B. Seismic restraints for all systems shall be installed in accordance with:

1.	Code	IBC 2009
2.	Building Occupancy Category	III
3.	Seismic Design Category	B
4.	Site Classification	2A
5.	Building I_p (Importance Factor)	1
6.	All Life Safety Systems	Importance Factor = 1.5
7.	Emergency Electrical	Importance Factor = 1.5
8.	Hazardous Systems	Importance Factor = 1.5
	a. Oil piping	Importance Factor = 1.5
	b. Gas piping	Importance Factor = 1.5
	c. Gas Vents	Importance Factor = 1.5
9.	HVAC	
	a. All smoke exhaust systems	Importance Factor = 1.5
	b. All stair pressurization systems	Importance Factor = 1.5
	c. Steam system	Importance Factor = 1.5
	d. Condensate system	Importance Factor = 1.5
	e. Snow melting piping system	Importance Factor = 1.0
	f. Heat recovery piping system	Importance Factor = 1.0
	g. Hospital ductwork	Importance Factor = 1.5
10.	Plumbing systems	
	a. Medical gas	Importance Factor = 1.5
	b. Laboratory gases	Importance Factor = 1.5
	c. Nitrogen piping system	Importance Factor = 1.5
	d. Compressed air system	Importance Factor = 1.5
	e. High Purity water system	Importance Factor = 1.5
	f. Pneumatic gases	Importance Factor = 1.5
	g. Domestic water system	Importance Factor = 1.5
	h. Non Potable water system	Importance Factor = 1.0
	i. Gray water system	Importance Factor = 1.0
	j. Waste and vent system	Importance Factor = 1.0
	k. Laboratory waste and vent	Importance Factor = 1.5

l. Acid waste and vent Importance Factor = 1.5
m. Storm Drain system Importance Factor = 1.0

11. Other systems

a. All other ductwork systems Importance Factor = 1.5
b. All other piping systems Importance Factor = 1.5
c. All other electrical systems Importance Factor = 1.5
d. All other plumbing systems Importance Factor = 1.5
e. Control conduits Importance Factor = 1.5

C. Piping Types

1. High deformability piping:

a. Welded steel
b. Welded stainless steel
c. Socket welded steel
d. Grooved steel that is ASME B31.1
e. Braised copper
f. Grooved copper

2. Limited-deformability

a. Threaded Steel
b. Grooved steel that is not ASME B31.1
c. Soldered copper

3. Low-deformability

a. PVC
b. Cast iron
c. Glass
d. Non-ductile plastic

D. All trapeze supported Items weighing 10 lbs. per foot or greater shall be braced. This weight shall include all pipes and conduits filled with water.

E. Secure all permits and local/state approval for the installation of all components included under this Section.

F. The work in this Section shall include the following:

1. Vibration isolation elements for equipment.
2. Equipment isolation bases.
3. Piping flexible connectors.
4. Seismic restraints for isolated equipment.
5. Seismic restraints for non-isolated equipment.
6. Seismic restraints for ductwork
7. Seismic restraints for piping
8. Certification of seismic restraint designs and installation supervision.
9. Certification of seismic attachment of housekeeping pads.

G. Coordinate closelywith Hangers and Supports, Pipe Expansion and Structural documents.

1.3 RELATED SECTIONS

A. Examine all drawings and criteria sheets and all other Sections of the Specifications for requirements which affect work under this Section whether or not such work is specifically mentioned in this Section.

B. Refer to Section 230529 – Hangers and Supports.

1.4 REFERENCES

A. Applicable provisions of the following Codes and Trade Standard Publications shall apply to the work of this Section, and are hereby incorporated into, and made a part of the Contract Documents.

B. Material standards shall be as specified or detailed hereinafter and as follows:

1. NEBB– Procedural Standards for Measuring Sound and Vibration; National Environmental Balancing Bureau.
2. NEBB– Sound and Vibration in Environmental Systems; National Environmental Balancing Bureau.
3. SMACNA – Guidelines for Seismic Restraint of Mechanical Systems.
4. ASHRAE Guidelines – HVAC Applications; Chapter– Sound and Vibration Control, Chapter – Seismic Restraint Design, Latest Edition.
5. ASCE Standard 7 Minimum Design Loads for Buildings and Other Structures

1.5 SUBMITTALS

A. See Section 230500 and General Conditions for additional requirements.

B. The Vibration Isolation Submittal shall include descriptive data for all products and materials including the following:

1. Product Descriptions

a. A complete description of products to be supplied, including product data, dimensions, specifications and installation instructions.

b. An itemized list of isolated and non-isolated equipment. Detailed schedule and selection data for each vibration isolator and seismic restraint supporting equipment, including:

1) Equipment identification mark
2) Isolator type
3) Actual load
4) Static deflection expected under actual load
5) Specified minimum static deflection
6) Additional deflection-to-solid under load
7) Ratio of spring height under load to spring diameter
8) Base type
9) Seismic restraint type

c. Steel rails, steel base frames, and concrete inertia bases showing all steel work, reinforcing, vibration isolator mounting attachment method, and location of equipment attachment bolts.

2. Show equipment base construction for all equipment, including dimensions, structural member sizes and support point locations.

3. Indicate isolation devices selected with complete dimensional and deflection data.

4. Show all methods of suspension and support for ceiling hung equipment.

5. Detail methods of isolation for ducts and pipes piercing walls and slabs.

6. Provide specific details of seismic restraints and anchors, including number, size and locations for each piece of equipment.

7. Provide special details necessary to convey complete understanding of the work to be performed.

C. Seismic Analysis and Certification submittals shall include the following:

1. Seismic restraint calculations must be provided for all connections of equipment to the structure.

2. Calculations to support seismic restraint designs shall be stamped by a registered Professional Engineer.

3. Analysis must indicate calculated dead loads, derived loads, and materials utilized for connections to equipment and structure. Analysis must detail anchoring methods, bolt diameter, embedment and weld length.

4. A seismic design liability insurance certificate must accompany all submittals.

5. Coordinate all hangers and supports.

6. Provide Approved Agencies Certificate of Compliance meeting Seismic Category D for all components. Tests shall include anchorage, structural and on line capability from analytical or shaker test method.

a. Where the requirements of this specification cannot be met by any vendor, the contractor will submit a written summary indicating the lack of resources.

D. Submission of samples may be requested for each type of vibration isolation and seismic device. After approval, samples will be returned for installation at the job if requested. All costs associated with submission of samples shall be borne by the Contractor.

E. Provide seismic certifications for all equipment including, but not limited to:

1. Boiler
2. Chiller
3. Air handling equipment
4. Fan coil units
5. Fans
6. VFDs
7. Motor control centers
8. Cooling towers
9. Pumps
10. Heat exchangers
11. Seismic joints

1.6 QUALITY ASSURANCE

A. All vibration isolators shall have calibration markings or some method to determine the actual deflection under the imposed load after installation and adjustment.

B. All isolators shall operate within the linear portion of their load versus deflection curves. Load versus deflection curves shall be furnished by the manufacturer and must be linear over a deflection range of at least 50% above the design deflection.

C. The theoretical vertical natural frequency for each support point, based upon load per isolator and isolator stiffness, shall not differ from the design objectives for the equipment as a whole by more than ±10%, and shall be non-resonant with equipment forcing frequencies or support structure natural frequencies.

D. All neoprene components shall have a shore hardness of 30 to 50 ±5%, after minimum aging of (20) days or equal oven aging.

E. Substitution of internally isolated and restrained equipment in lieu of the isolation and restraints specified in this Section is acceptable provided all conditions of this Section are met. The equipment manufacturer shall provide a letter of guarantee stating that the specified noise and vibration levels will be obtained and that the seismic restraints shall be in compliance with these specifications. All costs for converting to the specified external vibration isolation and/or restraints shall be borne by the equipment manufacturer/installing contractor should submissions or installations be found to be unacceptable pursuant to the intent of this specifications.

F. Should any rotating equipment cause excessive noise or vibration, the Contractor shall be responsible for rebalancing, realignment, or other remedial work required to reduce noise and vibration levels. Excessive is defined as exceeding the manufacturer's specifications for the unit in question.

G. Upon completion of the work, the Architect or Architect's representative shall inspect the installation and shall inform the Installing Contractor of any further work that must be completed. Make all adjustments as directed by the Architect that result from the final inspection. This work shall be done before vibration isolation systems are accepted.

H. Manufacturer Responsibility

1. Manufacturer of vibration and seismic control equipment shall have the following responsibilities:

a. Determine vibration isolation and seismic restraint sizes and locations.

b. Provide equipment vibration isolation and seismic restraints as scheduled or specified.

c. Guarantee specified isolation system deflections.

d. Provide installation instructions, drawings and field supervision to ensure proper installation and performance of systems.

e. Provide certification by a licensed engineer that all mounts and restraints meet the project requirements for seismic loading.

2. Substitution of internally isolated mechanical equipment in lieu of the specified isolation of

this Section must be approved for individual equipment units and is acceptable only if above acceleration loads are certified in writing by the equipment manufacturer and stamped and sealed by a licensed Civil or Structural Engineer.

3. Licensed Engineers shall be licensed in the project state.

I. Contractor Responsibilities

1. The Contractor performing the work on equipment in the section shall have the following responsibilities.

a. Identify the components that are part of the Quality Assurance Plan.

1) All flammable, combustible and highly toxic piping and their associated mechanical systems.

2) All ductwork containing hazardous materials.

3) All equipment using combustible or toxic energy sources.

b. Identify all Special inspection and Testing.

c. List control procedures within the contractor's organization including methods and frequency of reporting and their distribution.

d. List personnel and their qualifications exercising control over the seismic aspects of the project.

2. Purchased and/or fabricated equipment must be designed to safely accept external forces of 1.8 g load in any direction for all rigidly supported equipment, piping and ductwork without failure and permanent displacement of the equipment. Resiliently supported equipment, piping and ductwork and Life safety equipment such as fire pumps, smoke exhaust fans, emergency generators and other life safety designated equipment must be capable of accepting external forces of up to 3.6 g in any direction without permanent displacement or failure of the equipment.

1.7 REGULATORY REQUIREMENTS

A. Conform to ASME B31.9 code for installation of piping system and ASTM F708 for design and installation of pipe hangers.

B. Welding Materials and Procedures: Conform to ASME (BPV IX) and applicable state labor regulations.

C. Provide certificate of compliance from authority having jurisdiction, indicating approval of welders.

1.8 DELIVERY, STORAGE AND HANDLING

A. All vibration control and seismic restraint equipment shall be delivered in containers and shall be kept in a dry and protected area.

B. All exposed hangers, supports, etc. shall be given 2 coats of rust resistant paint of a color selected by the Architect prior to installation.

PART 2 – PRODUCTS

2.1 ISOLATORS AND RESTRAINTS – GENERAL

A. Acceptable Manufacturers subject to compliance to specifications.

1. Mason Industries (MI)
2. Amber/Booth (AB)
3. Kinetics Noise Control (KNC)
4. Vibration Eliminator Co. (VEC)
5. Vibration Mountings & Controls (VMC)

B. The Mechanical Contractor shall provide necessary vibration isolation materials to eliminate excessive noise and vibration from being transmitted from HVAC equipment to the occupied areas of the structure, and to serve as the basis for seismic restraint design for the entire HVAC system within the building. This includes all non-structural components such as, but not limited to, air handlers, fans, pumps, tanks, ductwork, piping, etc. (hereinafter called equipment).

C. Seismic restraints and vibration isolation types shall be capable of accepting, without failure, seismic forces determined in accordance with:

1. International Building Code
2. State/Country Codes
3. Local codes enforced at the specified project location.

D. Isolators and supports shall maintain the equipment in a captive position and not short circuit isolation during normal operating conditions. Isolators shall have provisions for bolting and/or welding to the structure.

E. All metal parts of vibration isolation units installed out-of-doors shall be cold dip galvanized, cadmium plated, or neoprene or PVC coated after fabrication. Galvanizing shall meet ASTM Salt Spray Test Standards and Federal Test Standard #14.

F. All base supported isolators shall have base plates with bolt holes for fastening the isolators to the support members.

G. Isolator types are scheduled to establish minimum standards. At the Contractor's option, laborsaving accessories can be an integral part of isolators supplied to provide initial lift of equipment to operating height, hold piping at fixed elevations during installation and initial system filling operations, and similar installation advantages. Accessories must not degrade the vibration isolation system.

H. Static deflection of isolators shall be as scheduled in this Section and as shown on the drawings. All static deflections stated are the minimum acceptable deflection under actual load. Isolators shall be selected for no less than 50% reserve deflection beyond actual operating conditions.

I. Attachment plates to be cast into housekeeping pads, concrete inserts, beam clamps, etc. that may be required for seismic compliance shall be provided by this Section.

J. Coordinate the size, location and special requirements of vibration isolation equipment and systems with other Trades. Coordinate plan dimensions with size of housekeeping pads.

2.2 SEISMIC RESTRAINT TYPES

A. Type I

1. Type I shall comply with general characteristics of spring isolator Type A with snubbing restraint in all directions capable of supporting equipment at fixed elevations during installation. Cast or aluminum housings, except ductile iron are not acceptable.

2. Type I seismic restraint shall be similar to Mason Industries Type SLRS.

B. Type II

1. Each corner or side of equipment base shall incorporate a seismic restraint snubber having a minimum of 5/8" thick resilient pad limit stop. Seismic snubbers shall be in accordance with manufacturer's recommendations.

2. Type II seismic restraints shall be similar to Mason Industries Type Z-1011 or Z-1225.

C. Type III

1. Type III shall be multiple metal cable or strut type with approved fastening devices to equipment and structure. System to be field bolted to deck or to overhead structural members using 2-sided beam clamps or appropriately designed inserts for concrete. All parts of the system including cables, excluding fasteners, are to be of a single supplier to ensure seismic compliance.

D. Type IV

1. Type IV shall have double deflection neoprene isolator (minimum 0.3") encased in ductile iron or steel casing.

2. Type IV seismic restraints shall be similar to Mason Industries Type BR, RBA or RCA.

E. Type V

1. Non-isolated equipment shall be field bolted or welded (powder shots not acceptable) to the structure as required to meet seismic forces. Bolt diameter, imbedment data and/or weld length must be shown in certified calculations.

2.3 VIBRATION ISOLATOR TYPES

A. Type A (Floor Spring and Neoprene)

1. The Type A spring isolator shall:

a. Have a minimum outside diameter to overall height of 0.8:1.

b. Have corrosion resistance where exposed to corrosive environment with:

1) Springs cadmium plated or electro-galvanized.
2) Hardware cadmium plated.
3) All other metal parts hot dip galvanized.

c. Have reserve deflection (from loaded to solid height) of 50% of rated deflection.

d. Have minimum 1/4" thick neoprene acoustical base pad on underside, unless designed otherwise.

e. Be designed and installed so that ends of springs remain parallel.

2. Type A isolator shall be similar to Mason Industries Type SLF.

Note: Must be used with Seismic Restraint II.

B. Type B (Floor Spring and Neoprene Travel Limited)

1. The Type B spring isolator shall be the same as Type A with the following additional features.

a. Built-in vertical limit stops with minimum 1/4" clearance under normal operation.
b. Tapped holes in top plate for bolting to equipment.
c. Capable of supporting equipment at fixed elevation during equipment installation. Installed and operating heights shall be identical.
d. Adjustable and removable spring pack with separate neoprene isolation pad.

2. Type B isolator shall be similar to Mason Industries Type SLR.

Note: This isolator must be bolted or welded to the structure.

C. Type C (Spring Hanger Rod Isolator)

1. Spring isolator (Type A) seated on a steel washer within a neoprene cup incorporating a rod isolation bushing.
2. Spring diameters and hanger box shall allow 30° of hanger rod movement.
3. When used on ductwork, provide eyebolts for attachment to duct straps.
4. Type C isolator shall be similar to Mason Industries Type 30 or W30.

Note: Must be used with Seismic Restraint III.

D. Type D

1. Same as Seismic Restraint Type IV.

E. Type E (Elastomer Hanger Rod Isolator)

1. Molded (minimum 1 3/4" thick) neoprene element with projecting bushing lining the rod clearance hole. Static deflection at rated load shall be minimum 0.035".
2. Steel retainer box encasing neoprene mounting capable of supporting equipment up to (4) times the rated capacity of the element.
3. Type E isolator shall be similar to Mason Industries Type HD.

Note: Must be used with Seismic Restraint III.

F. Type F (Combination Spring/Elastomer Hanger Rod Isolator)

1. Spring and neoprene elements in a steel retainer box with the features as described for Type C and Type E isolators.
2. Type F isolator shall be similar to Mason Industries Type 30N.

Note: Must be used with Seismic Restraint III.

G. Type G (Pad Type Elastomer Isolator)

1. 0.75" minimum thickness, 50 psi maximum loading, ribbed or waffled design.

2. Minimum 0.1" deflection.

3. 1/16" galvanized steel plate between multiple pad layers.
4. Provide load distribution plate where attachment to equipment bearing surface is less than 75% of the pad area.
5. Type G isolators shall be similar to Mason Industries Type Super W.

Note: Bolting required for seismic compliance. Neoprene and duck washers and bushings shall be provided to prevent short circuiting.

H. Type H (Pad Type Elastomer Isolator)

1. Laminated cotton duck and neoprene, maximum loading 1000 psi, minimum 1/2" thick.
2. Provide load distribution plate where attachment to equipment bearing surface is less than 75% of the pad area.
3. Type H isolator shall be similar to Mason Industries Type HL.

Note: Bolting required for seismic compliance. Neoprene and duck washers and bushings shall be provided to prevent short circuiting.

I. Type I (Thrust Restraints)

1. A spring element similar to Type A isolator shall be combined with steel angles, back-up plates, threaded rod, washers and nuts to produce a pair of devices capable of limiting movement of air handling equipment to 1/4".

2. Restraint shall be easily converted in the field from a compression type to tension type.

3. Unit shall be factory pre-compressed.

4. Thrust restraints shall be installed on all cabinet fan heads, axial or centrifugal fans and other equipment as scheduled.

5. Type I restraint shall be similar to Mason Industries Type WB.

J. Type J (Steel Rails)

1. Steel members of sufficient strength to prevent equipment flexure during operation.
2. Height saving brackets as required to reduce operating height.
3. Type J isolator shall be similar to Mason Industries Type ICS.

K. Type K (Pipe Anchors and Guides)

1. Acoustical pipe anchor or guide, consisting of a telescopic arrangement of (2) sizes of steel tubing separated by a minimum 1/2" thickness of Type H pad.

2. Vertical restraints shall be provided by a similar material arranged to prevent vertical travel in either direction (anchors only).

3. Allowable loads on isolation materials shall not exceed 500 psi, and the design shall be balanced for equal resistance in any direction.

4. Anchors and guides must be bolted or welded to meet seismic criteria.

5. Type K anchor shall be similar to Mason Industries Type ADA.

L. Type L (Isolated Clevis Hanger)

1. Combination clevis or rod roller hanger and a Type C, E, or F, isolation hanger.

2. System shall be pre-compressed to allow for rod insertion and standard leveling.

3. Type L hanger shall include Mason Industries Type CCB clevis brace.

2.4 EQUIPMENT BASES

A. All curbs and roof rails are to be bolted or welded to the building steel or concrete deck to attain acceleration criteria and shall be wind restrained for 110 mph wind loads.

B. Type B-1 (Integral Structural Steel Base)

1. The integral structural steel base shall be reinforced as required to prevent base flexure at equipment start-up and misalignment of driver and driven units. Centrifugal fan bases shall be complete with motor slide rails and shall be drilled for driver and driven units.

2. Height saving brackets shall be provided, as required, to reduce operating height and maintain 1" operating clearance under base.

3. Member depth shall be a minimum of 1/10 of the longest unsupported span.

4. Type B-1 equipment base shall be similar to Mason Industries Type M or WF.

Note: Must be used with Restraint I, II or IV.

C. Type B-2 (Concrete Inertia Base)

1. Concrete inertia base shall have rectangular structural concrete forms for floating foundations. Base for split-case pumps shall be large enough to support elbows. The base depth shall be a minimum of 1/12 the longest span, but not less than 6" or greater than 14". Forms shall include concrete reinforcement consisting of 1/2" bars or angles welded in place on 6" centers both ways in a layer 1 1/2" above the bottom. Provide an additional top layer of reinforcing for all bases exceeding 10'-0" in one direction.

2. Isolators shall be set into pocket housings which are an integral part of the base construction and set at the proper height to maintain 1" clearance below the base. Base shall be furnished with templates for equipment attachment and anchor bolt sleeves.

3. Type B-2 equipment base shall be similar to Mason Industries Type K or KIPWF.

Note: Must be used with Restraint I, II or IV.

D. Type B-3 (Spring Roof Curb)

1. Curb mounted rooftop equipment shall be mounted on structural spring isolation curbs that bear directly on the roof support structure, and are flashed and waterproofed into the roof's membrane waterproofing system. Equipment manufacturer's curb shall not be used.

2. All spring locations shall have removable waterproof covers to allow for spring adjustment and/or removal. Springs shall be Type A.

3. Curbs shall be thermal and sound attenuating type utilizing standard 2" roof insulation

supplied and installed by the Roofing Contractor.

4. Unit shall be provided with wood nailer and flashing.

5. Curbs shall meet all NRCA Standards.

6. Curbs shall include a means of incorporating a sound barrier package, Type SBC-3 consisting of (2) layers of waterproof sheetrock furnished and installed by others.

7. Curbs installed on pitched roofs shall be factory built to compensate for elevation changes.

8. Curbs shall be similar to Mason Industries Type RSC having a minimum 3" rated static deflection.

E. Type B-4 (Flashable Roof Rail System)

1. Rooftop fans, condensing units, air handlers, etc. shall be mounted on continuous support piers that combines equipment support and isolation into (1) assembly.

2. Rails shall incorporate Type A isolators which are adjustable, removable and interchangeable after equipment has been installed.

3. The system shall maintain the same installed and operating height with or without the equipment load.

4. The system shall have full plywood nailers on all (4) sides, designed to accept membrane waterproofing and shall be dry galvanized or plastic coated.

5. Unit to be supplied with flashing.

6. Roof rail shall be similar to Mason Industries Type R-7000 having a minimum 3" rated static deflection.

F. Type B-5 (Roof Rail Base)

1. Rails shall be constructed from structural steel angles sized as required to prevent flexure and misalignment under load.

2. Each rail shall be the full length of the supported equipment and be welded to a series of Type B isolators. Bolt-on angle cross ties at the ends and center shall form (1) rigid platform.

3. Roof rail shall be similar to Mason Industries Type TRSLR.

G. Type B-6 (Non-Isolated Roof Curb)

1. Non-isolated, curb mounted rooftop equipment shall be mounted on structural curbs that meet the acceleration criteria hereinbefore defined.

2. Curbs shall accept standard 2" roof insulation furnished and installed by the Roofing Contractor.

3. Non-isolated curbs shall be similar to Mason Industries Type RRC.

2.5 FLEXIBLE PIPE CONNECTOR

A. All flexible connectors shall be:

1. Installed on the equipment side of the shutoff valves, horizontal and parallel to equipment shafts whenever possible. All piping between the flexible connector and the equipment shall be independently supported off the equipment base.

2. Provided wherever rigidity supported piping is connected to equipment.

B. Type FC-1 (Elastomer Connector)

1. Manufactured of nylon tire cord and EPDM, both molded and cured in hydraulic presses. Neoprene used in lieu of EPDM is not acceptable.

2. Straight connectors to have (2) spheres reinforced with a molded in external ductile iron ring between the spheres.

3. Rated at 250 psig/170°F, dropping in a straight line to 170 psig/250°F for sizes 1 1/2" to 12".

4. All sizes shall employ control cables with neoprene end fittings isolated from anchor plates by means of 1/2" bridge bearing neoprene bushings.

5. Connectors shall be installed pre-extended per manufacturer's recommendations to prevent elongation under pressure.

6. Minimum safety factory of 3.6:1 at maximum pressure ratings shall be certified by test reports. Submittals shall also include (2) test reports by independent consultants showing minimum reduction of 20 dB in vibration accelerations and 10 dB in sound pressure levels at typical blade passage frequencies.

7. Connectors bolted to Victaulic type coupling or gage, butterfly or check valves to have a minimum 5/8" flange spacer installed between the connector and the coupling flange.

8. Connectors for pipe size 2" and smaller shall have threaded female union couplings on each end. Larger pipe sizes shall be fitted with flange couplings.

9. Type FC-1 flexible connector shall be similar to Mason Industries Super-Flex Type MFTNC or MFTFU.

C. Type FC-2 (Flexible Stainless Steel Hose)

1. Stainless steel hose and braid rated with 3:1 safety factor.

2. 2" and smaller with male nipples, 2 1/2" and larger with fixed steel flanges.

3. Lengths as follows:

Size		Length	Size		Length	Size		Length
1/2	x	9	2	x	14	8	x	22
3/4	x	10	2 1/2	x	13	10	x	26
1	x	11	3	x	14	12	x	28
1 1/4	x	12	4	x	15	14	x	30
1 1/2	x	13	5	x	19	16	x	32
			6	x	20			

4. Type FC-2 flexible connector shall be similar to Mason Industries Type BSS.
5. 250 PSIG working pressure.

D. Type FC-3 (Unbraided Exhaust Hose)

1. Low pressure stainless steel annularly corrugated with flanged ends.
2. Maximum temperature of 1500°F.
3. Lengths (in inches) as follows:

Size		Length	Size		Length
2 1/2	x	15	8	x	22
3	x	16	10	x	26
4	x	17	12	x	28
5	x	18	14	x	30
6	x	19	16	x	32

4. Type FC-3 flexible connector shall be Mason Industries Type SDL-RF or equal by approved manufacturer.

E. Type FC-4 (Bronze Braided Flexible Hose)

1. Bronze hose and braid rated with a minimum 3:1 safety factor (minimum 150 psi).
2. Copper tube ends.
3. Minimum lengths (in inches) as follows:

Size		Length	Size		Length	Size		Length
1/8	x	7 1/2	3/4	x	11 1/2	3	x	27
1/4	x	8 1/4	1	x	13	3 1/2	x	32
3/8	x	9	1 1/4	x	14 3/4	4	x	33
1/2	x	9 3/4	1 1/2	x	17	5	x	41
5/8	x	10	2	x	20	6	x	48
			2 1/2	x	24			

4. Type FC-4 flexible connector shall be similar to Mason Industries Type BFF.
5. 250 PSIG working pressure.

F. Seismic Expansion Joints

1. Provide seismic expansion joints on all ducts, piping, conduits or other systems crossing building expansion seismic joints. Provide these joints to allow for the movement in the XY&Z direction as indicated on the structural documents.

2. Pressure rated for 250 PSIG at maximum service temperature.

2.6 VIBRATION ISOLATION SCHEDULE

Equipment	HP	Mtng	On Grade ****				Above Grade			
			Isol	Defl	Base	Restr	Isol	Defl	Base	Restr
Air Conditioning Condensers, Air Cooled Chillers		Roof	---	---	---	---	A	2.50	B-1	I
Air Conditioning Units (DX)		Flr Clg	A ---	1.0 ---	--- ---	II ---	A F	1.0 1.0	B-1 ---	I,II III

Equipment	HP	Mtng	On Grade ****				Above Grade			
			Isol	Defl	Base	Restr	Isol	Defl	Base	Restr
Cabinet Type Fans & Packaged AHUs	To 1	Flr Clg	D ---	.50 ---	--- ---	IV ---	D	See Guide	--- ---	IV
Cabinet Type Fans & Packaged AHUs	>1	Flr Clg	A ---	1.0 ---	--- ---	II ---	A ** F	See Guide	--- ---	I,II III
Centrifugal Fans		Flr Clg	A ---	1.0 ---	B-1 ***	II ---	A** F	See Guide	B-2 ***	I,II III
Centrifugal Fans Arrangement 9 and 10		Flr Clg	A ---	1.0 ---	B-1 ---	II ---	A** F	See Guide	B-2	I,II III
Curb Mounted Equipment Other than AHU*****		Roof	---	---	---	---	---	---	B-6	V
Rooftop AHU >10 Ton		Roof	---	---	---	---	A	2.50	B-3	V
Unit/Cab. Heaters		Clg	---	---	--	--	E	.30	---	III

* Used on vertically arranged units. Rails shall be 1.5 times the unit height.
** Substitute Type B isolator for Outdoor installations.
*** Substitute Type B-2 base for floor mounted Class 2 and 3 fans.
**** "On Grade" shall mean slab on grade only.
***** Fans in all units shall be isolated in accordance with chart.

Notes:

1. "Isol", "Base" and "Restr" columns indicate letter type as appears in the specs.
2. "Mtng" refers to method of support of equipment from the structure.
3. "See Guide" indicates isolator deflection selection to be taken from Deflection Guide below.

Deflection Guide	
RPM	MW Deflection
<400	3.5"
<600	2.5"
>600	1.5"

PART 3 – EXECUTION

3.1 GENERAL

A. Isolation and seismic restraint systems must be installed in strict accordance with the manufacturer's written instructions and submittal data. Vibration isolators shall not cause any change of position of equipment resulting in stress on equipment connections.

B. Design Criteria

1. All mechanical equipment such as pumps, heat pumps, fans, air handling units, etc. shall be isolated from the building structure by means of noise and vibration isolators.

2. All piping ductwork in mechanical equipment rooms and penthouses shall be isolated from the building structure by means of noise and vibration isolation hangers and provided with seismic restraints.

3. Piping and/or ductwork penetrations through floors and walls shall not be rigidly connected to the building structure. Provide sleeves with clearances around the outside, as recommended by the vibration materials manufacturer. All such penetrations shall be smokeproofed and firestopped in an approved manner as hereinbefore specified.

4. Generally, isolation facilities shall be designed to limit equipment room floor or roof loading to a maximum of 50 lbs./sq.ft. and vibration isolators shall be carefully and specifically selected for each piece of equipment.

5. Flexible duct connections at fans and air handling units shall have a minimum clear gap of 3" between metal collars. Flexible connectors exposed to the weather shall be weatherproofed by the Mechanical Contractor. Refer to the Sheet Metal Section of this specification for requirements of flexible duct connections.

6. Piping found to have water hammer or other objectionable vibration or noise which cannot be eliminated by proper grading or other natural means shall be braced, trapped, hung with vibration isolation hangers, equipped with air chambers or mechanical shock absorbers, flexible pipe connectors, or otherwise silenced using means as approved by the Architect.

7. Motor driven equipment which is to be isolated shall have motor mounted on the isolated equipment or shall have motor, equipment and drive mounted on a common base.

8. The Contractor shall not install any equipment, piping or conduit which makes rigid contact with the "building" unless permitted in this Specification. Building includes, but is not limited to, slabs, beams, columns, studs and walls.

9. Isolation mounting deflection shall be (minimum) as specified or scheduled on drawings.

10. Coordinate work with other trades to avoid rigid contact with the building. Inform other trades following work, such as plastering or electrical, to avoid any contact which would reduce the vibration isolation.

11. Bring to the Architect's attention, prior to installation, any conflicts with other trades that will result in unavoidable rigid contact with equipment or piping as described herein, due to inadequate space or other unforeseen conditions. Corrective work necessitated by conflicts after installation shall be at the responsible contractor's expense.

12. Bring to the Architect's attention any discrepancies between the specifications and field conditions or changes required due to specific equipment selection, prior to installation. Corrective work necessitated by discrepancies after installation shall be at the contractor's expense.

1. Obtain inspection and approval of any installation to be covered or enclosed, prior to such closure.

2. Correct, at no additional cost, all installations which are deemed defective in workmanship or materials.

3.2 SPRING RISER SUPPORT SYSTEM

A. All vertical riser subjected to thermal expansion and/or construction as noted herein or on the documents, shall be supported by spring isolators and central anchors designed to insure loading within design limits at structural support points. The riser design must include the initial load, initial deflection, change in deflection, final load and change in load at all spring support locations. In order to minimize load changes, the initial spring deflection must be at least 4 times the thermal movement. The submittal must also include anchor loads when installed, cold filled, and at operating temperature. Include calculated pipe stress at end conditions and branch off locations as well as installation instruction. The submittals must be stamped and signed by a licensed Professional Engineer in the employ of the vibration vendor for at least five years.

B. Neutral resilient anchors close to the center of the run shall direct movement up and down. The anchors shall be capable of holding an upward force equal to the water weight when the system is drained. If one level cannot accommodate this force, anchors can be located on 2 or 3 adjacent floors. Resilient guides shall be spaced and sized properly depending on the pipe diameter.

C. Proper provision shall be made for seismic protection in seismic zones, as required.

D. The support spring mounts shall be specification Type A, anchors Type ADA, telescoping guides Type VSG, all similar to as manufactured by Mason Industries, Inc.

E. The isolation vendor shall provide and design all brackets at riser spring and anchor locations where standard clamps lack capacity or do not fit. The contractor must install and adjust all isolators under the supervision of the designing isolation vendor or his representative.

3.3 EQUIPMENT ISOLATION INSTALLATION

A. Equipment shall be isolated and restrained as per the vibration isolation schedule at the end of this Section.

B. Place floor mounted equipment on 4" high concrete housekeeping pads (unless detailed otherwise) properly doweled or expansion shielded to the deck to meet acceleration criteria. Anchor isolators and/or bases to housekeeping pads. Housekeeping pad concrete work shall be by Division 3. Housekeeping pads shall be sized to have a minimum of 6” of clearance all around the equipment or 12 bolt diameters, whichever is greater.

C. Additional Requirements

1. The minimum operating clearance under inertia bases shall be 2".

2. The minimum operating clearance under other bases shall be 1".

3. All bases shall be placed in position and supported temporarily by blocks or shims, as appropriate, prior to the installation of the equipment, isolators and restraints.

4. The isolators shall be installed without raising the equipment.

5. After the entire installation is complete, and under full operational load, the isolators shall be adjusted so that the load is transferred from the blocks to the isolators. The blocks shall be barely free and shall be removed. Remove all debris from beneath the equipment and verify that there are not short circuits of the isolation. The equipment shall be free in all directions.

6. Install equipment with flexibility in wiring.

3.4 PIPING AND DUCTWORK ISOLATION INSTALLATION

A. Isolate piping and ductwork outside shafts connected to rotating or reciprocating equipment and pressure reducing stations as follows:

1. All water piping in mechanical rooms.

2. Water piping within 50'-0" or 100 pipe diameters (whichever is greater) from connected isolated equipment.

B. The isolators shall be installed with the hanger box hung as closely as possible (without direct contact) to the structure.

C. The isolators shall be suspended from substantial structural members sized for a maximum deflection of L/360 at mid span, not from slab diaphragm, unless specifically permitted by the structural engineer.

D. Hanger rods shall not short circuit the hanger box.

E. Horizontal suspended water piping 1 1/4" to 2" shall be suspended by Type E isolators with a minimum 3/8" deflection. Water pipe larger than 2" shall be supported by Type F isolators with a minimum 0.75" deflection or same deflection as equipment for the first (3) locations nearest equipment, whichever is greater.

1. Type L isolators may be substituted for the above.

2. Horizontal floor and roof supported pipe shall be the same as above except use isolators Type D and Type A, respectively.

F. Ductwork shall be supported by Type C isolators with a minimum 0.75" deflection.

G. Vertical riser pipe supports, where required, under 2" diameter shall utilize Type H isolation.

H. Vertical riser guides, where required, shall avoid direct contact of piping with the building.

I. Pipe anchors or guides, where required, shall utilize Type K isolators.

J. Riser sway supports, where required, shall utilize (2) neoprene elements (Type G or H) to accommodate tension and compression forces.

K. Install Type FC-1 (FC-4 for refrigerant piping) flexible connectors at all connections of pipe to isolated equipment such as pumps, as shown on the drawings.

L. Install FC-2, FC-3 or FC-4 type connectors only at locations which exceed temperature or service (such as gas, fuel oil, or refrigerant) limitations of FC-1.

M. Emergency generator exhaust shall be provided with Type R isolators with a minimum deflection of 1" (larger deflections may be required). These isolators shall be closely coordinated with expansion and stress calculations and seismic restraints and movements.

3.5 SEISMIC RESTRAINTS INSTALLATION

A. All floor mounted equipment, whether isolated or not, shall be bolted or welded to the structure to allow for required acceleration. Bolt points, diameter of inserts, imbedment depth and weld length as shown on approved submittal drawings shall be followed in all respects.

B. All suspended equipment shall be 2-point or 4-point independently braced with Type III restraints, installed taut for non-isolated equipment, such as piping or ductwork and slack with 1/2" cable deflection for isolated equipment. Note: Stiffeners for support rods may be required, certifications shall clearly delineate when such stiffening is required or not.

1. Piping Bracing: Schedule 10 thru 40 welded, screwed, flanged or grooved; 40'-0" maximum transversely, 80'-0" maximum longitudinally, and within 4'-0" each change of direction. No- hub piping shall be at 10’-0” intervals or 40’-0” if 1.0 g couplings are used.

2. Ductwork Bracing: 30'-0" maximum, transversely, 60'-0" maximum longitudinally, and within 4'-0" of each change of direction.

C. Seismic restraints are not required:

1. Only when explicitly permitted by the code. These permitted exceptions shall be detailed clearly on the first page of the seismic submittal.

D. Seismic restraints are not required on the following (there are no exceptions for piping containing flammable or hazardous material or connected to life/safety equipment):

1. Piping in mechanical equipment rooms less than 1 1/4".

2. Other piping less than 2 1/2".

3. All rectangular ducts less than 6 sq.ft. in cross sectional areas.

4. All round ducts less than 28" diameter.

5. All pipe suspended by individual hangers 12" in length or less from the top of the pipe support to the bottom of the support for the hanger.

6. All top supported ducts suspended by hangers 12" or less in length from the top of the duct to the bottom of the support for the hanger.

E. Where base anchoring of equipment is insufficient to resist seismic forces, restraints such as Type III shall be located above the unit's center of gravity to resist "G" forces.

Note: Vertically mounted tanks and upblast tubular centrifugal fans may require this additional restraint.

F. For overhead supported equipment, overstress of the building structure must not occur. Bracing may occur from:

1. Upper flanges of structural beams.
2. Upper truss chords in bar joists.

3. Cast-in-place inserts or drilled and shielded inserts in concrete structures.

G. Chimneys and stacks passing through floors are to be bolted at each floor level or secured above and below each floor with riser clamps or approved vibration isolation systems with seismic restraints.

H. Chimneys and stacks running horizontally to be braced every 30 ft (9 m) with Type III restraining system.

I. Inspection

1. On completion of installation of all vibration isolation and seismic restraint devices herein specified, the local representative of the isolation materials manufacturer shall inspect the completed system and report in writing any installation errors, improperly selected isolation or restraint devices, or other faults that could affect the performance of the system. Contractor shall submit a report to the Architect, including the manufacturer's representative's final report, indicating all isolation reported as properly installed or requiring correction, and include a report by the Contractor on steps taken to properly complete the isolation work.

2. Provide all special inspections in accordance with IBC and as specified herein.

a. Continuous inspection: The full-time observation of work by an approved special inspector pursuant to IBC. The following pieces of equipment require these inspections:

1) All equipment using combustible or toxic energy sources.
2) All electric motors and motor control centers.
3) Reciprocating and rotating type machinery.
4) Pipe.
5) Tanks, heat exchangers & pressure vessels.
6) Ductwork.

b. Periodic inspection: Provide intermittent observation of work by an approved special inspector of the following pieces of equipment in compliance with IBC.

1) All smoke control systems during construction & prior to concealment for leakage testing.
2) Isolator units for seismic isolation system.
3) All flammable, combustible and highly toxic piping and their associated mechanical systems.
4) All ductwork containing hazardous materials.

c. After all inspections a written report shall be provided.

3.6 INSTALLATION INSTRUCTIONS

A. Adjust all base and piping isolators as required to prevent stress transfer to equipment.

B. Set steel bases for 1" clearance between housekeeping pad and base. Set concrete inertia bases for 2" clearance. Adjust equipment level.

C. Position equipment, structural base and concrete base on blocks or wedges at proper operating height.

D. Provide all equipment and provide operating load conditions before transferring base isolation loads to springs and removing wedges.

E. Install inertia bases of type and thickness, with isolators of type and static deflection indicated.

F. Provide isolators as specified and install in accordance with the manufacturers recommendations. Seismic restraints shall not be installed until isolators are adjusted and equipment height is finalized.

G. Provide forms for 4" high housekeeping pads under all floor mounted equipment, including those with inertia blocks. Provide necessary reinforcing.

H. Install equipment with flexibility in wiring connection.

I. Verify all installed isolators and mounting system permit equipment motion in all directions.

J. Adjust or provide additional resilient restraints to flexibly limit lateral motion to 1/4" during start-up of equipment.

K. Before start-up, clean out all foreign matter between bases and equipment to prevent short circuit.

L. Install flexible pipe connectors on pipe connected to equipment supported by vibration isolation. Hook up piping to equipment and mains with spool pieces. After completion of pressure testing but prior to start-up, remove spool pieces and install flexible pipe connectors. Identify spool pieces as to equipment served and either entering or leaving.

M. Provide seismic displacement joints for all piping, ductwork and conduits crossing building expansion joints or building seismic joints.

3.7 CERTIFICATION

A. Upon completion of installation of all vibration isolation devices and seismic restraints, the Mechanical Contractor shall hire an independent Seismic Professional Engineer to visit the site, inspect the completed project and certify in writing to the Architect that all systems are installed properly, or require correction.

END OF SECTION 230548

SECTION 230553 – MECHANICAL IDENTIFICATION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Section 230500, apply to this Section.

1.2 WORK INCLUDED

A. Furnish and install nameplates, valve tags, valve charts, stencils and pipe markers on all Mechanical equipment, piping and ductwork.

B. Provide nameplates with the unit number and service designation on all mechanical equipment.

C. Indicate all valve tag numbers on Record Drawings and submit framed under glass valve tag charts including valve service and location.

D. Install color coded ceiling tacks in acoustical tile ceilings or color coded tape on ceiling grid to identify location of equipment, valves and dampers that require regular maintenance or are part of a life safety system (fire dampers, smoke dampers, sprinkler valves or main isolation valves).

E. Provide underground plastic pipe markers 6 to 8 inches below finish grade, directly above buried pipes.

F. Provide manufactured pipe and ductwork identification stencils with flow arrows and service indicated. All backgrounds of the stencils shall be color coded with specific service designation

G. Prepare valve charts and frame under glass. All valves and the tag numbers shall be shown on the Record As-Built Drawings.

H. Provide valve computer data base to match chart.

I. Prepare and install exterior protected brass plaques indicating underground service entrances.

1.3 RELATED SECTIONS

A. Examine all drawings and criteria sheets and all other Sections of the Specifications for requirements which affect work under this Section whether or not such work is specifically mentioned in this Section.

1.4 REFERENCES

A. Applicable provisions of the following Codes and Trade Standard Publications shall apply to the work of this Section, and are hereby incorporated into, and made a part of the Contract Documents.

B. Material standards shall be as specified or detailed hereinafter and as follows:

1. ASME A 13.1 – Scheme for Identification of Piping Systems; The American Society of Mechanical Engineers.

1.5 SUBMITTALS

A. See Section 230500 and General Conditions for additional requirements.

B. Product Data: Submit product description including materials, attachment methods, color coding and lettering sizes.

1.6 QUALITY ASSURANCE

A. All materials, lettering and individual system color coding schemes shall be uniform and of one single manufacturer.

B. No identification shall be installed until all systems are complete and insulated.

C. All surfaces shall be cleaned.

D. No nametag or identification shall break or penetrate a surface used as a vapor barrier.

1.7 REGULATORY REQUIREMENTS

A. Conform to all local/state and NFPA requirements for color-coding or painting of systems, piping or equipment related to Life Safety or Fire Protection.

1.8 DELIVERY, STORAGE AND HANDLING

A. All identification systems shall be stored in sealed containers in suitable locations to keep the containers and contents dry and clean.

1.9 ENVIRONMENTAL REQUIREMENTS

A. All surfaces shall be cleaned and dry before applying any form of identification or tagging.

B. Consult with the manufacturer prior to installation for the proper tagging and identification procedure and materials to be used on exterior outdoor equipment.

PART 2 – PRODUCTS

2.1 GENERAL

A. Acceptable manufactures contingent on compliance with the specification.

1. Marking Services Incorporated
2. Seton
3. Brady Corporation

2.2 PIPE IDENTIFICATION AND VALVE TAGS

A. All piping, except that piping which is within inaccessible chases, shall be identified with semi-rigid plastic identification markers equal to Seton Setmark pipe markers.

1. Direction of flow arrows is to be included on each marker.

2. Each marker background shall be appropriately color coded with a clearly printed legend to identify the contents of the pipe in conformance with the “Scheme for the Identification of Piping Systems” (ASME A13.1-2015).

3. Setmark snap-around markers shall be used for overall diameters up to 6” and strap-around markers shall be used above 6” overall diameters.

4. Markers shall be located:

   a. Adjacent to each valve
   b. At each branch
   c. At each cap for future
   d. At each riser takeoff,
   e. At each pipe passage through wall (each side)
   f. At each pipe passage at 20’ – 0” intervals maximum.

5. Underground pipe markers:

   a. Provide detectable tape on all underground piping:
   b. Labels shall be color coded and labeled the same as indoors.

B. Valve tags

1. All valves shall be designated by distinguishing numbers and letters carefully coordinated with a valve chart.

2. Valve tags shall be color coded 0.032” anodized aluminum tags, with engraved letters similar to Seton S Type 250-BL or approved equal.

   a. HVAC tags shall be round 2” diameter, similar to Seton 15426.

   b. Plumbing tags shall be square 2” x 2” similar to Seton 42769.

   c. Fire Protection tags shall be square 2” x 2” similar to Seton 42769 RED.

   d. Lettering shall be 1/4” high for type service and 1/2” for valve number. Tag shall indicate service and valve number.

   e. Each service shall be a different color.

3. Tag shall be attached to valves with chain similar to Seton No. 16 stainless steel jack chain.

4. Whenever a valve is above a hung ceiling, the valve tag shall be located immediately above the hung ceiling.

5. Provide a tag for every valve except:

   a. Perimeter radiation shut-off valves that are located at the finned tube radiation element within the accessible (from the space) heating enclosure

C. Furnish a minimum of two (2) typed valve lists

1. Each framed under glass or Plexiglass. Each chart shall be enclosed in an approved 0.015” thick plastic closure for permanent protection.

2. Valve numbers shall correspond to those indicated on the Record Drawings and on the printed valve lists.

3. The printed list shall include the valve number, location and purpose of each valve.

4. It shall state other necessary information such as the required opening or closing of another valve when one valve is to be opened or closed.

5. Printed framed valve lists shall be displayed in each Mechanical Room or in a location designated by the Owner.

D. Valve data base.

1. Provide a valve data base for all valves to operate on the building computer.

2. Every valve shall include:

a. Tag Number
b. Service (Hot water, Chilled water, Sprinkler, etc.)
c. Size
d. Operation
e. Location
f. Manufacture
g. Model number
h. Submittal reference

2.3 DUCTWORK IDENTIFICATION

A. All ductwork (supply, return, exhaust, etc.) serving multiple spaces or floors shall be identified with directional flow arrows and unit identification numbers (AHU-1, EX-1, etc.) on the side of each duct (or bottom if abutting other systems or obstructions).

B. All flow arrows and labels shall be similar to Seton Name Plate Company vinyl labels or stencil painted.

C. The kitchen hood exhaust system shall also have identified access doors with numbers of specific doors identified on the Record As-Built Drawings.

D. All duct access doors.

2.4 EQUIPMENT NAMEPLATES

A. Equipment nameplates shall be 3” x 6” long, 0.02” aluminum with a black enamel background with engraved natural aluminum letters similar to Seton Style 2065-20. Nameplate shall have pressure sensitive taped backing.

B. The nameplate shall contain the unit or equipment designation (“AHU” for air handling unit, “HP” for heat pump, “P” for circulating pump, etc.), unit number and area or system served.

C. Nameplates for exterior equipment shall be applied with waterproof adhesive.

2.5 UTILITY ENTRANCE DESIGNATIONS

A. Provide a brass wall plaque, minimum 0.020” thickness, secured to the exterior wall just above the grade line for all buried service entrances or exits. Samples are: Water Service Below; Gas Service Below; Sanitary Sewer Below; Storm Sewer Below; Irrigation Water Below; etc.

2.6 CEILING TACKS OR TAPE

A. Provide steel color coded ¾ inch diameter ceiling tacks in acoustical tile ceilings or color coded tape applied to ceiling grid to locate equipment, valves or dampers that require regular maintenance or are part of a Life Safety System.

B. The tacks or tapes shall be color codes as follows (coordinate with Owner):

1. Yellow – HVAC
2. Red – Life Safety (fire dampers, sprinkler valves, etc.)
3. Green - Plumbing Valves.
4. Blue – Heating/Cooling Valves.

PART 3 – EXECUTION

3.1 PREPARATION

A. All surfaces shall be cleaned and insulated (if applicable) prior to installing any identification.

B. Exterior surfaces of outdoor equipment shall be dry and prepared to accept the specified identification.

3.2 INSTALLATION

A. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion. Seal with clear lacquer.

B. Install valve tags with chain.

C. Install duct markers in accordance with manufacturer’s instructions.

D. Install plastic pipe markers in accordance with manufacturer’s Instructions.

E. Install plastic tape markers complete around pipe in accordance with manufacturer’s instructions.

F. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.

G. Identify air handling units, pumps, boilers, domestic hot water heaters, fire pumps, heat transfer equipment tanks, water treatment devices, etc. with plastic nameplates. Small devices, such as in-line pumps, may be identified with tags.

H. Identify control panels and major control components outside panels with plastic nameplates.

I. Install detector tape on all underground services in accordance with the manufactures recommendations.

J. Identify thermostats relating to air handling equipment serving multiple spaces.

K. Identify valves in main and branch piping with valve tags.

L. Tag automatic controls, instruments and relays. Key to control schematic.

M. Identify piping, concealed or exposed, with pipe markers or where buried using plastic tape pipe markers. Use tags on piping 3/4 inch diameter and smaller. Identify service, flow direction and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.

N. Identify ductwork with plastic nameplates and flow arrows. Identify with air handling unit or fan identification number and area served. Locate identification at air handling unit or fan, at each side of penetration of structure or enclosure, and at each obstruction.

END OF SECTION 230553

SECTION 230593 – TESTING, ADJUSTING AND BALANCING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 23 Specification Sections, apply to this Section.

1.2 WORK INCLUDED

A. Provide all labor, instruments and materials necessary to completely test, adjust and balance all HVAC systems and equipment installed under this contract.

B. All instruments shall be newly calibrated for this specific project.

1.3 RELATED SECTIONS

A. Examine all drawings and criteria sheets and all other Sections of the Specifications for requirements which affect work under this Section whether or not such work is specifically mentioned in this Section.

1.4 REFERENCES

A. Applicable provisions of the following Codes and Trade Standard Publications shall apply to the work of this Section, and are hereby incorporated into, and made a part of the Contract Documents.

B. Material standards shall be as specified or detailed hereinafter and as follows:

1. AABC MN-1 – National Standard for Testing and Balancing Heating, Ventilating and Air Conditioning Systems.

2. ASHRAE 111 – Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning and Refrigeration Systems.

1.5 SYSTEM DESCRIPTION

A. Provide under this contract the services of an independent test and balance firm that specializes in testing and balancing of HVAC systems. The following services shall be provided:

1. Balance Plan Check and Review: Review the design documents prior to commencing balancing. Submit any noted questions or discrepancies in writing to the Architect.

2. On-going job site inspections of equipment, controls and metering devices during construction to verify conformance with design specifications, manufacturer’s installation instructions.

3. Air System Balance

4. Hydronic System Balance

5. Control Systems Verification

6. Special System Testing and Verification

a. Duct leakage testing
b. Sound and vibration testing

7. System Performance Verification

8. Opposite Season Test

1.6 SUBMITTALS

A. See Section 230500 – Submittals, for submittal procedures.

B. Submit name of testing, adjusting and balancing contractor for approval within 30 days after award of Contract.

C. Field Reports: Indicate deficiencies in systems that would prevent proper testing, adjusting and balancing of systems and equipment to achieve specified performance.

1. Submit under provisions of Section 014000 – Quality Control.

2. Prior to commencing work, submit report forms or outlines indicating adjusting, balancing and equipment data required.

3. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for inclusion in operating and maintenance manuals.

4. Provide reports in letter size, 3 ring binder manual, complete with index page and indexing tabs with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets and indicating thermostat locations.

5. Include detailed procedures, agenda, sample reports forms and copy of AABC National Project Performance Guaranty prior to commencing system balance.

6. Test Reports: Indicate data on AABC MN-1 forms, forms prepared following ASHRAE 111, NEBB forms, or forms containing information indicated in Schedules.

7. Include the following on the title page of each report.

a. Name of Testing, Adjusting and Balancing Agency.
b. Address of Testing, Adjusting and Balancing Agency.
c. Telephone number of Testing, Adjusting and Balancing Agency.
d. Project name.
e. Project location.
f. Project Architect.
g. Project Engineer.
h. Project Contractor.
i. Report date.

D. Project Record Documents: Record actual locations of all water systems balancing valves and rough setting.

1.7 DEFINITIONS

A. AABC: The Associated Air Balance Council is a non-profit association of independent, certified agencies specializing in testing and balancing HVAC systems.

B. ASHRAE: American Society of Heating, Refrigerating and Air Conditioning Engineers.

C. HVAC: Heating, Ventilating and Air Conditioning.

D. TAB: Testing, Adjusting and Balancing of HVAC Systems to meet design objectives and obtain optimum system performance.

E. NEBB: National Environmental Balancing Bureau

F. TBE: Test and Balance Engineer is an individual certified by AABC as having a degree in Engineering and (3) years of test and balance experience, or (5) years of background in the air conditioning field and (5) years continuous field experience in testing and balancing work. The TBE must also pass the AABC Test and Balance Engineer Certification Examination.

1.8 AGENCY QUALIFICATIONS

A. Testing and balancing agency shall be a member of AABC or NEBB with a minimum of five (5) years of documented experience.

B. An AABC certified NEBB certified testing and balancing person shall be responsible for certification of the total work of this section.

C. All work shall be performed in accordance with AABC National Standards. If these specifications set forth more stringent requirements than the AABC National Standards, the more stringent specifications shall prevail.

1.9 QUALIFICATION SUBMITTALS

A. Testing and Balancing Agency shall submit a company resume listing personnel and project experience in the field of air and hydronic system balancing.

B. Testing and balancing agency shall submit an inventory and calibration data of all instruments and devices in possession of the balancing agency to enable the Owner or his representative to evaluate the balancing agency's performance capability.

C. The testing and balancing agency shall submit to the Owner or the Owner's representative, upon acceptance of the contract, an AABC or NEBB "Quality Assurance Guaranty."

D. Within (30) days after acceptance of the contract, the testing and balancing agency shall submit to the Design Engineer a working agenda which will include procedures for testing and balancing each type of air and water flow system. The Test and Balance Report format will also be submitted indicating data to be recorded.

1.10 CONTRACT DOCUMENTS

A. Within (30) days after selection of the test and balance agency, the Mechanical Contractor/ Construction Manager shall provide the agency with the following:

1. Construction Drawings

2. Equipment Specifications
3. Equipment Submittals

B. The testing and balancing agency shall be provided the following as issued or received:

1. Change Orders/Current Updated Construction Mechanical Drawings incorporating all revisions

2. Equipment Manufacturer's Submittal Data

3. Mechanical/Air Conditioning Contractor's Shop Drawings

4. Temperature Control Drawings

5. Project Schedule

1.11 NOTIFICATION AND SCHEDULING

A. A prebalance conference shall be held prior to job start as scheduled by the Owner or Owner's representative. Attendees at the meeting shall include representatives of the test and balance agency, General Contractor, Mechanical Contractor, Control Contractor, Owner and Mechanical Engineer.

B. The schedule for testing and balancing the HVAC system shall be established by the Owner or Owner's representative, in coordination with the testing and balancing agency on a critical path network.

C. The testing and balancing agency is responsible for initiating this continuing coordination to determine schedule for final testing and balancing services.

D. It will be necessary for the testing and balancing agency to perform its services in close coordination with the Mechanical Contractor, with all scheduling and deficiencies reported through the Owner or Owner's representative.

E. Before testing and balancing commences, the testing and balancing agency shall receive notification, in writing, from the Mechanical Contractor that the system is operational, complete, and ready for balancing.

F. A completed system exceeds physical installation: the Mechanical Contractor shall certify that all prime movers, fans, pumps, cooling towers, boilers, etc., are installed in good working order, and that full load performance has been preliminary tested.

G. The Mechanical Contractor shall certify in writing, that all equipment has been checked, started, adjusted by the manufacturer, and operated for the specified period of time.

1.12 COORDINATION WITH OTHER TRADES

A. To bring the HVAC system into a state of readiness for testing, adjusting and balancing, the Mechanical Contractor shall perform the following:

1. Air Distribution Systems

a. Ensure that all splitters, extractors, volume, smoke and fire dampers are properly located and functional. Dampers serving requirements of smoke, minimum and

maximum outside, return, relief, and exhaust air shall provide tight closure and full opening, with a smooth and free operation.

b. Verify that all supply, return, exhaust, and transfer grilles, registers and diffusers are installed and operational.

c. Ensure that air handling systems, units, heat pumps, makeup air units and associated apparatus, such as heating and cooling coils, filter sections, access doors, etc. are blanked and/or sealed to eliminate excessive bypass or leakage of air.

d. Ensure that all fans (supply, return, relief, and exhaust) are operating and free of vibration. All fans and drives shall be checked for proper fan rotation and belt tension. Overload protection shall be of proper size and rating. A record of motor current and voltage shall be made to verify that the motors do not exceed nameplate rating.

e. Make any necessary changes to the sheaves, belts, and dampers, as required by the testing and balancing agency, at no additional cost to Owner.

f. Install clean filters prior to testing.

2. Water Circulating Systems

a. Check all pumps to verify pump alignment and rotation.

b. Ensure that systems are clean, with the proper strainer screens installed for normal operation.

c. Check all pump motors for current and voltage, to ensure that motors do not exceed nameplate rating.

d. Provide overload protection of proper size and rating.

e. Ensure that all water circulating systems shall be clean, full and free of air, that expansion tanks are set for proper water level, and that all air vents are installed at high points of systems and are operating.

f. Check and set operating temperature of heat exchangers to design requirements.

B. The Temperature Control Contractor shall perform the following:

1. Verify that all control components are installed in accordance with project requirements and are functional, including all electrical interlocks, damper sequences, air and water resets, and fire and freeze stats.

2. Verify that all controlling instruments are calibrated and set for design operating conditions.

3. Calibrate room thermostats after installation and before the thermostat control verification tests are performed. The test and balance agency shall verify the accuracy of final settings by taking temperature readings. The readings shall be in a typical conditioned space for each separately controlled zone.

4. The Control Contractor shall allow sufficient time in the project to provide assistance and instruction to the testing and balancing agency in the proper use and setting of control components such as, but not limited to, computers, static pressure controllers or any other device that may need setpoints changed so that the testing and balancing work can be performed.

C. The Mechanical Contractor, Temperature Control Contractor, and the suppliers of the HVAC equipment shall all cooperate with the testing and balancing agency to provide all necessary data on the design and proper application of the system components. In addition, they shall furnish all labor and materials required to eliminate any system deficiencies.

D. In coordination with the General Contractor, the testing and balancing agency shall arrange for an area of ample size and convenient location for storage of tools, equipment, and other items as required.

PART 2 - PRODUCTS

2.1 GENERAL

A. The Construction Manager/General Contractor/HVAC Contractor shall procure the services of an independent Balancing and Testing Contractor who specializes in the balancing and testing of heating, ventilating and air conditioning systems to balance and adjust, all moving equipment and air distribution and exhaust systems and test all water systems and equipment, as herein specified. All work by the Balancing Contractor shall be done under direct supervision of a qualified heating and ventilating Engineer employed by the Balancing Contractor. Balancing Contractor shall submit credentials and be approved prior to any contract award.

B. Balance and testing shall not begin until all HVAC systems have been completed and are in full working order, as determined by the Architect. Where construction is phased, the Testing and Balancing Contractor shall submit a plan of action which outlines how each phase will be balanced and how, when completed, the entire system will be verified to be tested and balanced. The Balancing Contractor shall coordinate his work with the HVAC and ATC Contractors, shall place all heating, ventilating and air conditioning systems and equipment into full operation, and continue the operation of same during each working day of adjusting and balancing.

C. The Balancing Contractor shall perform all tests as hereinafter specified, compile the test data, and submit five (5) copies of the complete test data to the Construction Manager/General Contractor/HVAC Contractor for forwarding to the Architect for evaluation and approval.

D. The Construction Manager/General Contractor/HVAC Contractor shall award the test and balance contract to the approved agency at the beginning of construction of the project to allow the Balancing Contractor to schedule this work in cooperation with the HVAC Contractor, ATC Contractor and other Trades involved and comply with completion data and requirements, as well as provide a list of areas where special requirements for balancing devices (dampers, valves) might occur.

E. The Balancing Contractor shall provide all testing instruments used for balancing air and water systems. Testing instruments shall have been calibrated within a period of six (6) months prior to balancing. Types, serial numbers and dates of calibration of all instruments shall be listed in the final air and water balance reports herein specified.

F. The Architect's, Engineer's and Owner's designated representatives shall be notified minimum five (5) days in advance of proceeding with balancing work to allow time for the witnessing of the testing, balancing and adjusting.

G. The Balancing Contractor shall provide all manpower, instruments, temporary connections and all other materials required to accomplish the balancing and testing as hereinafter specified. In the case of phased construction, the action plan shall include an explanation of all temporary facilities and their effect on the overall system.

H. The Balancing Contractor shall balance cooling systems in the air conditioning season and heating systems in the heating season. **This requirement is mandatory.**

I. In the event it becomes necessary for the Owner to balance the HVAC systems correctly, after the balancing is complete, the cost of this work will be back charged to the Balancing Contractor.

2.2 SCHEMATIC SYSTEM DRAWINGS

A. Piping Systems

1. The Balancing Contractor shall prepare schematic diagrammatic drawings for the following systems:

   a. Chilled Water
   b. Hot Water
   c. Process Chilled Water
   d. Condenser Water

2. The drawings will be 1-line schematic representation of the systems as they are installed, indicating all major automatic control valves, strainers, pressure reducing valves, etc., as well as all water flow and energy meters.

3. The diagrams shall indicate, in addition to the graphic representation requirements outlined above, all pressure drops (design conditions and actual conditions) of each valve, strainer, meter, etc., as well as all flows at each meter.

4. The use of the Engineer's construction drawing diagrams can be utilized by the Balancing Contractor as the base of the diagrams required. However, the drawings will have to be updated by the Balancing Contractor for field modifications which may have occurred during construction.

B. Ductwork Systems

1. The Balancing Contractor shall prepare schematic diagrammatic drawings for the following:

   a. Supply air systems (all units)
   b. Return air systems (all units)
   c. All exhaust air systems including specialized exhaust systems

2. The drawings will be 1-line airflow schematics emanating from the air handling equipment, through shafts, to the first major split of duct branches on each floor. The drawings will indicate the air quantities measured at these major branches, pressure drop and any other pertinent information deemed necessary by the Architect.

3. In addition to the duct schematic drawings, the Balancing Contractor shall prepare individual schematic drawings for each air handling unit indicating the pressure drop of each component of the unit, including the discharge plenum and unit duct discharge and shall prepare composite schematic drawing of all "special pressure" rooms or spaces which shall show on one drawing, the supply, return and/or exhaust systems, flow rates (design and actual) and final offset pressure/CFM.

4. Balance “special pressure” spaces to the minimum differential pressure as scheduled:

a.	Operating room	+0.025” Water Gauge
b.	Surgical Cystoscopic room	+0.025” Water Gauge
c.	Protective isolation	+0.025” Water Gauge
d.	Infectious isolation	-0.025” Water Gauge (relative to Anti-room)
e.	Infectious Anti-room	-0.010” Water Gauge (relative to Corridor)
f.	Protective anti-room	-0.010” Water Gauge (relative to Corridor)
g.	Bronchoscopy	-0.025” Water Gauge
h.	Pressurized Elevator Shafts	+0.05” Water Gauge
i.	Pharmacy	+0.025” Water Gauge
j.	Pressurized stairs shaft	+0.10” Water Gauge
k.	Pressurized stairs vestibule	+0.10” Water Gauge
l.	Others Positive	+0.025” Water Gauge
m.	Others Negative	-0.025” Water Gauge
n.	Building Pressurization	+0.01” to +0.05” Water Gauge

C. The intent of the required documentation would be to clearly indicate the balancing and performance of the systems as they are installed. Furthermore, the above-required information will be utilized by the Owner for future renovation and/or alterations of the various systems. Therefore, the drawing content and presentation will be submitted to the Architect for review prior to actual commencement of the work. In the case of phased construction, the schematics shall indicate the limit of each phase and any temporary measures taken to obtain system performance.

D. The drawings shall be produced on AutoCAD and shall be submitted to the Owner through the Architect for his use. All costs associated with the production of the documents shall be included under the Balancing Contractor's contract.

E. Test Code Drawings

1. Each report shall contain a single line drawing or drawings of the air distribution system with the fan system, applicable zoning, etc., indicated. Each and every outlet supply and return shall be indicated on this drawing by a number corresponding to the number of the outlet test sheet.

2.3 TEST FORMS USED BY BALANCING ENGINEERS AND TECHNICIANS SHALL BE SET UP TO INCLUDE THE FOLLOWING INFORMATION:

A. Each sheet shall have the job name and address, the name of the Balancing Contractor, Owner, Architect and Engineer, the instruments used to perform the test, and the name of the test Technician, date and time of test, outside db/wb temperatures.

B. All forms shall be submitted on a standard 8 1/2" by 11" good quality paper, bound together to form a complete report. All forms shall be submitted in typewritten form; handwritten forms are not acceptable. Cover of first sheet shall list the name of the job and the location of same.

Copies of all forms shall be submitted to the Architect for review and acceptance prior to the work beginning.

C. Diffuser, Grille, Register, Fume Hoods, and All Types of Air Terminal Test Sheets

1. Each sheet shall be arranged in columns and all final sheets shall show the following data:

a. Fan system.

b. Room number or area designation.

c. Outlet code number which shall correspond to code number.

d. Size of outlet - manufacturer's listed data.

e. Type of outlet per manufacturer's model designation.

f. Manufacturer of outlet.

g. Manufacturer's effective area for each size.

h. Schedule FPM and required CFM of each outlet, individually for heating and cooling.

i. Test resultant FPM and CFM of each outlet, individually for heating and cooling.

j. Testing, setting and report of CFM settings for each terminal box, including pressure drop at each setting (heating and cooling).

k. All rooms/spaces with ducted supply and return/exhaust are to have supply, return/exhaust quantities shown on the same sheet. All rooms are to have air quantities for supply, return/exhaust listed per individual room. Supply, return/exhaust readings shall be listed sequentially, with final CFM offset, or room pressure clearly identified.

2. Each exhaust hood that is exhausted by ductwork shall be tested, adjusted and balanced in coordination with the hood manufacturer, ATC Contractor, HVAC Contractor and fume hood controls manufacturer. Verify manufacturer’s procedures and schedule testing with the required contractors prior to proceeding. Submit and coordinate the proposed testing procedure with the Owner's representatives and engineer prior to proceeding. Testing of face velocity shall be performed using a multipoint thermal anemometer device that is professionally calibrated prior to testing. Face velocity shall be measured at a minimum of one (1) reading per each square foot of open sash. Readings shall be recorded individually and averaged over the entire openings.

a. Constant Volume Fume Hoods (With Fan)

1) Test exhaust fan as described.

2) Set the sash in full open position.

3) Measure airflow CFM and face velocity across open sash per ASHRAE 110 and ANSI Z9.5.

4) Resheave fan as required to achieve desired CFM exhaust.

b. Constant Volume Fume Hoods

1) Set exhaust valve to desired exhaust rate (CFM).

2) Set sash in full open (or normal operating) position.

3) Measure airflow CFM and face velocity across open sash per ASHRAE 10 and ANSI Z9.5.

4) Adjust exhaust valve setting to achieve desired CFM exhaust.

5) Calibrate exhaust flow transducer reading to match measured exhaust CFM.

c. VAV Fume Hoods (With Individual Fan)

1) Test exhaust fan as described in paragraph 5. at full flow and at minimum sash height.

2) Set sash in full open, normal operating and minimum positions. (Normal operating position as selected by institution or designated by engineer.)

3) Measure exhaust airflow CFM and face velocity across open sash per ASHRAE 110 and ANSI Z9.5 at all positions.

4) Resheave fan as required at full capacity on VFD (60 Hz) to match full open exhaust flow rate.

5) Verify and adjust fume hood controls in coordination with fume hood control manufacturer to maintain 100 FPM (adj.) face velocity at full open normal operating and minimum positions.

d. VAV Fume Hoods (With Exhaust Valves)

1) Procedures shall be as outlined in previous paragraph except the adjustment of the fan and VFD shall be deleted.

2) Exhaust valves shall be set to desired maximum exhaust rate and minimum exhaust flow rate. Measure face velocity and reset flow as required.

3) Exhaust flow readings via duct traverse shall be compared to output from airflow measuring device. Adjust output as required.

4) Two position fume hoods (with 2-speed fan).

5) Two position hoods (with exhaust valve control).

D. Air Handling Equipment Test Sheets

1. Each sheet shall contain two (2) columns, one (1) for specified conditions and one (1) for test conditions obtained. When units tested are variable air volume (VAV) data shall be submitted for maximum and minimum air flows.

2. All final sheets shall list the following data:

a. System fan number.
b. Fan manufacturer and model number.
c. Fan curve.
d. Total CFM.
e. Return air, CFM.
f. Outside air, CFM.
g. Total static pressure.
h. Suction static pressure.
i. Discharge static pressure.
j. Motor manufacturer.
k. Motor size, voltage, phase and RPM.
l. Amperage nameplate rating.
m. Final operating amperage.
n. Fan RPM (supply).
o. Fan RPM (return).
p. Component pressure drop.

E. Exhaust and Ventilating Fan Test Sheets

1. Each sheet shall contain in two (2) columns, one (1) for specified conditions and one (1) for test conditions obtained. Variable volume systems data is to be submitted for both maximum and minimum air flows.

2. All final sheets shall list the following data:

a. Exhaust fan system and exhaust fan number.
b. Fan manufacturer.
c. Fan curve.
d. Size and model.
e. Motor HP, voltage and phase.
f. Changes made or recommended.
g. Amperage nameplate rating.
h. Final operating amperage.
i. Fan RPM.
j. Total CFM.
k. Suction static, discharge static, total static.

F. Temperature Test Sheets (As Applicable For Each Air Handling Unit)

1. The temperature test sheets shall list both the specified conditions and the actual operating conditions in opposite columns. Items listed on this sheet shall be as follows:

a. Cooling Cycle: Chilled Water

1) Entering air db and wb temperature.

2) Leaving air db and wb temperature.
3) Outside air db and wb temperature.
4) Chilled water supply temperature.
5) Chilled water return temperature.
6) Unit discharge temperature.

b. Heating Cycle: Hot Water/Steam

1) Entering air db temperature.
2) Leaving air db temperature.
3) Entering and leaving coil water temperatures/entering steam pressure.
4) Outside air db and wb temperatures.
5) Unit discharge temperature.

G. Pump Test Sheets

1. For each pump the following data shall be listed:

a. Pump number and system name.
b. Pump manufacturer and model number.
c. Pump curve.
d. Motor HP and RPM.
e. Voltage - Nameplate, test.
f. Amperage - Nameplate, test.
g. GPM, rated, tested.
h. Pressure rise rated, test.
i. Inlet pressure, outlet pressure.
j. Inlet temperature.
k. Shut-off pressure.

H. Coil and All Other Heating Element Test Sheets (Unit Heaters, Reheat Coils, Reheat Boxes, Cabinet Unit Heaters, Fan Coil Unit)

1. For each element both the specified and test conditions shall be listed:
2. Inlet water temperature (hot/chilled water).
3. Inlet air temperature.
4. Outlet water temperature (hot/chilled water).
5. Outlet air temperature.
6. Pressure drop through unit.

I. Velocity and Pressure Test Sheets for Main and Branch Ducts

1. Duct location or designation.
2. Duct size.
3. Number of velocity readings.
4. Duct average velocity.
5. Total CFM.
6. Duct average static pressure.

J. Calibration of air flow measurement stations in cooperation and in conjunction with ATC contractor, provide all necessary pitot tube traverses and/or other air measurements necessary to field verify the accuracy of all installed air flow measurement stations at all air handling units, exhaust air handling units, return fans and cuts. Calibration readings shall be taken at 100%,

75%, 50% of rated flow and a curve shall be prepared that indicates any deviation between air flow station readings and field readings at these floors.

PART 3 - EXECUTION

3.1 AIR SYSTEM BALANCING AND TESTING PROCEDURES

A. The Balancing Contractor shall perform the following tests, and balance all systems in accordance with the following requirements after clean filters are installed in all filter banks before tests are performed:

1. Test and adjust blower RPM or blade pitch angle on vane axial fans to achieve design requirements.

    a. Test and record motor full load ampere.

    b. Make pitot tube transverse of main supply, return and exhaust air ducts to obtain design CFM at fans.

    c. Test and report system static pressure, suction and discharge.

    d. Test and adjust system for design CFM recirculated air.

    e. Test and adjust system for design CFM outside air.

    f. Test and record entering and leaving air temperatures (db-wb cooling and db heating).

    g. Adjust all main supply, return and exhaust air ducts to proper design CFM.

    h. Adjust all zones and branches to proper design CFM, supply, return and exhaust systems.

    i. Test and adjust each diffuser, grille, register, and constant volume box to within ±5% of design requirements.

    j. Test and adjust all special pressure rooms to maintain pressure relationship indicated on the drawings and to the pressures specified herein. Note that air quantities on the drawing may have to be changed to satisfy the pressure relationship.

    k. Identify and list size, type and manufacturer of diffusers, grilles, registers, and terminal volume boxes. Include information regarding coils where applicable.

    l. Measure air quantities in main and branch ducts by traversing entire cross sectional area of duct with pitot tube. Ducts having velocities of 1000 feet per minute or more shall be measured with inclined manometers (draft gauge) or magnehelic gauges; ducts having velocities of less than 1000 per feet per minute shall be measured with micromanometers, hook gauges, or similar low pressure instruments. Openings in ducts for pitot tube insertion shall be sealed with snap-in plugs and covered with duct tape after air balance is complete. Diffuser, grille and register air quantities shall be determined by direct reading velocity meters in accordance with the manufacturer's recommendations.

m. Identify, adjust, balance and measure air quantities in all types of hoods or exhaust "trunks", where applicable. Identify systems by fan designation and room name.

n. Obtain design air quantities in main ducts by adjusting fans. Branch duct air quantities shall be adjusted by volume dampers. Dampers shall be permanently marked after air balance is complete to enable them to be restored to their correct position if disturbed at any time.

o. As part of this Contract, the Balancing Contractor shall change the pulleys, belts, and fixed sheaves to provide for permanent sheaves, pulleys and belts, based on the final balancing, in order to ensure proper air delivery of the various systems. The Balancing Contractor shall also make all necessary adjustments to vane axial fan blade pitch angle to achieve required airflow.

p. In cooperation with the ATC Contractor, determine the proper setpoint for all automatically operated dampers, air valves, static pressure sensors, inlet vane actuators, or other variable or controllable devices requiring coordination between Balancing Contractor and ATC Contractor. The Balancing Contractor shall determine the lowest system static setpoint possible that will deliver the proper air quantities to all outlets at the maximum cooling condition, and will adjust the fan system to operate at its most economical setting to achieve this static setpoint. Fans will be adjusted to the most economical setting by adjusting the fan speed (or blade pitch angle) with any variable volume devices in their maximum or wide-open position. Final static pressure setpoints are to be recorded in the test and balance report and listed for each unit.

q. Any dampers required for final balancing, as determined by the Balancing Contractor and the Architect/engineer, will be provided by the HVAC Contractor/Sheet Metal Contractor to ensure proper performance, at no extra cost to the Owner.

3.2 WATER SYSTEM BALANCING AND TESTING PROCEDURES

A. Preparation of the System for Water Testing and Balancing

1. The Balancing Engineer or Technician must prepare the water system for balancing in the following manner:

a. Open all valves to full position, including coil stop valves, return line balancing cocks and close all bypass valves, including system differential pressure bypass valve if applicable.

b. Remove, clean and/or replace all strainers.

c. Examine water in system to determine if it has been treated and is clean.

d. Check pump rotation, correct if necessary.

e. Check expansion tank to make sure it is not air bound and that the system is full of water.

f. Check all air vents at high points of water systems to make sure they are installed properly and are operating freely.

g. Make certain all air is removed from circulating system.

h. Check operation of differential automatic bypass valves, set valve in closed position.

i. Check and set operating temperature of systems to design requirements.

j. Complete air balancing must have been accomplished before water balance is begun.

k. Set all temperature controls so that all cooling coils are calling for full cooling and heating coils are calling for full heating.

l. Set hot and chilled water systems to proper GPM delivery.

m. Check leaving water temperature, return water temperature and pressure drop through all coils. Reset to correct design temperatures.

n. Balance each hot water coil, chilled water coil and all other heating elements.

o. After making adjustments to coils and other waterflow elements, reset settings at pumps, as required to obtain proper flows.

p. Determine system operating differential pressure and, in conjunction with the ATC Contractor, set any differential pressure valves for proper operation.

q. Upon completion of flow readings and coil adjustments, and after water balance is complete, permanently mark all balancing valves, cocks and flow meters so that they can be restored to their correct position if disturbed. Properly set memory stops on all balancing valves so equipped.

r. After the Balancing Contractor sets all waterflow balancing devices to proper design GPM, he shall mark the GPM flows on the piping schematic drawings.

s. The Balancing Contractor shall determine the lowest possible differential pressure control point possible for all variable speed pumping systems and for all differential pressure bypass control valves. In systems that have both variable speed pumping controlled by differential pressure and a differential pressure bypass valve, the Balancing Contractor shall assure, in conjunction with the ATC Contractor, that a minimum of 3 psig difference in setpoints is maintained between the two control settings with the differential pressure setpoint for the variable speed pumping system being the lower of the two settings.

3.3 INSTALLED ELEMENT TEST PROCEDURES

A. Element identification (location or number designation).

B. Required temperature drop corrected for actual entering air and water conditions.

C. Element adjusted until the required drop is obtained.

3.4 CONTROL SYSTEMS VERIFICATION

A. Verify all control devices are properly connected.

B. Verify all dampers, valves and other controlled devices are operated by the intended controller.

C. Verify all dampers and valves are in the position indicated by the controller (open, closed, modulating).

D. Verify the integrity of valves and dampers in terms of tightness of close off and full open positions.

E. Check all valves are properly installed in the piping system in relation to direction of flow and location.

F. Check calibration of all controllers.

G. Verify the proper application of all normally open and normally closed valves.

H. Check the location of all thermostats and humidstats for potential erratic operation from outside influences such as sunlight, drafts or cold walls.

I. Check the locations of all sensors to determine whether their position will allow them to sense only the intended temperatures or pressures of the media. Control Contractor will relocate as deemed necessary by the testing and balancing agency.

J. Check the sequence of operation that any control mode is in accordance with approved shop drawings. Verify that only minimum simultaneous heating and cooling occurs. Observe that the control valves at the boiler/heat pump loop are properly sequenced.

K. Verify all controller setpoints meet the design intent.

L. Check all dampers for free travel.

M. Verify the operation of all interlock systems.

N. Perform all systems verification to ensure the safety of the system and its components.

3.5 SPECIAL SYSTEMS TESTING

A. Duct Leakage Testing

1. Testing shall be conducted before external insulation is applied and before ducts are connected.

2. Mechanical Contractor to close off and seal all openings in the duct section to be tested.

3. Each section shall be tested by the Mechanical Contractor in accordance to the leakage class as specified under Section 233100 and SMACNA Standards. All tests shall be witnessed and documented by the TAB Contractor.

B. Sound and Vibration Testing

1. Sound

a. Sound level readings shall be taken in at least (10) locations in the building with an octave band analyzer.

b. The test data for each area will be recorded on noise criteria curves indicating the decibel level read in each frequency band, the NC level required, and the NC level measured.

c. Readings shall be taken at night in order to reduce the ambient noise level.

d. The testing and balancing agency will submit the test data and test equipment data to the Architect and Engineer for their review and include the approved forms in the testing and balancing report.

2. Vibration

a. Vibration field measurements shall be taken as required for each circulating water pump, cooling towers, air handling unit, and fan driven by a motor over 10 HP.

b. Readings shall include shaft alignment, equipment vibration, bearing housing vibration, foundation vibration, and building structure vibration.

c. Readings shall be made using portable equipment capable of filtering out unwanted frequencies.

d. Maximum vibration at any point listed above shall not exceed criteria listed in the ASHRAE Handbook, HVAC Systems and Application, Chapter 52 "Sound and Vibration Control", Table 26 "Equipment Vibration Criteria", unless otherwise specified. Readings shall be taken with vibration isolation blocked solid to the foundation.

C. Cooling Tower Testing (Not used)

D. Kitchen Hood and Dishwasher Exhaust Testing (Not used)

E. Building Pressure Testing (Not used)

3.6 SYSTEM PERFORMANCE VERIFICATION

A. At the time of final inspection, the test and balance agency shall recheck, in the presence of the Owner's representative, specific and random selections of data, air quantities, and air motion recorded in the Certified Report.

B. Points and areas for recheck shall be selected by the Owner's representative.

C. Measurement and test procedures shall be the same as approved for work forming basis of Certified Report.

D. Selections for recheck, specific plus random, will not normally exceed 25% of the total number tabulated in the report, except that special air systems may require a complete recheck for safety reasons.

E. If random tests elicit a measured flow deviation of 10% or more from that recorded in the Certified Report listings, by 10% or more of the selected recheck stations, the report is rejected, all systems shall be readjusted and tested, new data recorded, new Certified Report submitted, and new inspection tests made, all at no additional cost to Owner.

F. Following system verification of the Certified Report by the Owner's representative, the settings of all valves, splitters, dampers, and other adjustment devices shall be permanently marked by the testing and balancing agency so that adjustment can be restored if disturbed at any time. Devices shall not be marked until after system verification.

3.7 OPPOSITE SEASON TEST

A. The testing and balancing agency shall perform an inspection of the HVAC system during the opposite season from that in which the initial adjustments were made. The testing and balancing agency shall make any necessary modifications to the initial adjustments to produce optimum system operation.

3.8 RECORD AND REPORT DATA

A. The test and balance report shall be complete with logs, data and records as required herein. All logs, data and records shall be typed on white bond paper and bound. The report shall be certified accurate and complete by the testing and balancing agency's certified balancing engineer.

B. Six (6) copies of the test and balance report are required and shall be submitted to the Owner or the Owner's representative.

C. The report shall contain the following general data in a format selected by the testing and balancing agency.

1. Project number.
2. Contract number.
3. Project title.
4. Project location.
5. Project Architect.
6. Project Mechanical Engineer.
7. Test and Balance Agency.
8. Balancing Engineer.
9. General Contractor.
10. Mechanical Contractor.
11. Date tests were performed.
12. Certification.

D. The test and balance report shall be recorded on report forms conforming to the recommended forms in AABC National Standards. At a minimum, the report shall include:

1. Preface: A general discussion of the system, any abnormalities and problems encountered.

2. Instrumentation List: The list of instruments including type, model, manufacturer, serial number, and calibration dates.

3. System Identification: In each report the supply, return and exhaust openings and traverse points shall be numbered and/or lettered to correspond to the numbers and letters used on the report data sheets.

4. Air Handling Equipment (Heat Pumps, Makeup Air, Roof Top Units, etc.)

    a. Manufacturer, model number, and serial number.

    b. All design and manufacturer related data.

    c. Total actual CFM by traverse if practical; if not practical, the sum of the outlets may be used, or a combination of each of these procedures. For specific systems, such as ones with diversity, see the AABC National Standards.

    d. Suction and discharge static pressure of each fan, as applicable.

    e. Outside air and return air total CFM.

    f. Actual operating current, voltage, and brake horsepower of each fan motor.

    g. Final RPM of each fan.

    h. Fan and motor sheave manufacturer, model, size, number of grooves, and center distance.

    i. Belt size and quantity.

    j. Static pressure controls final operating setpoints.

5. Pumps

    a. Manufacturer, size, and serial number.

    b. All design and manufacturer's related data.

    c. Pump operating suction and discharge pressure and final total dynamic head.

    d. No flow (pump discharge valve closed) suction and discharge pressure and corresponding total dynamic head. This procedure is to determine actual impeller size.

    e. Rated and actual operating current, voltage, and brake horsepower of each pump motor.

    f. Submit pump curve showing design, operating, and no-flow points of operation.

6. Boilers

    a. Manufacturer, model number, and serial number.
    b. All design and manufacturer's rated data.
    c. Rated and actual pressure drop across boilers and related GPM.
    d. Entering and leaving water temperatures.

7. Heat Exchangers

    a. Manufacturer and model number.
    b. All design and manufacturer's related data.
    c. Service and location.
    d. Actual pressure drop and related GPM – condenser water side.
    e. Actual pressure drop and related GPM – heat pump side.
    f. Entering and leaving temperatures condenser water and heat pump water.
    g. Temperature control setting.

8. Electric Heating/Gas Heating

    a. Manufacturer and model number.
    b. All design and manufacturer rated data.
    c. Actual operating current and voltage.
    d. Coil location and identification number.

9. Cooling Tower

    a. A copy of the Cooling Tower Test Data Summary sheet.

    b. A sketch of the cooling tower installation showing tower orientation, principal dimensions, location of temperature and flow rate measurement points, and notation of any building obstructions or other equipment in the immediate vicinity of the tower.

    c. Copies of completed test data sheets.

    d. A copy of test calculations, including performance curves and cross plots.

    e. Observations on compliance with test code limitations and uniformity of test conditions. Include comments on any suggested changes to the tower such as increasing fan speed or blade pitch to obtain rated brake horsepower.

END OF SECTION 230593

SECTION 230713 – DUCT INSULATION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Section 230500, apply to this Section.

1.2 WORK INCLUDED

A. Furnish and install all duct insulation, vapor barriers, jackets, finishes, adhesives, cements and accessories to make a complete and insulated system of ductwork, fittings, joints, air-handling components and accessories.

B. All insulation system materials shall conform to the maximum flame spread/smoke developed ratings specified herein.

1.3 RELATED SECTIONS

A. Examine all drawings and all other Sections of the Specifications for requirements which affect work under this Section whether or not such work is specifically mentioned in this Section.

B. The following Sections are directly referenced herein:

1. Section 23 07 19 – HVAC Piping Insulation
2. Section 23 31 00 – Sheet Metal Work and Accessories
3. Section 23 31 00.10 – Fire-Resistive Duct Construction

1.4 REFERENCES

A. Applicable provisions of the most-current editions of the following Codes, Standards and Trade Standard Publications shall apply to the work of this Section, and are hereby incorporated into, and made a part of the Contract Documents.

1. ANSI/ASHRAE 90.1 - Energy Conservation in New Building Design

2. ASTM B 209 – Standard Specification for Aluminum and Aluminum-Alloy Steel and Plate.

3. ASTM B 209M – Standard Specification for Aluminum and Aluminum-Alloy Sheet and plate (Metric).

4. ASTM C 518 – Standard Test method for Steady-State Thermal Transmission Properties by Means of Heat Flow Meter Apparatus.

5. ASTM C 553 – Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.

6. ASTM C 612 – Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
7. ASTM C 916 – Standard Specification for Adhesives for Duct Thermal Insulation

8. ASTM C 921 – Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.

9. ASTM C 1071 – Standard Specification for Thermal and Acoustical Insulation (Glass, Fiber, Duct Lining Material).

10. ASTM C1136 –Standard Specification for Flexible Low-Permanency Vapor Retarder for Thermal Insulation.

11. ASTM E 84 – Standard Test Method for Surface Burning Characteristics of Building Materials.

12. ASTM E 96 – Standard Test Methods for Water Vapor Transmission of Materials.

13. ASTM F 1249 – Standard Test Method for Water Vapor Transmission Rate Through Plastic Film and Sheeting Using a Modulated Infrared Sensor

1. ASTM E 162 – Standard Test Method for Surface flammability of Materials Using a Radiant Heat Energy Source.

2. ASTM G 21 – Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

3. ASTM D 5590 -- Standard Test Method for Determining the Resistance of Paint Films and Related Coatings to Fungal Defacement by Accelerated Four-Week Agar Plate Assay

4. ICC-International Energy Conservation Code

5. MICA/NIA – National Commercial and Industrial Insulation Standards

6. NFPA 90A – Standard for the Installation of Air Conditioning and Ventilation Systems

7. NFPA 255 – Standard Method of Test of Surface Burning Characteristics of Building Materials.

8. SMACNA (DCS) – HVAC Duct Construction Standards – Metal and Flexible.

9. UL 723 – Standard for Test for Surface Burning Characteristics of Building Materials.

10. ASHRAE 189.1 - Standard for the Design of High-Performance Green Buildings Except Low-Rise Residential Buildings

11. California Department of Public Health - "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Formaldehyde emissions shall not exceed 16.5 mcg/cu. m or 13.5 ppb, whichever is less, except for insulation manufactured without formaldehyde.

1.2 DEFINITIONS

A. Thermal Conductivity (K value): Heat flow property of a homogeneous material; the lower the “k” the better the insulating value. Expressed in units of Btu-inch/hour per square foot per degree F.

B. Underwriters Laboratories Environment (UL Environment): independent, third-party green claims validation, product assessment and certification.

1. Environmental Claim Validation (ECV): Independent third-party review to single attribute environmental claims.

2. Environmental Product Declaration (EPD): Independently verified and registered document providing information about the life-cycle impact of products.

C. EPA: Environmental Protection Agency.

D. LEED: Leadership in Energy and Environmental Design, a voluntary rating system for high performance green buildings developed by the US Green Building Council (USGBC).

E. UL Classified: Underwriters Laboratory product label of fire resistance testing that includes on-going evaluation of the product to assure it continues to meet the Fire Hazard Classification (FHC) 25 Flame Spread/50 Smoke Developed rating; unlike other FHC testing which is a one-time only test.

F. ASJ+: All Service Jacket composed of aluminum foil reinforced with glass scrim bonded to a kraft paper interleaving with an outer polymer film layer leaving no paper exposed.

G. ASJ: All Service Jacket (no outer film).

H. FSK: Foil Scrim Kraft; facing.

I. PSK: Poly Scrim Kraft; facing.

J. PVC: Poly Vinyl Chloride; jacketing.

1.3 SUBMITTALS

A. Refer to Section 230500 and General Conditions for additional requirements. Refer to Division 1 for LEED and other applicable Building Rating Program submittal requirements.

B. Product Data: Provide product description, thermal characteristics, table of materials and thickness for each service, and locations.

C. Manufacturer’s Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

D. EPD or HPD Submittals: Third Party Validated.

E. Sustainable Design Submittals: Submittals required by Division 1 may include:

1. Product Data: For recycled content, indicating postconsumer and pre-consumer recycled content and cost.
2. Product Data: For adhesives, indicating VOC content.
3. Laboratory Certificates or Validations: For adhesives, indicating compliance with requirements for low-emitting materials.
4. Laboratory Certificates or Validations: For insulation, indicating compliance with requirements for low-emitting materials.

1.4 QUALITY ASSURANCE

A. Surface Burning Characteristics: For insulation and related materials, UL/ULC Classified per UL 723 or meeting ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame spread index of 25 or less, and smoke developed index of 50 or less.
2. Insulation Installed Outdoors: Flame spread index of 75 or less, and smoke developed index of 150 or less

B. All insulation materials herein specified shall be used subject to the manufacturer's temperature limitations and their compatibility with other materials.

C. Installation of all insulation work shall be executed by a qualified Insulation Contractor who is thoroughly experienced in this particular type of work and who has adequate facilities and equipment for installation of all insulation work herein specified and who is familiar with the requirements of the Code enforcing Authorities.

D. The finished installation shall present a neat and workmanlike appearance with all jackets smooth, with all vapor barriers sealed and intact.

E. Where insulation is specified for ductwork, insulate similarly all collars, dampers, coils, joints, in-line fans, etc. connected to system subject to heat loss or gain. Do not cover damper actuators or other maintenance points on equipment unless identified on the insulation with removable access panels or covers.

1.5 REGULATORY REQUIREMENTS

A. All insulation materials, finishes, coatings, cements, tapes, jackets and other insulation accessories shall have minimum composite or individual fire hazard ratings as well as thickness and “R” and “K” values conforming to the Building Codes and Energy Conservation Codes which control building construction materials that may be used on this project. Where specification requirements exceed the Code requirements, the specification shall govern.

B. Conform to maximum flame spread/smoke developed rating of 25/50 in accordance with ASTM E 84, NFPA 255, or UL 723.

1.6 DELIVERY, STORAGE AND PROTECTION

A. Accept materials on site, labeled with manufacturer’s identification, product density and thickness.

B. All materials shall be stored indoors, off of the floor or ground in a dry area free from moisture and debris, protected from construction damage and other abuse.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Maintain ambient conditions required by manufacturers of each product. Maintain conditions before, during and after installation for minimum of 24 hours.

PART 2 – PRODUCTS

2.1 THE FOLLOWING MANUFACTURERS ARE ACCEPTABLE FOR PRODUCT TYPES INDICATED, CONTINGENT UPON PRODUCTS' COMPLIANCE WITH THE SPECIFICATIONS

A. Duct Insulation:

1. Johns Manville Corporation.
2. Owens-Corning Fiberglass Corporation.
3. Certainteed Corporation.
4. Knauf Insulation

B. Fire Resistive Duct Insulation System

1. Refer to Section 23 31 10 Fire-Resistive Duct Construction for acceptable products.

C. Mastics Coatings, Sealants and adhesives:

1. Childers
2. H. B. Fuller Company, Foster
3. 3M Company Adhesives, Coatings and Sealers
4. Insul-Coustic
5. Vimasco

D. Jackets

1. Polyguard Products
2. 3M (Ventureclad)

2.2 FACED FLEXIBLE FIBER GLASS INSULATION

A. Flexible fiber glass duct insulation shall be equal to Knauf Atmosphere Fiberglas FSK-Faced Duct Wrap, Type 75 having an approximate density of 0.75 lb./cu.ft. and an approximate thermal conductivity (K-value) of 0.29 at 75° F, and facing water vapor permeance of 0.02 perm.

2.3 RIGID FIBERGLASS BOARD INSULATION

A. Rigid fiberglass board insulation shall be equal to Knauf Earthwool Insulation Board with FSK facing having an approximate density of 3 lbs./cu.ft. and an approximate thermal conductivity of 0.23 at 75°F, and facing water vapor permeance of 0.02 perm.

1. For ductwork exposed to weather, board density of 6.0 lb./cu.ft. shall be substituted on the top surface. . K-value shall be 0.23 or better.

2. For irregular surfaces, board density of 1.6 lb./cu. ft. may be substituted K-value shall be 0.25 or better.

3. For round ductwork, semi-rigid faced pipe and vessel insulation comprised of same base materials and facing shall be substituted. Density shall be 3.0 lb./cu. ft. or greater; K-value shall be 0.26 or better; compressive strength 120 psf or greater at 10% compression. Material shall be equal to Knauf Earthwool Pipe and Tank Insulation with FSK facing, meeting ASTM C13493.

4. Wherever insulation is intended to be exposed within finished spaces, a white all-service jacket (ASJ+) facing shall be substituted for FSK facing.

2.4 FIRE RESISTIVE DUCT INSULATION SYSTEM

A. Refer to Section 23 31 10 Fire-Resistive Duct Construction.

2.5 INSULATION FACING

A. Code FSK: 0.35 mil aluminum foil reinforced with fiberglass yarn reinforcing scrim and laminated to chemically treated fire resistive Kraft paper. Water vapor permeance shall not exceed 0.02 perms. Longitudinal laps and butt strips shall be a minimum of 3 inches. Facing shall comply with ASTM C1136 Type II, and have puncture-resistance rating of 25 Beach Units per TAPPI T803.

B. Code ASJ+: All service jacket composed of high intensity white chemically treated Kraft paper reinforced with fiberglass yarn and mesh and laminated to aluminum foil with a fire retardant adhesive. Longitudinal laps and butt strips shall be a minimum of 3 inches. Jacket shall be paintable. Water vapor permeance shall not exceed 0.02 perm. Facing shall comply with ASTM C1136 Type I, II, III, IV and VIII and have puncture-resistance rating of 120 Beach Units per TAPPI T803.

2.6 ADDITIONAL JACKETING

A. For duct insulation exposed to weather: Code WP: Polyguard Products Alumagard All-Weather® flexible weatherproof jacket or Venturecla d™ 1579CW 13-ply laminate. Installation shall be in strict accordance with the manufacturer's published literature. Jacket finish color and texture to be selected by Architect. Furnish samples of all available finishes – minimum 12 sq. in.

B. WP jacket system applied to positive pressure ductwork shall include air leakage relief vents. Relief vents shall be equivalent to Alumaguard Air Release Valve.

2.7 ADHESIVES

A. Code ADH-2A: Mold-resistant lagging adhesive: Foster 30-36 AF; Childers CP-137 AF Coatings shall meet ASTM D 5590 with 0 growth rating.

B. Code ADH-3: Fast-drying neoprene base adhesive for lap joints of foil-faced facing applied insulation. Similar to Childers CP-82 and Foster 85-75.

C. Code ADH-4: Adhesive for use in adhering fiberglass board or blanket insulation to equipment. Adhesive shall adhere to ASTM C916, Type II or IV. Foster 85-60/85-15, Childers CP-127/CP-85, 3M Company Insulation Adhesive No. 35 or 38 non-flammable adhesive.

2.8 MASTICS

A. Code MAS-1A: Mold-resistant coating: Foster 30-80 AF. Coating shall meet ASTM D 5590 with 0 growth rating. Maximum perm rating of 0.08 perms or less at 37 mils dry tested at 100ºF (38ºC) and 90% RH per ASTM F 1249.

B. Code MAS-2: Avinyl-acrylic weather barrier mastic, breathing type, for above ground installations. Similar to Childers CP-10 and Foster 46-50.

C. Code MAS-3: Vapor barrier coating made with alatex emulsion. For use on ductwork exposed to weather. Similar to Childers CP-35 and Foster 30-80/30-90. Permeance shall be no greater than 0.09 perms at 55 mil dry as tested by ASTM F 1249.

2.9 REINFORCING FABRIC

A. Glass fiber mesh, 10 x 10 strands per square inch, 2 oz./sq. yard, equal to Foster Mast a Fals or Childers Chil Glas #10.

2.10 TAPE

A. Refer to Part 3 for project-specific restrictions on the use of self-adhesive tape.

B. Code T-FSK for Installation with FSK Facing: 3” wide reinforced insulation tape made of foil scrim on Kraft paper liner. Tape is to be UL listed with a 5/10 flame spread and smoke developed rating, similar to 3M Company 1525 CW.

C. Code T-ASJ for Insulation with ASJ+ Facing: 3” wide reinforced insulation tape made of Kraft scrim on foil laminate. Tape is to be UL listed with a 5/0 flame spread and smoke developed rating, similar to 3M Company 1540 CW. Tape outer surface shall be white color to match adjoining ASJ+ color.

2.11 MECHANICAL ATTACHMENTS

A. Staples shall be galvanized clad outward clinching insulation staples.

B. Welding Studs (Weld-Pins)

1. Welding studs shall be capacitor type split pin or TCP tipped insulation pins with speed clips. Similar to Nelson Stud Welding Spec. 28.

PART 3 – EXECUTION

3.1 INSTALLATION OF INSULATION – GENERAL

A. The methods of application of insulation, finishes, adhesives, cements, accessories shall equal or exceed the manufacturer’s published recommendations

B. All insulation shall be applied by experienced insulating contractors in accordance with best Trade practice.

C. Duct systems as scheduled in Part 4 shall be insulated in their entirety.

a. Cover standing seams, stiffeners, trapezes with same insulating material as duct.

b. Duct system components that are not factory-insulated to a minimum of R-2.5--such as air terminals, air control valves, sound attenuators, filter-housings, un-cased fans, in-duct coils and dampers, diffuser back-pans and boots exceeding 4sf – shall be insulated to the same thickness as the associated ducts.

D. Take all possible precautions to protect work of other Trades. Provide protective covering as required to accomplish this end. This Trade shall be responsible for returning all equipment and material to its original new condition and appearance where damage occurs due to neglect.

E. All ductwork shall have been leak-tested and approved prior to installation of insulation.

F. All surfaces to be insulated shall be clean, dry and free from dirt and scale when insulation is being applied. Insulation shall be dry at the time of installation and before and during the process of finished application.

G. Exposed fiberglass material will not be permitted. Jacket material shall be pasted over exposed ends and taped or banded to give a neat and finished appearance.

H. Surfaces of insulation shall be smooth, even and true to line with jackets drawn tight and smoothly secured. Scrap pieces of insulation shall not be used where a full length section will fit.

I. Butt covering neatly to walls, floors, ceiling and other terminations. Apply band at end and position so band covers gap between surface and insulation where exposed.

J. Cover standing seams, stiffeners, braces and supportive trapezes with same insulation material as duct. Seal all hanger penetrations with vapor-barrier coating.

K. Fastenings: Provide where required to securely hold insulation. Apply adhesive and weld pins on exposed risers to prevent slipping and turning of insulation.

L. Thickness of insulation shall not be compromised due to piping interferences, improper installation or any other reason.

3.2 INSTALLATION OF BLANKET INSULATION

A. Install insulation using manufacturer’s stretch-out tables to obtain specified R-value using a Maximum Compression of 25%. Insulation shall be wrapped on the duct work with all circumferential joints butted and longitudinal joints lapped 2 inches and stapled. All joints shall be sealed with approved adhesive. Additionally, secure insulation to bottom of rectangular ducts over 24 inches wide with weld pins at no more than 18 inches on center.

B. Insulation shall be butted with facing overlapping all joints at least 2 inches and sealed with approved fire retardant vapor barrier adhesive mastic reinforced with woven glass fabric or with vapor barrier tape, Code T-FSK. All breaks, punctures and pin penetration in facing, shall be sealed with vapor barrier tape or fabric-mastic per the manufacturer’s published installation instructions. Tapes shall be applied with sealing tool using moving pressure.

C. Seal all support, instrument, and access penetrations to ensure vapor-barrier integrity.

D. Include support trapezes within insulation envelope. Seal hanger penetrations.

3.3 INSTALLATION OF BOARD INSULATION

A. The insulation shall be applied by use of weld pins. Such fasteners shall be spaced 3 inches from each corner of the board with intermediate pins spaced no more than 12 inches on center. Pin caps shall be covered with vapor seal patches that match the jacket on the ASJ board.

B. Insulation shall be scored to conform to sharp bends and curved surfaces to provide a neat and workmanlike appearance when finished.

C. All insulation edges, seams, and joints shall be sealed with a fire-retardant vapor barrier adhesive, mastic reinforced with woven glass fabric, or with vapor barrier tape Code T-ASJ, similar to that of the board facing. Mastic or tape shall be 3 to 5 inches wide as recommended by the insulation manufacturer. All breaks, punctures and pin penetration in facing shall be sealed with vapor barrier tape or fabric/mastic per the manufacturer's published installation instructions. Tapes shall be applied with a sealing tool using moving pressure.

D. Seal all support, instrument, and access penetrations to ensure vapor-barrier integrity.

E. Finish shall present a neat and uniform appearance as to color and workmanship.

F. Semi-rigid wrap insulation applied to round ductwork shall require weld pins and/or banding intervals per insulation manufacturer's guidelines. Submit spacing schedule.

G. Duct-support trapezes shall be external to insulation and vapor barrier. Use pre-faced non-compressable insulation board inserts full width of trapeze and depth of abutting insulation, and minimum of 8" wide to permit flat seam-taping of vapor-barrier facing at butt joints.

3.4 DUCTWORK EXPOSED TO WEATHER

A. When duct installation, sealing and testing is completed per Section 23 31 00 Sheet Metal Work and Accessories and submitted and approved by the AE/Owner, cover all ducts exposed to weather with board insulation in accordance with the insulation specification and Table 4.1. In no case shall insulation work proceed until the duct has been confirmed to be sealed in accordance with SMACNA Seal Class A.

B. In all cases the insulation shall be installed with a watershed design, including minimum 2% transverse pitch, to prevent water ponding on the top of the ductwork.

C. When insulation application is completed, the entire installation shall be covered with weatherproof jacket code WP with the joints overlapping in a shingled manner a minimum of 6 inches. All joints shall be staggered and shingled to ensure a weatherproof system. Installation shall also comply fully with jacket manufacturer's installation guidelines.

D. Install relief vents on all positive-pressure WP-jacketed ducts. Vents shall be spaced minimum one/200 sq. ft. of jacket, and located on bottom of duct only. Vents shall be self-draining.

E. Install all insulation facing and jacketing to be sandwiched between duct and its trapeze or cradle supports and wind-restraint banding. Provide non-compressible insulation inserts at all load-bearing conditions. Inserts shall be pre-jacketed and have sufficient flat surface projection beyond supports to allow flat vapor-seal and weather-seal lap joints.

PART 4 – SCHEDULES

4.1 TABLE 4.1 -- DUCTWORK INSULATION APPLICATION SCHEDULE

TABLE 4.1 Section 23 07 13	Minimum Insulation Installed Thickness (inch) / R-value by Duct External Environment			Service Key Notes
Duct Service	Conditioned Space	H&V Space	Unheated Space/ Outdoors	1
Heating and/or Cooling Supply	1.0”/R-4	1.5”/R-6	3.0”/R-12	2
Return & heat-recovery exhaust	Not required	1.5”R-6	3.0”/R-12	3
Exhaust <140°F	Not required	1.0”/R-4	1.0”/R-4	4
Exhaust >140°F	1.0”/R-4	1.0”/R-4	1.0”/R-4	5
Exhaust/Relief stacks	Not applicable	Not applicable	Not required	6
Outdoor air, relief, intermittent exhaust	3.0”/R-12	3.0”/R-12	Not required	7
Dedicated life-safety supply	See Key Note 8	See Key Note 8	See Key Note 8	8
Kitchen grease exhaust	See Key Note 9	See Key Note 9	See Key Note 9	9

GENERAL NOTES:

1. Table values apply to all Climate Zones defined in ASHRAE 90.1 -2013.

2. R-values stated are installed R-values without credit for surface air-film, and at installed thickness. Thicknesses are all referenced to fiberglass board insulation. E.g., R-4 can be achieved with 1.0”-labeled/installed board insulation or with 1.5”-labeled (1.1”-installed/compressed/stretched) flexible blanket as specified in Part 2 of this Section. .

3. Flexible blanket insulation may be used only where ducts are concealed from occupied space, e.g., above ceilings, in shafts, and for round ducts in all indoor locations. Board insulation shall be used where ducts are exposed within conditioned and H&V space, for all outdoor and other applications requiring additional jacket Code WP, and wherever scheduled R-value is R-8 or greater.

4. All ducts exposed to weather, within vehicular facilities, within unheated enclosures, and exposed in wash-down environments shall have additional jacket Code WP applied.

SERVICE KEY NOTES:

1. “Conditioned Space” is any space controlled–directly or in-directly--to be between 60F and 90F, and de-humidified to <70°F dewpoint. Such spaces include occupied space and associated ceiling cavities or return air plenums, interior shafts and mechanically-cooled equipment rooms, and heated overhangs within the building thermal envelope. “H&V Space” is heated spaces (>60°F) that are cooled by ambient outdoor air (e.g., “ventilated” mechanical and electrical rooms). “Un-heated Space/Outdoors” includes

ducts exposed to weather, and in un-heated sheltered spaces such as attics, crawl space, overhangs, parking garages).

2. Supply service includes all ducts supplying air that can be heated or cooled to 15°F above or below the space temperature of zone served. Supply service insulation is not required where the duct is exposed within a thermostat zone that it serves and downstream of the zone control terminal.

3. Return/heat-recovery service includes all ducts returning air to HVAC equipment for re-circulation or for heat-recovery prior to discharge.

4. Exhaust >60°F and <140°F includes any contaminated airstream to be discharged outdoors. Includes room exhaust, lab hood exhaust, toilet exhaust, clothes-dryer exhaust, vapor-capture hoods diluted with conditioned room air, e.g., for batch autoclaves. . Insulation for H&V and un-heated space is to control internal or external condensation. Insulation may be deleted for indoor ducts that are specified to be drained in Section 23 31 00 Sheet Metal Work and Accessories.

5. Exhaust >140°F includes any contaminated airstream to be discharged outdoors. Temperature criteria are based on sustained or continuous duct air temperature. Service examples include drying ovens, controlled environment chambers. Insulation in un-conditioned space may be deleted for hot ducts that are not subject to accidental human contact with surface.

6. Exhaust stack service includes all outdoor positive pressure ducts, stacks and hoods from which internal condensation or precipitation may freely weep to a roof.

7. Outdoor air, relief and intermittent exhaust service includes all ducts, plenums and louver blank-offs that can enclose untempered outdoor air. This service functions as part of the building thermal envelope. This service includes relief and exhaust service on the outdoor side of automatic isolation dampers, where duct interior may reach outdoor temperature when not flowing.

8. Life-safety service includes dedicated stair and elevator pressurization ducts. Field-applied thermal insulation for these systems is used for the following conditions:

    a. Life-safety service that is heated or cooled shall be insulated per heating/cooling supply service.

    b. Life-safety service that is on the outdoor side of isolation dampers shall be insulated for outdoor air service.

    c. Portions of life-safety service that requires a fire-rated duct enclosure may include field-applied insulation as a component of a fire-rated duct system. Refer to Section 23 31 10 Fire-Resistive Ductwork and Accessories for system options and requirements of each.

END OF SECTION 230713

SECTION 230719 – HVAC PIPING INSULATION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Section 230500, apply to this Section.

1.2 WORK INCLUDED

A. Furnish and install all piping insulation, vapor barriers, jackets, finishes, adhesives, cements and accessories to make a complete insulated system for all piping, valves, fittings, joints, offsets and flanges specified herein.

B. All insulation system materials shall conform to the maximum flame spread/smoke developed ratings specified herein.

C. Hard insulation material shall be provided at all hangers.

D. Insulate the following:

1. All scheduled piping, all valves, fittings, elbows, flanges and accessories.

2. All piping exposed to weather including provision of additional weatherproof jacket.

3. All cold water make-up piping and valves. All drain and overflow piping receiving cold water. Piping to/from expansion/compression tanks.

4. All vents and blow-offs in mechanical rooms and elsewhere within reach of personnel.

5. Emergency generator piping and entire exhaust systems.

6. Piping jacket covers.

7. All heat traced piping.

1.3 RELATED SECTIONS

A. Examine all drawings and criteria sheets and all other Section of the Specifications for requirements which affect work under this Section whether or not such work is specifically mentioned in this Section.

1.4 REFERENCES

A. Applicable provisions of the following Codes and Trade Standard Publications shall apply to the work of this Section, and are hereby incorporated into, and made a part of the Contract Documents.

B. Material standards shall be as specified or detailed hereinafter and as follows:

1. ASTM A 666 – Standard Specification for Austenitic Stainless Steel Sheet, Strip, Plate and Flat Bar.

2. ASTM B 209 – Standard Specification for Aluminum and Aluminum-Alloy Steel and Plate.

3. ASTM B 209M – Standard Specification for Aluminum and Aluminum-Alloy Sheet and plate (Metric).

4. ASTM C 177 – Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded Hot Plate Apparatus.

5. ASTM C 195 – Standard Specification for Mineral Fiber Thermal Insulating Cement.

6. ASTM C 240 – Standard Test Methods of Testing Cellular Glass Insulation Block.

7. ASTM C 449/C 449M – Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.

8. ASTM C 518 – Standard Test method for Steady-State Heat Flux Measurements and Thermal Insulating and Finishing Cement.

9. ASTM C 533 – Standard Specification for Calcium Silicate Block and Pipe Terminal Insulation.

10. ASTM C 534 – Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.

11. ASTM C 547 – Standard Specification for Mineral Fiber Pipe Insulation.

12. ASTM C 552 – Standard Specification for Cellular Glass Thermal Insulation.

13. ASTM C 578 – Standard Specification for Preformed, Cellular Polystyrene Thermal Insulation.

14. ASTM C 591 – Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.

15. ASTM C 610 – Standard Specification for Molded Expanded Perlite Block and Pipe Thermal Insulation.

16. ASTM C 795 – Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.

17. ASTM C 921 – Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.

18. ASTM D 1056 – Standard Specification for Flexible Cellular Materials – Sponge ore Expanded Rubber.

19. ASTM D 1667 – Standard Specification for Flexible Cellular Materials – vinyl Chloride Polymers and Copolymers (Closed-Cell Foam).

20. ASTM D 1784 – Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.

21. ASTM D 2842 – Standard Test Method for Water Absorption of Rigid Cellular Plastics.

22. ASTM E 84 – Standard Test Method for Surface Burning Characteristics of Building Materials.

23. ASTM E 96 – Standard Test Methods for Water Vapor Transmission Materials.

24. NFPA 225 – Standard Method of Test of Surface Burning Characteristics of Building Materials.

25. UL 723 – Standard for Test for Surface Burning Characteristics of Building Materials.

26. ANSI/ASHRAE 90.1 – Energy Conservation in New Buildings.

1.5 SUBMITTALS

A. See Section 230500 and General Conditions for additional requirements.

B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

C. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

D. Installation Graphic Details.

E. Buildings Seeking LEED Certification

1. All adhesives and sealants used in projects that are seeking LEED certification shall comply with the following:

a. Adhesives and Sealants for Insulation: All adhesives and sealants used on interior building insulation shall comply with the South Coast Air Quality Management District (SCAQMD) Rule #1168; VOC limits shall comply with the limits indicated in Table 1 of LEED Version 2.2, Indoor Environmental Quality Section, Credit EQ-4.1. Those limits correspond to an effective date of the SCAQMD Rule #1168 of July 1, 2005, and Rule Amendment date of January 7, 2005.

b. Coatings and Mastics for Insulation: All coatings and mastics used on interior building insulation shall comply with VOC limits set forth by Green Seal

c. GS-11 and comply with the South Coast Air Quality Management District (SCAQMD) Rule #1113; VOC limits shall comply with the limits indicated in

d. Table 1 of LEED Version 2.2, Indoor Environmental Quality Section, Credit EQ-4.2.

e. Product Data for Credit IEQ 4.1: For adhesives and sealants, documentation including printed statement of VOC content.

1.6 QUALITY ASSURANCE

A. All insulation materials, finishes, coatings, cements, jackets and other insulation accessories shall have minimum composite or individual fire hazard ratings as well as thickness and "C" values conforming to State Building Codes which control building construction materials that may be used on this project. Where specification requirements exceed the Code requirements, the specification shall govern.

B. Piping insulation for the various piping systems and associated equipment shall be composed of materials which are non-combustible and/or provide a fire resistive system of insulation which complies with the applicable Code having jurisdiction. Generally, it is required that fire hazard ratings shall not exceed the following, except as noted:

1. Flame Spread Rating 25 (No Exceptions)
2. Smoke Developed Rating: 50

C. All fire hazard ratings shall be as determined by NFPA 255 "Method of Test of Surface Burning Characteristics of Building Materials", ASTM E84 or UL 723.

D. All insulation materials herein specified shall be used subject to the manufacturer's temperature limitations and their compatibility with other materials.

E. Installation of all insulation work shall be executed by a qualified Insulation Contractor who is thoroughly experienced in this particular type of work and who has adequate facilities and equipment for installation of all insulation work herein specified and who is familiar with the requirements of the Code enforcing Authorities as to fire hazard rating.

F. The finished installation shall present a neat and workmanlike appearance with all jackets smooth, with all vapor barriers sealed and intact.

G. Where insulation is specified for piping, insulate similarly all connections, vents, drains and any piping connected to system subject to heat loss or gain. Do not cover vent petcocks, cleanouts or other maintenance points on equipment unless identified on the insulation with removable access panels or covers.

H. All chilled water system piping, components and accessories are to be insulated in a manner so as to provide a complete, uninterrupted vapor barrier.

1.7 REGULATORY REQUIREMENTS

A. Conform to maximum flame spread/smoke developed rating of 25/50 in accordance with ASTM E 84, NFPA 255, or UL 723.

1.8 DELIVERY, STORAGE AND PROTECTION

A. Accept materials on site, labeled with manufacturer’s identification, product density and thickness.

B. All materials shall be stored in a dry area free from moisture and debris.

1.9 ENVIRONMENTAL REQUIREMENTS

A. Maintain ambient conditions required by manufacturers of each product.

B. Maintain temperature before, during and after installation for minimum of 24 hours.

PART 2 – PRODUCTS

2.1 MANUFACTURERS ACCEPTABLE FOR PRODUCT TYPES INDICATED CONTINGENT UPON PRODUCTS' COMPLIANCE WITH THE SPECIFICATIONS

A. Insulation

1. Manville Corporation.
2. Owens-Corning Fiberglass Corporation.
3. Armstrong World Industries, Incorporated.
4. Certainteed Corporation.
5. Knauf

B. Elastomeric Insulation

1. Armacell

C. Mastics and Adhesives

1. Childers Products Company.
2. H. B. Fuller Company, Foster Products Division.
3. 3M Company Adhesives, Coatings and Sealers.
4. Armstrong World Industries, Incorporated.
5. Ruston Plant.
6. Chicago-Mastic
7. Insul-Coustic
8. St. Clair Rubber
9. Vimasco
10. Baldwin-Ehret-Hill

D. Pipe Insulation of Hanger and Support

1. Pipe Shields, Inc.
2. Rilco Manufacturing Company.
3. Elcen Metal Products Company.
4. Power Piping Company.
5. NPS Industries.

E. PVC Fitting Covers

1. Manville, Corporation.
2. Ceel-Co.
3. Certainteed, Corp.
4. Cell Co. Plastics

2.2 GENERAL

A. Adhesives and insulation materials: Composite fire and smoke hazard ratings maximum 25 for flame spread and 50 for smoke developed for pipe insulation. Adhesives to be waterproof when cured.

B. The installation of thermal insulating materials coverings and coatings containing asbestos fibers is forbidden.

C. Insulation shall not be chemically reactive to the metal over which it is applied. Insulation installed on steel shall be neutral or slightly alkaline. Insulation installed on aluminum shall be neutral or slightly acidic.

2.3 MATERIALS AND COMPONENTS

A. Fiberglass Insulation

1. Pre-molded pipe fiberglass: Recommended temperature to 850 degrees Fahrenheit with facing. Molded in one piece split or hinged circular sections in three foot lengths for piping and tubing. Insulation shall be made from long, fine, glass fibers bonded together with a thermosetting resin. Insulation shall have a minimum density of 4.0 pounds per cubic foot and a K value of 0.23 at 75 degrees Fahrenheit mean temperature. Insulation furnished with facing as specified below and as indicated in insulation schedule. Insulation similar to Owens-Corning Type SSL-II. Pressure sensitive tapes using rubber based or acrylic based adhesives are not permitted.

2. Pipe and tank fiberglass: Recommended temperature to 450 degrees F with facing. Insulation shall be made from long, fine, glass fibers bonded together with a thermosetting resin. Insulation shall have a minimum density of 3 pounds per cubic foot and a k-valve of 0.27 btu in/(Hr sq.ft. degree F) at 75 degrees F main temperature. Insulation furnished with facing as specified below and as indicated in insulation schedule. Insulation similar to Manville pipe and tank insulation. Pressure sensitive tapes using rubber based or acrylic based adhesives are not permitted.

3. Flexible fiberglass: Recommended temperature to 250 degrees Fahrenheit. Glass fibrous flexible blanket insulation having density of 0.75 pounds per cubic foot and a K value of 0.30 at 75 degrees mean temperature. Insulation furnished with facing as specified below and indicated in insulation schedule. Insulation and jacket similar to Owens-Corning Type SSL-II.

4. Use pipe and tank fiberglass only when pre-molded pipe fiberglass is not available. Pipe and tank insulation shall not be used on pipe sizes 24 inches and smaller.

B. Hydrous Calcium Silicate Pipe Insulation

1. Molded, rigid, asbestos free, hydrous calcium silicate water resistant pipe insulation shall be Owens-Corning Fiberglas Kaylo 10 or Manville Thermo-12, molded to dimensional standards conforming to the pipe. Insulation shall have an approximate density of 11 lbs./cu.ft., an approximate thermal conductivity of 0.41 at 200°F mean temperature and shall be suitable for application on surfaces which reach 1200°F. Additional jacket, as hereinafter specified, shall be applied in the field. This material shall be used in finished and concealed areas. In all areas, insulation shall have all joints made with an approved insulation cement to prevent heat leakage through joints. Insulation shall be secured by wire on 9 inch centers.

2. Valves, flanges and fittings occurring in lines insulated with calcium silicate insulation shall be covered with fabricated, mitered segments of molded calcium silicate of thickness equal to insulation on adjacent pipe, wired in place and made smooth with a thin coat of insulating cement. Fittings on pipes 2 inches and smaller may be insulated with insulating cement to a thickness equal to that of adjacent pipe insulation. All fittings shall be finished with glass fabric embedded in fire retardant adhesive

C. Mineral Wool Pipe and Tank/Equipment Insulation

Pre-formed, high density, asbestos free, mineral (rock) wool with inorganic binders to for a non-combustible, high-temperature insulation. Pipe cover shall be two-piece, Insulation shall be as manufactured by IIG MinWool 1200 (a Johns Manville Co.) or approved equal. Insulation and fitting coverings shall be molded to dimensional standards conforming to the pipe. Insulation shall have an approximate density of 8 lbs./cu.ft., an approximate thermal conductivity of 0.30 at 200°F mean temperature and shall be suitable for application on surfaces which reach 1200°F. Additional jacket, as

hereinafter specified, shall be applied in the field. This material shall be used in finished and concealed areas. In all areas, insulation shall have all joints made with an approved insulation cement to prevent heat leakage through joints. Insulation shall be secured by wire on 9 inch centers. All piping, fittings and equipment shall be finished with all-service jacket.

1. Valves, flanges and fittings occurring in lines insulated with Mineral Wool shall be covered with fabricated, molded and mitered segments of thickness equal to insulation on adjacent pipe, wired in place and secured/finished in according to the manufacturer's recommendations. All fittings shall be finished with all-service jacket.

D. Equipment Insulation

1. Rigid fiberglass: Recommended temperature to 450 degrees F. Fiberglass rigid board having a density of 3.0 pounds per cubic foot and a K value of 0.23 at 75 degrees F mean temperature. See schedule for facing type.

2. Flexible fiberglass: Recommended temperature to 250 degrees F with facing. Glass fibrous flexible blanket insulation having a density of 0.75 pounds per cubic foot and a K value of 0.30 at 75 degrees F mean temperature.

3. Rigid fiberglass high temperature: Recommended temperature to 850 degrees Fahrenheit. Fiberglass high temperature board having a density of 3 pounds per cubic foot and a K value of 0.30 at 200 degrees Fahrenheit mean temperature.

E. Closed-Cell Elastomeric

1. Insulation material shall be a flexible, closed-cell elastomeric insulation similar to AP Armaflex as manufactured by Armacell LLC.

2. The product shall meet the requirements as defined in ASTM C 534.

3. Insulation materials shall have a closed-cell structure to prevent moisture from wicking.

4. Insulation material shall be manufactured without the use of CFCs, HFCs or HCFCs.

5. Insulation material shall be formaldehyde free, low VOCs, fiber free, dust free and resists mold and mildew.

6. Materials shall have a flame spread index of less than 25 and a smoke-developed index of less than 50 when tested in accordance with ASTM E 84, latest revision.

7. In addition, the product, when tested, shall not melt or drip flaming particles, the flame shall not be progressive and all materials shall pass simulated end-use fire tests.

8. Materials shall have a maximum thermal conductivity of 0.27 Btu-in./h-ft2- °F at a 75°F mean temperature when tested in accordance with ASTM C 177 or ASTM C 518, latest revisions.

9. Materials shall have a maximum water vapor transmission of 0.08 perm-inches when tested in accordance with ASTM E 96, Procedure A, latest revision.

F. Insulation Facing

1. Code ASJ: All service jacket composed of high intensity white chemically treated Kraft paper reinforced with fiberglass yarn and mesh and laminated to aluminum foil with a fire retardant adhesive. Longitudinal laps and butt strips shall be a minimum of 3 inches.

2. Code FSK: Foil Scrim Kraft Laminated. 0.35 mil aluminum foil reinforced with fiberglass yarn reinforcing scrim and laminated to chemically treated fire resistive Kraft paper having a minimum 35 pound per inch width tensile strength when tested in accordance with ASTM D 828. Water vapor permeability 0.04 perms. Longitudinal laps and butt strips shall be a minimum of 3 inches.

G. Additional Insulation Jacket:

1. ADJ-1: Approximately 6 ounce per square yard glass cloth jacket with thread count of 5 strands per square inch.

2. ADJ-2: Approximately 2 ounce per square yard glass cloth jacket with a thread count of 10 strands by 10 strands per square inch. Jacket shall be used for covering pipe and pipe fittings.

3. ADJ-3a: 0.016 inch thick aluminum jacket conforming to ASTM B-209 with a 1 mil factory applied polykraft moisture barrier. Longitudinal joints shall be placed at the side of the pipe facing downward at either the 4 o'clock or 8 o'clock position so as to shed water. Aluminum fitting covers, two piece elbows, tees, valve and flange covers, etc., with a 1 mil polykraft or acrylic vapor barrier.

4. ADJ-3b: 0.020 inch thick aluminum jacket conforming to ASTM B-209 with a 3 mil factory applied polykraft moisture barrier. Longitudinal joints shall be placed at the side of the pipe facing downward at either the 4 o'clock or 8 o'clock position so as to shed water. Aluminum fitting covers, two piece elbows, tees, valve and flange covers, etc., with a 3 mil polykraft or acrylic vapor barrier.

5. ADJ-4: 20 mil PVC jacket suitable for all types of paint. Similar to Manville Zeston 25/50.

6. ADJ-5: (Not used)

7. ADJ-6 A finish jacket of an Asbestos-free and woven as high temperature, heat-resistant fabric. Lagging Cloth having a treated weight of 24 oz./sq.yd. Material shall be suitable for a sustained operation at 1100°F. Calcium silicate piping for generator exhaust piping shall also be jacketed with corrugated aluminum.

8. ADJ-7: 0.16-inch thick type T-316 stainless steel jacket. Alloys conforming to ASTM A-240. System shall have a 3-mil polykraft vapor barrier.

H. Adhesives

1. Code ADH-1: Fibrous adhesive, non-flammable, quick setting adhesive for calcium silicate. Similar to Childers CP-97, 98.

2. Code ADH-2: Fast-drying vinyl base coating and lagging adhesive. Similar to Childers CP-50A HV2.

3. Code ADH-3: Fast-drying neoprene base adhesive for lap joints of foil-faced facing

applied over pipe insulation. Similar to Childers CP-82.

4. Code ADH-4: Adhesive for use in adhering fiberglass board or blanket insulation to pipe and equipment. 3M Company Insulation Adhesive No. 35 or 38 non-flammable adhesive.

I. Caulking Components

1. Code CC-1: For use with foam glass and/or joint sealant applications. Flexible elastomeric vapor barrier sealant. Similar to Childers CP-76.

J. Mastics

1. Code MAS-1: Vapor barrier mastic made with an elastomeric resin. For indoor use. Similar to Childers CP-30.

2. Code MAS-2: A non-water vapor barrier asphaltic emulsion coating, breathing type, for above ground installations. Similar to Childers CP-10.

3. Code MAS-3: Vapor barrier mastic made with an elastomeric resin. For outdoor use.

K. Tie Wire

1. Tie wire for securing insulation in place shall be type 304 stainless steel annealed steel wire of gauge and proper spacing as recommended by the insulation manufacturer. Wire shall be drawn up tightly enough to become embedded in the insulation and the ends of the loop twisted, bent over, and pressed into the insulation so as to leave no ends protruding.

L. Banding

1. 3/8 inch x 0.02 inch type 304 stainless steel for pipe insulation.

2. 3/4 inch x 0.02 inch type 304 stainless steel for additional insulation jackets.

M. Wire Mesh

1. Wire mesh shall be one inch by No. 20 BGW hexagonal mesh galvanized.

2. Expanded metal: Expanded metal shall be 1/2 inch Hi-Rib metal lath of copper bearing steel.

N. Tape

1. Lead foil tape shall be 3M Company Lead Foil Tape No. 422, 4 mil thick, acrylic adhesive, 2 inch wide.

2. Vinyl plastic tape, silver gray, flame resistant, vapor barrier sealant tape on rigid and flexible insulation material for warm or cold air ducts. Similar to 3M Company Duct Sealing Tape No. 474.

3. Aluminum foil tape, dead soft aluminum foil, point seal on stick pin, metal patching, moisture barrier, heat reflecting and general sealing on aluminum facing foil. Similar to 3M Company Aluminum Foil Tape No. 425.

O. Staples

1. Staples shall be galvanized clad outward clinching insulation staples.

P. Insulating cement shall be a mineral-fiber (wool) ASTM C 195 base material having essentially the same insulating characteristics as the adjacent insulation. Similar to PABCO High Temperature Insulating Cement. Insulating cement shall be applied in layers to a maximum thickness of 1/2 inch at one time. Each layer shall be allowed to dry thoroughly before subsequent layers are applied.

Q. Finishing Cement

1. Finishing cement ASTM C 449 shall be diatomaceous silica thermal insulating materials with a suitable proportion of heat resistant binder, hydraulic setting insulating cement capable of withstanding maximum temperature of 700 degrees Fahrenheit. When mixed with water it shall be a plastic mix suitable for trowel applications and shall present a hard, smooth and durable surface after drying. Similar to PABCO No. 127.

R. Combination Insulating and Finishing Cement

1. Similar to Ryder One Coat or equal.

S. Welding Studs

1. Welding studs shall be capacitor type split pin or TCP tipped insulation pins with speed clips. Similar to Nelson Stud Welding Spec. 28.

PART 3 – EXECUTION

3.1 PREPARATION

A. No insulation shall be applied until the surfaces of the equipment to be insulated are thoroughly cleaned and until pipes and equipment to be insulated have been leak tested and proven tight and accepted by the Engineer.

B. Insulation shall not be applied to piping or equipment until authorization is given to the Contractor by the Engineer. Contractor shall submit a request for authorization. If any insulation is applied without first obtaining authorization, it will be the Contractor's responsibility to remove the insulation and apply it again if so directed.

C. Ensure surface is clean and dry prior to installation. Ensure insulation is dry before and during application. Finish with systems at operating conditions.

D. The execution of the insulation work shall be in strict accordance with the best practices of the trade and with the specifications.

E. The insulation shall be handled and applied in a manner that will not adversely affect its structural or insulating properties.

F. The installation instructions provided by the insulation material manufacturer of all materials specified in this Section shall be followed when installing these materials. Where the specifications are in conflict with manufacturers' instructions, such conflicts shall be brought to

the attention of the Engineer for a decision.

G. Welding operations will not be permitted on certain specific items of equipment, piping and components for the application of studs, pins, support rings, angles, etc. Contractor shall obtain permission in writing from the Engineer to perform any welding.

H. Coat to seal all insulating cement and calcium silicate surfaces with primer similar to Childers CP-53 or equal before applying any mastic coating.

3.2 PIPING INSULATION INSTALLATION

A. Ensure insulation is continuous through interior walls. Pack around pipes with fire proof self-supporting insulation material, fully sealed. Insulation on all cold surfaces where vapor barrier jackets are specified must be applied with a continuous, unbroken vapor seal. Hangers, supports, anchors, and other heat conductive parts that are secured directly to cold surfaces must be adequately insulated and vapor sealed to prevent condensation.

B. Insulate fittings, valves, unions, flanges, and strainers. Do not insulate flexible connections and expansion joints. Terminate insulation neatly with PVC or aluminum end caps.

C. Pre-molded fiberglass, or mineral wool, where specified) insulation for straight pipes shall be applied, neatly fitted around piping and sealed with adhesive ADH-3. Adhesive shall be applied to only one side of each joint and shall not be applied to the pipe surface.

D. Where two sections of pipe insulation butt together provide a 3 inch wide butt strip of same facing material as adjacent insulation facing. Adhere neatly in place using adhesive ADH-3.

E. All pipe elbows shall be insulated with short radial and mitered pieces of board or block insulation or pre-molded pieces of pipe insulation. Each piece shall be butted tightly against the adjoining piece and all joints, seams, voids and irregular surfaces shall be filled with insulating cement finished to a smooth, hard and uniform contour. Coat with MAS-1 mastic and reinforce with ADJ-2 additional jacket. In addition, place a fitted PVC cover (ADJ-4) over insulated elbow exception. Tape elbow to adjoining insulation.

F. All valves and fittings shall be insulated with pre-molded fittings, sectional pipe insulation, or blocks of the same material and thickness as used for the adjacent pipe. Flange insulation shall overlap the adjoining pipe insulation by not less than the thickness of the pipe insulation. Sectional pipe covering or block insulation shall be cut to fit, and each section butted closely to the next and held in place with tie wire.

G. Fittings on pipe lines in finished and concealed areas shall be covered with pre-molded fiberglass pipe fitting insulators Insul-Coustic or equal, where sizes are available, otherwise, use mitercut segments of molded pipe insulation, wire in place with joints and raw edges sealed with adhesive and smoothed out with a coat of insulating cement.

H. On cold pipes the fittings shall be finished with (2) coats of an approved vapor barrier mastic, reinforced with glass cloth extending 2 inches onto adjacent pipe insulation. Hot pipes shall be finished in a similar manner except the mastic need not be of the vapor barrier type.

I. Insulation shall cover the entire surface of the fittings and bodies of the valves up to and including the bonnets, and to the valve stuffing box studs, bolts, or nuts. All joints, seams, and irregular surfaces shall be filled with insulating cement. The insulated surfaces shall be covered with a 1/4 inch thick layer of finishing cement and heavily coated with vapor barrier mastic MAS-1 for cold services and mastic MAS-2 for hot services and reinforced with ADJ-2 additional jacket. Mastic shall be trowelled to a smooth and well-shaped contour compatible with adjoining

pipe insulation jackets as specified.

J. Use ADJ-4 covers over fittings and flanges everywhere except when ADJ-3a, or ADJ-3b is specified.

K. Repair separation of joints or cracking of insulation due to thermal movement or poor workmanship on all joints of all piping.

L. All instrument connections for thermometers, thermocouples, gauges, test connections, flow meters, etc., on insulated pipes, vessels, or equipment shall be insulated. The insulation shall be shaped at these connections by tapering it to and around the connection with insulating cement and finishing with finishing cement, vapor barrier adhesive, applicable mastic, or caulking compound.

M. Where removable flange and valve insulation is required or specified, installation shall conform to the following:

1. Removable flange insulation shall be made from sectional pipe insulation of the same thickness as that on the adjoining pipe or from block insulation 1/2 inch thinner than the pipe insulation and finished with insulating cement. Insulation jackets shall be the same as adjoining pipe insulation unless indicated otherwise.

2. When flange covers are made from sectional pipe insulation, they shall enclose the flanges and be long enough to extend at least 2 inches over the adjacent pipe insulation on each side of the flange. The space between the flange cover and the pipe insulation shall be filled with insulating cement. Secure the flange cover in place with stainless steel banding.

3. When flange covers are made from block insulation, they shall be made in two halves. Each half shall consist of mitered blocks wired to 1/2 inch galvanized hardware cloth mesh. This wire frame, with its attached insulation, shall then be secured to the flanges with tie wire. The insulation cover shall be long enough to extend at least 2 inches over the adjacent pipe insulation on each side of the flange. The space between the flange cover and the pipe insulation shall be filled with insulating cement. The whole flange cover assembly shall be finished with 1/2 inch of insulating cement applied in two coats. After the first coat is dry, the second coat shall be trowelled to a smooth hard finish. All surfaces shall then be finished with jackets as specified in the schedule.

4. Removable valve insulation covers shall be constructed in the same manner as for flanges with the following exception; the two part section shall be divided on the vertical center line of the valve body, bonnet, flange or joint.

5. When specified to insulate the complete valve, the hand wheel or lug wrench shall be removed to accommodate the valve bonnet box. The valve bonnet box shall be constructed in a one piece closure, one end closed, one end opened to fit up to the valve body insulation. Securing the valve and bonnet box sections, sealing and pointing of the insulation shall be done in same manner as specified for flange covers.

6. Unless indicated as removable, a permanent installation as previously specified shall be used.

7. Protect insulation on piping 2 ½” and up where supported in hangers by means of calcium silicate rigid pipe insulation or jackets. Saddles or shaped galvanized steel pieces approximately 10” long by half the circumferences of insulated pipe.

8. All piping shall have been tested and approved prior to installation of insulation.

9. All piping or surfaces where subject to condensation on the outside shall be insulated including vaporseal finish.

PART 4 – SCHEDULES

4.1 PIPING INSULATION SCHEDULE (ASJ = "All-Service-Jacket")

Service	Type Insulation and Thickness (Inches)	Facing	Additional Jacket*
LPS Steam (Up to 15 psig) Up to 1-1/2” 1-1/2” to 6” 6” & Up	Molded Fiberglass 2.5 3 3 1/2	 ASJ ASJ ASJ	
Hot Water Heating, Glycol Systems & Condensate Water (up to 200°F) Up to 2” 2 1/2” & Up	Molded Fiberglass 2 2	 ASJ ASJ	
Chilled Water Up to 2” 2 1/2” & Up	Molded Fiberglass 1 1/2 2	 ASJ ASJ	
Condenser Water (up to 100°F) Up to 12” 14” & Up	Molded Fiberglass 1 2	ASJ ASJ ASJ	
Condensation Drains & Vents, Cold Water Make-up	Molded Fiberglass 1	 ASJ	
All outdoor piping	Two times thickness scheduled		ADJ-3b
Others not scheduled	Molded Fiberglass 1	ASJ	

*Including elbows, fittings, valves, complete system.

A. Refer to jacket specifications for finish covering to be installed on calcium silicate insulation in finished areas.

B. Where "Finishing Cement" finishes are scheduled, refer to specifications for Cement herein for materials, method of application, thickness, etc.

C. Provide vapor barrier on all cold water and rainwater piping.

D. Piping exposed to weather shall be insulated with pipe insulation using double the thicknesses scheduled hereinbefore, up to 24 inches beyond the point where pipes enter the building. Provide weatherproof jacket as hereinafter specified.

E. Equipment drains and floor drains from cooling coils as well as drinking fountain waste shall be insulated 6 feet downstream from connection point.

END OF SECTION 230719

SECTION 232113 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:

1. Hot-water heating piping.
2. Air-vent piping.
3. Strainers

B. Related Sections include the following:

1. Division 23 Sections.

1.2 QUALITY ASSURANCE

A. Installer Qualifications:

B. Steel Support Welding: Qualify processes and operators according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

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 01.

E. Steel Pipe Welding:

1. Qualify processes and operators according to ASME Boiler and Pressure Vessel Code:
   Section IX, “Welding and Brazing Qualifications.”
2. Welders shall be qualified for all required pipe sizes, material, wall thickness, and

position in accordance with the American Society of Mechanical Engineering (ASME) Section IX, boiler and pressure Vessel Code

3. Copies of the certified welder qualification reports shall be maintained by the responsible welding agency and the company performing the welding, and shall be submitted to the owner and/or Inspector upon request.

4. All defective welds shall be chipped out and repaired at no cost to the Owner, based on procedure to be specified at the time.

5. The contractor shall bear the cost of re-inspection of the repaired welds and the inspection of two (2) additional welds, as selected by the owner, for each failed weld.

6. Field Procedures:

   a. Clean pipe free from rust, scale and oxide.

   b. Bevel pipe on each end per acceptable procedures.

   c. Contractor is responsible for preparation of pipe in accordance with ASME B 31.1, Chapter V and for visual inspection during the welding operation and for all required welding examinations with certified welding inspector(s), in accordance with ANSI/AWS B.1.10-86 or latest issue section 3.1, 3.1.1, 3.1.2, and 3.1.3.

F. Copper Tube Brazing

1. Qualify process and operators in accordance with ASME Boiler and Pressure Vessel
Code, Section IX, “Welding and Brazing Qualifications”

2. Brazers shall be qualified for all required tube sizes, material, wall thickness, and position in accordance with the American Society of Mechanical Engineering (ASME), Section IX, boiler and Pressure Vessel Code.

3. Brazing qualification testing shall be performed an agency/laboratory certified by ASME.

4. Copies of the certified brazer qualification reports shall be maintained by the responsible brazing agency and the company performing the brazing, and shall be submitted to the owner and/or Inspector.

5. All defective brazements shall be chipped out and repaired at no cost to the Owner, based on procedure to be specified at the time.

6. The contractor shall bear the cost of re-inspection of the repaired brazements and the inspection of two (2) additional brazements, as selected by the owner, for each failed brazement.

7. Field Procedures:

   a. Clean tubing free from surface oxidation on the O.D.
   b. Ream all tubes and remove burrs created by the cutting operation, on each end

per acceptable procedures.

c. Contractor is responsible for preparation of tubes and for visual inspection during the brazing operation in accordance with all applicable ASME, ANSI and AWS standards.

1.3 FACILITY OPERATIONS REQUIREMENTS

A. Product Data: For each type of the following:

1. Submit a schedule indicating the following:

a. System., Service, Operating temperature, Operating pressure, Pipe material, Fittings, Methods of joining, Gaskets, Specialties, Test pressure, Flange gaskets, , Fittings., Unions, Dielectric unions.

2. Valves. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.

3. Strainers

4. Air control devices.

5. Hydronic specialties.

B. Shop Drawings: Detail, at 3/8 inch scale piping layout with fittings, valves and equipment, use single line for pipe sizes 3 inches and smaller, and double line for pipe sizes 4 inches and greater. fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to the building structure. Detail location of anchors, alignment guides, and expansion joints and loops

1. Minimum 3/8 inch scale double line layout and sections where required or coordination drawings.

C. Welding certificates.

D. Qualification Data: For Installer.

E. Field quality-control test reports, Written reports of tests specified Include the following:

1. Test procedures used.

2. Test results that comply with requirements.

3. Failed test results and corrective action taken to achieve requirements.

F. Operation and Maintenance Data: For air control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 APPROVED MANUFACTURERS

REFER TO RESPECTIVE PARAGRAPHS FOR APPROVED MANUFACTURERS FOR EACH TYPE OF PIPING PRODUCT.

2.2 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tubing: ASTM B 88, Type K

B. Annealed-Temper Copper Tubing: ASTM B 88, Type K

C. Wrought-Copper Fittings: ASME B16.22.

1. 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.

D. Wrought-Copper Unions: ASME B16.22.

2.3 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; type, grade, and wall thickness as indicated in Part 3 "Piping Applications" Article.

B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in Part 3 "Piping Applications" Article.

C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in Part 3 "Piping Applications" Article.

D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in Part 3 "Piping Applications" Article.

E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced as indicated in Part 3 "Piping Applications" Article.

F. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.

G. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

1. Material Group: 1.1.

2. End Connections: Butt welding.

3. Facings: Raised face.

H. Materials and wall thicknesses as pipe in which they are installed.

2.4 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.

b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

c. For high temperature water – Klinger C4500

d. For medium temperature water - Klinger C4500

e. For chilled water systems – Klinger suitable for glycol use.

f. For hot water – Klinger C4500

g. For joints of dissimilar metals, provide isolating gaskets, sleeves and washers between flanges, bolts and nuts. Gaskets shall be similar to Dupont Teflon

B. Flange Bolts, Studs, Nuts and Washers:

1. Bolts and studs shall be chrome-molybdenum bolt stud in accordance with ASTM A 193 grade B7 with full-length threads in accordance ANSI B 31.1. Length shall be sufficient to project beyond nuts three complete threads when joint is made.

2. Nuts shall be carbon-steel in accordance with ASTM A 194 Grade 2H. Nuts shall be hexagon heavy series type. Threads shall the same as for bolts.

3. Washers shall be flat, plain, stamped, in accordance with ANSI/ASME B18.22.1.

C. Ring Spacers and Test Blanks:

1. Provide between flanges where shown on drawing or where necessary to isolate equipment from the piping system, in accordance with B3.1.1, Chapter VI, section 137.2.4. Ring spacers to be replaced by test blanks during hydrostatic testing and/or during chemical cleaning for equipment isolation.

2. Size and rating to match companion flanges.

D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.

F. 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.

1. Comply with Section II, Part C of the ASME Boiler and Pressure Vessel Code for welding materials appropriate for wall thickness and for chemical analysis of pipe being welded.

G. Crimp or press fittings shall not be used.

2.5 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper-alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. 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. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

d. Zurn Plumbing Products Group; AquaSpec Commercial Products Division.

2. Factory-fabricated union assembly, for 250-psig minimum working pressure at 180 deg F.

D. Dielectric Flanges:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Capitol Manufacturing Company.

b. Central Plastics Company.

c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

3. Factory-fabricated companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.

E. Dielectric-Flange Kits:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Advance Products & Systems, Inc.

b. Calpico, Inc.

c. Central Plastics Company.

d. Pipeline Seal and Insulator, Inc.

2. Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

3. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.

F. Dielectric Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Calpico, Inc.

b. Lochinvar Corporation.

2. Galvanized-steel coupling with inert and noncorrosive thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

G. Dielectric Nipples:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Perfection Corporation; a subsidiary of American Meter Company.

b. Precision Plumbing Products, Inc.

c. Sioux Chief Manufacturing Company, Inc.

d. Victaulic Company of America.

2. Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, and 300-psig minimum working pressure at 225 deg F.

2.6 VALVES

A. Gate, Globe, Check, Ball, safety relief and balancing Valves,: Comply with requirements specified in Division 23 Section "General-Duty Valves for HVAC Piping."

B. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Division 23 Section "Instrumentation and Control for HVAC."

2.7 AIR CONTROL DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Amtrol, Inc.

2. Bell & Gossett Domestic Pump; a division of ITT Industries.

B. Manual Air Vents:

1. Body: Bronze.

2. Internal Parts: Nonferrous.

3. Operator: Screwdriver or thumbscrew.

4. Inlet Connection: NPS 1/2.

5. Discharge Connection: NPS 1/8.

6. CWP Rating: 150 psig.

7. Maximum Operating Temperature: 225 deg F.

C. Automatic Air Vents:

1. Body: Bronze or cast iron.

2. Internal Parts: Nonferrous.

3. Operator: Noncorrosive metal float.

4. Inlet Connection: NPS 1/2.

5. Discharge Connection: NPS 1/4.

6. CWP Rating: 150 psig.

7. Maximum Operating Temperature: 240 deg F.

2.8 CHEMICAL TREATMENT

A. The HVAC Contractor shall hire the services of the building water treatment contractor and provide all required labor and materials. Provide temporary metering and mixing devices as required. The HVAC contractor shall obtain and provide all requirements from the Owner/ water treatment vendor.

2.9 HYDRONIC PIPING SPECIALTIES

A. Y-Pattern Strainers:

1. Hot Water Systems of Steel Construction:

a. Working pressure: To 250 psig, non-shock.

1) Sizes 1/4 inch to 2 inch: ANSI 250 lb. Class.

a) Connections: Threaded.

b) Body: Cast iron, ASTM A126, Class B. With machined seat for screen retention. Galvanized as required to match connecting piping.

c) Cap: Bronze, gasketed.

d) Screen: 20 mesh. 304 stainless steel, ASTM 240. Free area not less than 2-1/2 times inlet area.

e) Blowoff outlet: With female NPT tapping.

f) Mueller model No. 11 MFCB.

b. Working pressure: To 285 psig at 100 deg F ANSI Class 150 and 740 psig at 100 deg F ANSI Class 300, non-shock:

1) Sizes 1/2 inch to 12 inch:

a) Connections: Flanged or butt welded to match piping system.

b) Body: Carbon steel, ASTM A216, Grade WCB. With machined seat for screen retention.

c) Cover: Carbon steel, ASTM 215, Grade WCB. With machined seat for screen retention. With female tapped NPT blowoff connection. With non-asbestos gasket.

d) Screen: Screen to 8 inch: 1/8 inch perforations. 304 stainless steel, ASTM 240. Free area not less than 4 times inlet area.

e) Screen 10 inch and larger: 5/32 inch perforations. 304 stainless steel, ASTM 240. Free area not less than 4 times inlet area.

f) Magnets: Provide magnets for strainers. All 8 inch and larger. At each pump suction. With continuous magnetic field around entire circumference of screen. With removable cast Alnico No. 5 channel magnets with acceptable baskets constructed of magnetic alloy. Secured with stainless steel retaining lugs and threaded rods.

g) Blowoff outlet: With female NPT tapping.

h) Mueller model No. 761 for ANSI Class 150. Mueller model No. 762 for ANSI Class 300.

2. Hot Water Systems of Copper Construction:

a. Working pressure: To 250 psig, non-chock.

1) Sizes 1/4 inch to 2 inch: Class 250

a) Connections: Threaded.

b) Body: Bronze, ASTM B62. With machined seat for screen retention.

c) Cap: Bronze, ASTM B62. With machined seat for screen retention.

d) Screen: 20 mesh. 304 stainless steel, ASTM 240. Free area not less than 2-1/2 time inlet area.

e) Blowoff outlet: With female NPT tapping.

f) Mueller model No. 352M.

2.10 PIPING APPLICATIONS

A. Low Temperature Water System, IN EXCESS of 100 psig up to 300 PSIG, except as noted and 40 to 220 deg F supply temperature for hot water,

1. Material shall be steel in accordance with ASTM A 53, seamless Grades A or B.

2. Wall thickness shall be:

a. To 2 inch: Schedule 80 with threaded ends or Schedule 40 with socket weld ends.

b. 2-1/2 inch to 10 inch: Schedule 40, butt weld ends only.

3. 4 inch and smaller up to 300 PSIG and 100 deg F or 150 PSIG and 250 deg F, Type K, drawn-temper copper tubing, wrought-copper fittings, and brazed joints

4. No threaded joints are allowed in glycol systems

B. Provide dielectric fittings for connection of dissimilar metals. Use of bronze valves is not acceptable as a dielectric

2.11 VALVE APPLICATIONS

A. Install shutoff-duty valves at each branch connection to supply mains, and at supply connection to each piece of equipment.

B. Install calibrated-orifice, balancing valves at each branch connection to return main.

C. Install calibrated-orifice, balancing valves in the return pipe of each heating or cooling terminal.

2.12 FIELD QUALITY CONTROL

A. Prepare hydronic piping according to ASME B31.9 and as follows:

1. Leave joints, including welds, uninsulated and exposed for examination during test.

2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.

3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.

4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.

B. Perform the following tests on hydronic piping:

1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.

2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.

3. Isolate expansion tanks and determine that hydronic system is full of water.

4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A in ASME B31.9, "Building Services Piping." Systems less than 100 psig, hydrostatically test to 150 psig.

5. After hydrostatic test pressure has been applied for at least 4 hours, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.

6. Prepare written report of testing.

C. Perform the following before operating the system:

1. Open manual valves fully.

2. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).

3. Set temperature controls so all coils are calling for full flow.

4. Verify lubrication of motors and bearings.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping before welding.

3.2 INSTALLATION

A. Installation of Appurtenances and Sensors in Piping:

1. Provide all fittings, wells and openings required for installation of devices to indicate flow, temperature, pressure, etc., in piping systems.

B. Piping Systems - General:

1. The drawings indicate schematically the size and location of piping. Piping shall be set up and down and offset to meet field conditions and coordination between trades without additional cost. Piping shall conform to the latest revisions of ANSI/ASME B31.9 - "Building Services Piping."

2. Pipework shall conform fully to the following requirements:

3. Provide proper provision for expansion and contraction in all portions of pipework, to prevent undue strains on piping or apparatus connected therewith. Provide double swings at riser transfers and other offsets wherever possible, to take up expansion. Arrange riser branches to take up motion of riser.

4. Approved bolted, gasketed, flanges (screwed or welded) shall be installed at all apparatus and appurtenances, and wherever else required to permit easy connection and disconnection. Screwed unions with steel faces can be used on piping 1" or less.

5. All piping connections to coils and equipment shall be made with offsets provided with screwed or welded bolted flanges so arranged that the equipment can be serviced or removed without dismantling the piping.

6. If, after plant is in operation, any coils or other apparatus are stratified or air bound (by vacuum or pressure), they shall be repiped with new approved and necessary fittings, air vents, or vacuum breakers at no extra cost. If connections are concealed in furring, floors, or ceilings, this trade shall bear all expenses of tearing up and refinishing construction and finish, leaving same in as good condition as before it was disturbed.

C. All apparatus subject to high temperature differentials and high steam demand loads such as outdoor air heating coils, domestic hot water heaters and steam-water converters, shall have vacuum breakers installed.

D. Pitch water piping upward in direction of flow to ensure adequate flow without air binding, and to prevent noise and water hammer. Branch connections to mains are to be made in such a manner to prevent air trapping and permit free passage of air. To meet job conditions mains shall set up to maintain headroom, and clear other trades. Provide oversized float operated automatic air vent (with valve & strainer) at all high points particularly at the highest points of return mains and risers and high points of supply risers. Avoid 90 degree lift set-ups in supply lines by using 45 degree ells. Where 90 degree lifts exceed 12" install automatic air vent in

supply lines. All lifts in return lines shall be installed with automatic air vents. Pipe outlet of all automatic air vents to an open sight drain if the vent is concealed, or to within two feet of the floor within machine rooms.

E. Miscellaneous drains, vents and reliefs are to be provided as follows:

1. Provide 1" drain valves with caps at the heel of all interior main water risers. Provide 2" drain valves with caps at the heel of all perimeter water risers.

2. Miscellaneous drains, vents, reliefs, and overflows from tanks, equipment, piping relief valves, pumps, etc., shall be run to the nearest open sight drain or roof drain. Provide drain valves whenever required for complete drainage of piping, including the system side of all pumps.

3. Provide domestic water connections from valved outlets to any equipment requiring same.

4. Provide automatic relief valves set 50# psi below rating pressure of all hot water heating vessels on vessel or in leaving hot water line on vessel side of any valve.

5. Contractor shall cap or plug in all systems, all open ended valves for future connections, drains and vents. Also, in order to prevent a dead leg of water and consequent corrosion, provide a 1" open bypass from supply to return with balancing valve in all open condenser water systems.

F. Screwed piping shall conform to the following:

1. Pipe nipples - Any piece of pipe 3" in length and less shall be considered a nipple. All nipples with unthreaded portion 1-1/2" and less shall be extra heavy. Only shoulder nipples shall be used. No close nipples will be provided.

2. Screw threads shall be cut clean and true; screw joints made tight without caulking. No caulking will be permitted. A non-hardening lubricant will be permitted. No bushings shall be used. Reductions, otherwise causing objectionable water or air pockets, to be made with eccentric reducers or eccentric fittings. All pipe shall be reamed out after cutting to remove all burrs.

END OF SECTION 232113

SECTION 232116 – HYDRONIC PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes special-duty valves and specialties for the following:

1. Hot-water heating piping.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of the following:

1. Valves: Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.

2. Air-control devices.

3. Hydronic specialties.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air-control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Differential Pressure Meter: For each type of balancing valve and automatic flow control valve, include flowmeter, probes, hoses, flow charts, and carrying case.

1.6 QUALITY ASSURANCE

A. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

1. 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.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature unless otherwise indicated.

1. See Division 23; Section titled “Hydronic Piping” for minimum working pressures and temperature.

2.2 VALVES

A. Gate, Globe, Check, Ball, and Butterfly Valves: Comply with requirements specified in Division 23; Section titled "General-Duty Valves for HVAC Piping.”

B. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Division 23; Section titled "Instrumentation and Control for HVAC.”

C. Diaphragm-Operated Safety Valves: ASME labeled.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, the following:

a. Amtrol, Inc.

b. Armstrong Pumps, Inc.

c. Bell & Gossett Domestic Pump.

d. McDonnel and Miller.

2. Body: Bronze or brass.

3. Disc: Glass and carbon-filled PTFE.

4. Seat: Brass.

5. Stem Seals: EPDM O-rings.

6. Diaphragm: EPT.

7. Wetted, Internal Work Parts: Brass and rubber.

8. Inlet Strainer: See strainer specification in subsequent subparagraph titled “Hydronic Piping Specialties” in this Section of Division 23. Strainer removable without shutting down system.

9. Valve Seat and Stem: Noncorrosive.

10. Valve Size, Capacity, and Operating Pressure: Comply with ASME Boiler and Pressure Vessel Code: Section IV, and selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

D. Automatic Flow-Control Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, the following:

a. Flow Design Inc.

b. Griswold Controls.

c. Nexus Valve, Inc.

2. Body: ¾ to 1 ½ inch forge brass ASTM B238-06; 2 to 3 inch Cast Brass

3. Piston and Spring Assembly: Stainless steel, tamper proof, self-cleaning, and removable.

4. Combination Assemblies: Include bronze or brass-alloy ball valve.

5. Identification Tag: Marked with zone identification, valve number, and flow rate.

6. Size: Same as pipe in which installed.

7. Performance: Maintain constant flow, plus or minus 5 percent over system pressure fluctuations.

8. Minimum CWP Rating: Minimum working pressure rating equal to working pressure rating of piping system.

9. Maximum Operating Temperature: 250 deg F (121 deg C).

10. Inlet Strainer: See strainer specification in subsequent subparagraph titled “Hydronic Piping Specialties” in this Section of Division 23. Strainer removable without shutting down system.

11. End Connections: ¾” to 2½; Threaded; 3”; Flanged.

12. Ball Valve Seals: Telfon.

13. Union Seals: EPDM O-Ring.

14. Two combination Pressure/Temperature valves and manual air vent (CPTA).

2.3 AIR-CONTROL DEVICES

A. Manual Air Vents:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, the following:
    a. Amtrol, Inc.
    b. Armstrong Pumps, Inc.
    c. Bell & Gossett Domestic Pump.
    d. Nexus Valve, Inc.
    e. Taco, Inc.
2. Body: Bronze.
3. Internal Parts: Nonferrous.
4. Operator: Screwdriver or thumbscrew.
5. Inlet Connection: NPS 1/2 (DN 15).
6. Discharge Connection: NPS 1/8 (DN 6).
7. CWP Rating: Minimum working pressure rating equal to working pressure rating of piping system.
8. Maximum Operating Temperature: 225 deg F (107 deg C).

B. Automatic Air Vents:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, the following:
    a. Spirax/Srco – 13 WS.
    b. Bell & Gossett Domestic Pump #107 High Capacity Air Vent
2. Body: Bronze or cast iron.
3. Internal Parts: Nonferrous.
4. Operator: Noncorrosive metal float.
5. Inlet Connection: NPS 1/2 (DN 15).
6. Discharge Connection: NPS 1/4 (DN 8).
7. CWP Rating: 150 psig (1035 kPa).
8. Maximum Operating Temperature: 240 deg F (116 deg C).

2.4 HYDRONIC PIPING SPECIALTIES

A. Y-Pattern Strainers:

1. Body: Cast iron, bronze, semi-steel, ductile iron or malleable iron material suitable for the working pressure of piping system the strainer is installed in.

2. Bottom drain connection and Bolted Flanged Cover for access to perforated screen.

3. End Connections: Threaded ends for NPS 2½ (DN 65) and smaller; flanged ends for NPS 3 (DN 75) and larger.

4. Strainer Screen: Cylindrical or conical screens of monel or stainless steel with 1/16 inch perforation for pipe sizes NPS 3 (DN 75) and smaller and 1/8 inch perforation pipe sizes NPS 4 (DN 100) and larger.

5. Strainers 8 inch and larger shall be reinforced for the full operating conditions.

6. Working Pressure: Equal to the working pressure of piping system strainer is installed in.

7. Strainer design shall allow for blow out of strainer and screen removal without disconnecting strainer from piping system.

8. Strainer Size: equal to size of pipe strainer installed in.

9. All strainers shall be “Y” pattern installed in a horizontal or vertical downward section of pipe.

10. Manufacturer:

a. Sarco Type I t (2” and Under)

b. Sarco Type F-125 (Above 2”)

c. Mueller

PART 3 - EXECUTION

3.1 VALVE APPLICATIONS

A. Furnish and install valves shown on drawings and/or as necessary for control and easy maintenance of all piping and equipment.

B. See Division 23; Section titled “General-Duty Valves for HVAC Piping” for valve requirements.

C. Valves shall have a minimum working pressure and material as specified for the piping system installed.

D. Ball and butterfly valves shall be installed wherever possible.

E. Furnish and install shutoff duty valves to allow for removal of control valves

F. Furnish and install shutoff duty valves on the branch connection to main distribution supply piping. Supply branch piping connection is defined as a piping connection to a main distribution, supply sub-branch piping serving more than two pieces of hydronic equipment connection to a supply branch pipe or a supply vertical riser.

G. Furnish and install shutoff duty valve on the supply piping to each piece of hydronic equipment.

H. Furnish and install calibrated-orifice (shut-off/balancing) valves on the return branch connection to main distribution return piping (return branch piping connection is defined as a piping connection to a main distribution), return sub-branch piping serving more than two pieces of hydronic equipment connection to a return branch pipe and a return vertical riser.

I. Furnish and install calibrated-orifice (shutoff/balancing) valve on the return piping to each piece of hydronic equipment.

J. Furnish and install check valves at each pump discharge and elsewhere as required to control flow direction.

K. Furnish and install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; and pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.

L. Furnish and install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

3.2 STRAINER APPLICATION

A. Furnish and install strainers at the following locations

1. Inlet to each water pump.

2. Inlet to each water feeder and make-up water connection.

3. Inlet to each water regulating valve.

4. Inlet to each vent.

5. Inlet to each diaphragm valve.

6. Inlet to each control valve.

B. The intention of this specification is to protect by furnishing and installing strainers for all apparatus of an automatic character whose proper functioning would be interfered with by dirt on the seat or by scoring of the seat.

C. All strainers shall be “Y”, set in the horizontal or vertical downward run of the pipe. Where it is not feasible to install a “Y” type strainer, an enlarged-cross-section type strainer maybe used.

D. Strainers shall be so arranged as not to “trap” pipes and to facilitate disconnection and opening up
for cleaning.

E. Provide drain valve for strainers NPS 11/2 (DN 37) and larger a minimum of 6 to 12 inches below strainer. Strainers NPS 11/2 (DN 37) and smaller with capped nipples 6 inches long.

3.3 HYDRONIC SPECIALTIES INSTALLATION

A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.

B. Install automatic air vents at high points of system piping in mechanical equipment rooms only. Install manual vents at heat-transfer coils and elsewhere as required for air venting.

C. Install expansion tanks on the floor. Vent and purge air from hydronic system, and ensure that tank is properly charged with air to suit system Project requirements.

END OF SECTION 232116

SECTION 233100 – SHEET METAL WORK AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Section 230500, apply to this Section.

1.2 WORK INCLUDED

A. Furnish and install a complete system of air distribution, including accessories, to all areas indicated on the contract documents.

B. Create, coordinate and submit 3/8" scale Coordination Drawing in accordance with Section 230500.

C. Provide all ductwork, fittings and accessories to make a complete and operational system in all respects.

1.3 RELATED SECTIONS

A. Examine all drawings and criteria sheets and all other Sections of the Specifications for requirements which affect work under this Section whether or not such work is specifically mentioned in this Section.

1.4 REFERENCES

A. Applicable provisions of the following Codes and Trade Standard Publications shall apply to the work of this Section, and are hereby incorporated into, and made a part of the Contract Documents.

B. Material standards shall be as specified or detailed hereinafter and as follows:

1. ASTM A 36/A 36M – Standard Specification for Carbon Structural Steel.

2. ASTM A 1008/A 1008M – Standard Specification for Steel, Sheet, Carbon, Cold Rolled, Commercial Quality.

3. ASTM A 1011/A 1011M – Standard Specification for Steel, Carbon (0.15 Maximum, Percent), Hot-Rolled Sheet and Strip, Commercial Quality.

4. ASTM A 653/A 653M – Standard Specification for Steel Sheets, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot Dip Process.

5. ASTM A 666 – Standard Specification for Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

6. ASTM B 209 – Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

7. ASTM B 209M – Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).

8. ASTM C 443 – Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.

9. ASTM C 443M – Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets (Metric).

10. NFPA 90A – Installation of Air Conditioning and Ventilating Systems.

11. NFPA 90B – Installation of Warm Air Heating and Air Conditioning Systems.

12. NFPA 96 – Installation of Equipment for the Removal of Smoke and Grease-laden Vapors from Commercial Cooking Equipment.

13. SMACNA (LEAK) – HVAC Air Duct Leakage Test Manual.

14. SMACNA (DCS) – HVAC Duct Construction Standards – Metal and Flexible.

15. UL 181 – Factory-Made Air Ducts and Connectors.

1.5 SUBMITTALS

A. See Section 230500 and General Conditions for additional requirements.

B. Product Data: Provide data for duct materials, duct connectors and all accessories. Include sound attenuator test data in accordance with ASTM E477.

C. The Sheet Metal Contractor shall submit duct fabrication standards and methods of installation, in compliance with SMACNA and these specifications, for review and approval by the Architect, clearly indicating the combination of metal gauges and reinforcement intended for use for each pressure classification. Duct fabrication shall not be allowed until a satisfactory review of this Standard has been performed and fabrication drawings have been reviewed and coordinated. MERELY SUBMITTING COPIES OF THE SMACNA PRESSURE CLASS TABLES DOES NOT COMPLY WITH THIS REQUIREMENT.

D. Provide scaled ductwork fabrication drawings. Fabrication drawings shall be double line and as a minimum include elevations, dimensions, sizes, all offsets rises and drops, air distribution devices.

E. Provide scaled ductwork coordination drawings for all floors and systems in accordance with Section 230500, Submittals.

F. Test Reports: Indicate pressure tests performed. Include date, section tested, test pressure, and leakage rate, following SMACNA – HVAC Air Duct Leakage Test Manual.

G. Manufacturer’s Installation Instructions: Indicate special procedures for glass fiber ducts.

H. Manufacturer’s Certificate: Certify that installation of glass fiber ductwork meet or exceed recommended fabrication and installation requirements.

I. Project Record Documents: Record actual locations of ducts, duct fittings and all accessories. Record changes in fitting location and type. Show additional fittings used.

1.6 QUALITY ASSURANCE

A. All ducts and fittings shall be manufactured by a sheet metal fabrication company whose primary business experience is the manufacture of commercial and industrial quality ducts and fittings. Sheet Metal Contractor shall have adequate experience of building ductwork of the types required for this project as well as successful experience with projects of similar scope. Bids from sheet metal shops which do not meet the specified requirements shall not be acceptable.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Do not install duct sealants when temperature is less than those recommended by sealant manufacturers.

B. Maintain temperatures within acceptable range during and after installation of duct sealants.

C. Confirm duct sealant materials meet LEED requirements.

PART 2 - PRODUCTS

2.1 SHEET METAL WORK

A. General

1. Acceptable Manufacturers (Provided they are in compliance with these specifications)

a. Sheet Metal

1) All ducts and fittings shall be manufactured by a sheet metal fabrication company whose primary business experience is the manufacture of commercial and industrial quality ducts and fittings. Sheet Metal Contractor shall have adequate experience of building ductwork of the types required for this project as well as successful experience with projects of similar scope. Bids from sheet metal shops which do not meet the specified requirements shall not be acceptable.

2) All branch duct connections shall be made by clinch lock using clinch collars.

b. Sheet Metal Accessories

1) Access Doors

a) Ruskin
b) Air Balance
c) Hart and Cooly
d) Ductmate
e) Elgen

2) Flexible Connectors

a) Ventlock
b) Elgen Manufacturing
c) Duro Dyne
d) Ventglass

e) Elgen

3) Flexible Ductwork

a) Clevepak Corp.
b) Flexible Technologies
c) Unaflex Rubber Corp.
d) Flexmaster

4) Fire Dampers

a) Ruskin
b) Greenheck Fan Corp.
c) Air Balance
d) Pottorff

5) Fire/Smoke Dampers

a) Ruskin
b) Greenheck Fan Corp.
c) Air Balance
d) Pottorff

6) Smoke Dampers

a) Ruskin
b) Greenheck Fan Corp.
c) Air Balance
d) Pottorff

7) Automatic Dampers (Airfoil Blade)

a) Ruskin
b) Greenheck Fan Corp.
c) T.A. Morrison & Co. Inc. (TAMCO)
d) Air Balance
e) Pottorff

8) Balancing Dampers (OBD)

a) Ruskin
b) Greenheck Fan Corp.
c) T.A. Morrison & Co. Inc. (TAMCO)
d) Air Balance
e) Pottorff

9) Bellmouth Takeoffs

a) Buckley Bellmouth BM and BMD (with damper)

2. Unless otherwise noted, all supply, return and exhaust air ductwork of all types shall be constructed of galvanized sheet metal based on the "Pressure Class" indicated in the "Minimum SMACNA Construction Standards" table found hereinafter.

3. The drawings are diagrammatic and indicate the arrangements of the principal apparatus, ductwork and piping and shall be followed as closely as possible. Because of the scale of the drawings, it is not possible to show all offsets, rises, drops, rises, fittings, accessories, etc. The Contractor shall carefully investigate the structure, finish conditions, and the work of other trades affecting the work and arrange ductwork, piping, equipment, accessories, etc. accordingly. Provide the best possible arrangement so as to provide the maximum headroom and access to apparatus while providing the minimum resistance to airflow. This work and any extra fittings and offsets required shall be included in the project without extra charge.

4. In addition to sheet metal ductwork provided under this Contract furnish and/or install accessories and devices furnished by others, including but not limited to smoke detectors. Provide and install miscellaneous sheet metal work including safing, mixing baffles, and blank off panels at unused louver areas.

5. All duct systems specified to be installed under this Contract, shall conform to the drawings, specifications, Standards, details and recommendations of the latest edition of SMACNA "HVAC Duct Construction Standards - Metal and Flexible"; and "Round and Industrial Duct Construction Standards" (hereinafter referred to as Duct Manual). Where the building code references a specific edition of SMACNA "HVAC Duct Construction Standards - Metal and Flexible", then that edition shall be followed. Where the requirements under this Section exceed the requirements of the Duct Manual and/or SMACNA Interpretations of the Duct Manual, the specification shall govern. Wherever the word "should" appears, replace with the word "shall".

6. The Sheet Metal Contractor shall submit duct fabrication standards and methods of installation, in compliance with SMACNA and these specifications, for review and approval by the Architect, clearly indicating the combination of metal gauges and reinforcement intended for use for each pressure classification. Duct fabrication shall not be allowed until a satisfactory review of this Standard has been performed. MERELY SUBMITTING COPIES OF THE SMACNA PRESSURE CLASS TABLES DOES NOT COMPLY WITH THIS REQUIREMENT.

7. All galvanized steel sheet metal shall conform to ASTM A653/A653M (G-90), having not less than 0.90 oz. of zinc (total for both faces) per each square foot of sheet, and be of lock-forming quality. All other duct materials shall be as hereinafter specified as applicable to this Contract.

8. The Sheet Metal Contractor shall install all duct mounted smoke detectors and provide proper cross trade layout coordination to allow for appropriate service/access requirements.

9. The Sheet Metal Contractor shall furnish and install all plenums with automatic or manual dampers attached to louvers.

10. The Sheet Metal Contractor shall provide enclosures for all structural columns/cross bracing/steel beams penetrating or contained within plenums.

    a. This sheet metal enclosure shall match plenum construction for:

        1) Pressure class.
        2) Leakage class.
        3) Material.

11. There will be no supply and/or return air system ductwork internally lined, unless otherwise noted.

12. The Sheet Metal Contractor shall clean and provide temporary caps on all ductwork during installation to prevent dust, dirt and debris from entering ducts during construction, including during shipping, handling and storage in the field.

13. All shop applied fabrication labels shall be applied to the exterior of the ducts. The Sheet Metal Contractor shall remove any material applied to the inside of the ducts before installation.

14. All inline fans shall have companion flanges intake and discharge for removal for servicing.

15. Seal all joints to VAV/VCV/SAV/EV in the field, including reheat coils and sound attenuators.

2.2 DUCT CONSTRUCTION

A. Duct Construction Schedule

Minimum SMACNA Construction Standards						
Ductwork Location	**Pressure Class Inches W.G.**	**Seal Class**	**Leakage Class**	**Material**	**Sound Lining**	**Table Notes**
Supply from Air Handling units to terminal boxes	±6	A	4	G-90	No	
Within 50'-0" from Air Handling units	±6	A	4	G-90	Yes	1
Supply from terminal boxes to outlets	±2	A	4	G-90	No	
Return from Air Handling units to terminal boxes	-6	A	4	G-90	No	
Return within 50'-0" of the Air Handling units	-6	A	4	G-90	Yes	1
Return from outlets to terminal boxes	-2	A	4	G-90	No	2
Exhaust from Exhaust Air Handling units to terminal boxes	-6	A	4	G-90	No	
Exhaust within 50'-0" of the Exhaust Air Handling units	-6	A	4	G-90	Yes	1
Exhaust branch duct from the shaft to the terminal box (medium pressure)	-4	A	4	G-90	No	
Exhaust from outlets to terminal boxes	-2	A	4	G-90	No	2
Exhaust Stacks located on the exterior of the building	-6	A Welded	0.5	316L S.S.	No	
Shower exhaust	-3	A	4	Aluminum	No	
Soiled docks exhaust, isolation room exhaust	-3	A	4	G-90	No	2, 4, 5
Toilet exhaust	-3	A	4	G-90	No	2
General exhaust	-3	A	4	G-90	No	2
Other	±3	A	4	G-90	No	2

Table Notes
1 Ductwork shall be double wall with solid metal liner.
2 Ductwork in the following locations shall be constructed of aluminum or stainless steel and continuously welded (Joints & Seams) and pitched back to the outlets. · Within 20'-0" of a shower area exhaust. · Within 20'-0" downstream and 5'-0" upstream of a duct humidifier. · Within 20'-0" of a sterilizer area exhaust. 3 Within 20'-0" of a cartwasher exhaust. Pitch horizontal duct back to hood equipment where exhaust originates. 4 Sound lining shall not be provided at exhaust fans serving wet exhausts, isolation exhaust, radioactive exhaust, kitchen hood exhaust, ETO exhaust or biohazard exhaust. 5 Bubble tight dampers shall be provided as shown on the plans. · Ductwork in the following locations shall be pitched back to the outside. · Within 20'-0" of a locker room and within room (exhaust).

2.3 ADDITIONAL CONSTRUCTION REQUIREMENTS

A. Minimum Requirements

1. The minimum gauge for any steel duct shall be 24 gauge except when specified heavier.

2. The minimum gauge for black steel kitchen exhaust ductwork shall be 16 gauge.

3. The minimum gauge for stainless steel kitchen exhaust ductwork shall be 18 gauge.

4. The minimum thickness of any aluminum duct shall be 0.040".

5. The minimum diameter of any tie rod shall be 1/2".

6. The maximum tie rod spacing shall be 42" unless specifically engineered in accordance with the SMACNA Industrial Rectangular Duct Standard.

7. When tie rods intersect, they shall be welded to each other.

8. No ductwork shall be constructed to less than ±2"w.g. This means nothing is constructed to a standard between –1.99”w.g. and +1.99”w.g.

9. Duct dimensions indicated are clear inside dimensions. The sheet metal dimensions shall be increased to accommodate internal liner where liner is required.

B. All joints and seams in all ductwork and casings shall be sealed to SMACNA Seal Class “A”, and be constructed in accordance with the SMACNA Transverse Reinforced Joints details, and shall be suitable for the rated pressure and leak class classifications. In finished areas, sealing compound shall be neatly applied to exposed ductwork and bands shall be provided over, to cover the sealant.

1. Some SMACNA constructions may not be suitable for the leakage classes specified even though they may meet the pressure class and should not be used.

2. Seal class A Welded means all welded (i.e. transverse joints, longitudinal seams, spiral seams, fire dampers, volume dampers or any accessories) and in addition it means continuously welded.

3. All sealants, adhesives and coatings shall be of approved kinds and qualities for each point of application, complying with recommendations for the use and storage.

4. The method of installation and materials for sealing the ductwork shall be submitted by the Sheet Metal Contractor for review and approval by the Architect, as part of the ductwork construction standards and installation submittal.

5. All screw holes in duct shall be sealed to include, but not limited to, joints, seams, connections, strap hangers, hangers, etc.

C. All longitudinal seams in all ductwork in excess of +2”w.g. or less than -2"w.g pressure class shall be made with formed Pittsburgh locks.

D. Grooved seam/flat lock/pipe lock joining methods is restricted to 2"w.g. pressure class only.

E. Button punch-snap lock seams are not to be used.

F. Concealed stainless steel ductwork shall have an ASTM mill rolled No. 1 or No. 2 D finish. Exposed stainless steel ductwork shall have an ASTM mill rolled No. 2 B finish, or higher grade as required by the Architect, with all welds ground smooth and final brushed with stainless steel wire brushes. All welds on exposed stainless steel ductwork shall be free of stain, burn-through, or discoloration to the satisfaction of the Architect.

G. Tie rods shall not be used in any plenum or large duct requiring internal access or use as an access pathway.

H. All ductwork required to be removable shall be companion flanged SMACNA Type T-22 for ductwork constructed to SMACNA Metal Duct Standard and companion flanged in accordance with Industrial Standards for ductwork required to be constructed to Industrial Standards.

I. Elbows

1. All dust collection ductwork elbows shall be a centerline radius equal to (2) duct widths or diameters. No reduction shall be allowed.

2. Radius rectangular elbows shall be used wherever possible. Where it is impossible or impractical to install a 1.5 times width to centerline radius of elbow (full radius elbow) lesser radii configurations shall be used, each with "radius-proportional" splitter vanes permanently installed within. No radius shall be less than 1.0 times the width. Provide square elbows in rectangular ducts with double thickness vanes with a minimum radius of 4 1/2". Square elbows may only be used when radius elbows will not fit and where specifically approved by the Architect prior to fabrication and/or as required by coordination shop drawings. All offsets shall be of the radium type.

3. Round elbows shall be constructed in one of the following manners:

a. Round elbows of diameters 4” to 18” shall be Spiral Lockseam or fully welded seam. Spiral Lockseam elbows shall be equal to those manufactured by Northeastern Sheet Metal, Goffstown, NH or approved equal. Elbows larger than 18” diameter to have a fully welded seam or a gore-locked seam that should be sealed in the factory to meet ASHRAE 90.1-2010. **OR**

b. Round elbows of diameters 3" through 14" shall be 2-section stamped or pleated

elbows. Larger elbows shall be gored construction. Elbows shall be fabricated to a centerline radius of 1.5 times the diameter. All fittings seams (including gore) shall be spot-welded and sealed. All gored longitudinal seams shall be staggered. All gored elbows shall be fabricated according to the following schedule:

Elbows	# of Gores
Up to 35°	2
36° to 71°	3

J. Auxiliary Drain Pans

1. Provide 1-1/2” deep auxiliary drain pans under any units with cooling coils located above hung ceilings.
2. Pans shall be 6” larger then equipment in all directions.
3. This includes but not limited to all fan coil units.
4. Drains shall be piped to floor drains or utility sinks.
5. Drain pan slope:

    a. Pan shall slope at a minimum of 1/8 in. per foot from the horizontal towards the drain outlet.

    b. Drain pan outlet shall be at the lowest point or points of the pan with sufficient size to prevent overflow under any normal expected operating condition.

    c. Provide a seal trap in accordance with the contract detail and verify the trap will fit.

    d. Sheet Metal Contractor shall test all drain pans provided by the Sheet Metal Contractor to ensure pans are sloped towards the drain outlet. Sheet Metal Contractor shall challenge the performance of the drain pan by pouring water around the perimeter of the entire drain pan to ensure all water flows to the drain pan outlet and no puddles of water are present in the drain pan after testing is complete. This testing shall be mandatory for all drain pans fabricated and/or provided by the Sheet Metal Contractor.

K. Ducts Exposed to Weather

1. For all ducts exposed to weather, after all ducts and joints are sealed and tested as specified herein, apply all over and around the same areas of possible leakage (joints), an approved sealer system, so that ductwork outside the building shall be installed in a manner to result in less than 0.5 leakage class.
2. Exposed ductwork shall be insulated and weather-protected by the Insulation Contractor after the installation is completed and tested.

L. Provide baffles and/or diffusion plates as required in all air handling units, to ensure proper air mixing, coil velocities and air distribution across filters or coils as determined in the field by the Architect, at no additional cost to the Owner.

M. It is the intent of this specification to provide a duct system with minimum resistance to airflow. All take-offs shall be throated and transitions made as gradually as possible. "Bullhead" or sharp take-offs shall not be acceptable.

N. In addition to SMACNA requirements, ductwork in return systems without boxes, ductwork in supply systems without boxes, ductwork in exhaust systems without boxes, ductwork in any Constant Volume System and/or ductwork downstream of VAV, supply, return or exhaust boxes or valves shall be provided with:

1. Volume dampers in all branch takeoffs and in all main branches and ducts of all ductwork systems (supply, return and exhaust) for properly regulating and balancing airflow to all terminal outlets, for all duct sizes, whether shown on the drawings or not. **The above requirement is mandatory.**

a. Provide manual adjustable rectangular opposed blade dampers with factory installed locking hand quadrants extended 2" for all dampers installed in externally insulated duct. Dampers shall be manufactured approximately 5/16" smaller in width and 1/8" smaller in height than size of duct in which they are installed; e.g., nominal damper size is 24" x 10", actual size is approximately 23-11/16" x 9-7/8".

b. Damper frame shall be constructed of galvanized steel reinforced channel with minimum thickness of 20 ga. Opposed damper blades shall be minimum 20 ga. galvanized steel with reinforcing ribs. Each blade shall be supported in the damper frame by individual Teflon axle bearings, and shall be driven by stainless steel connecting slide linkage controlled by 3/8" or ½" square steel control shaft, depending upon duct pressure classification and damper size. When installed in stainless steel duct systems, the dampers shall be constructed of all stainless steel components.

c. All manual volume dampers handles shall be flagged with brightly colored ribbon tape, extending a minimum of 6" down from the handle, to enhance visibility. Ribbons shall not be installed in areas without ceilings.

2. Volume dampers shall be provided upstream for all Air Terminal Boxes and Exhaust/Supply venturi valves where excessive system pressure is greater than exceeds the range of the equipment and/or associated controls operating limits.

3. Where dampers are located in inaccessible locations, provide dampers with a means for remote adjustment

a. All balancing dampers that are:

1) Inaccessible for adjustment, including those isolated by mechanical obstructions (e.g. piping, conduit, cable trays, other ductwork, etc.).
2) Above drywall ceilings
3) Above plaster ceilings
4) Where specified
5) Where noted on the drawings.

O. All rectangular dampers shall be opposed blade and each shall be controlled by an approved galvanized locking quadrant indicating the damper position, as detailed on the drawings.

1. Volume dampers installed into ductwork that is specified to be externally insulated shall have extended activator/handle rods with extension bracket such that adjustment of the damper handle will not disturb the insulation.

P. Submit the sheet metal shop drawings to the Balancing Contractor of the project for his review and placement of dampers with the final balancing procedures and requirements in mind.

1. Coordinate the location and areas with the Balancing Contractor, and fabricate the ductwork system accordingly.

2. Provide any and all balancing dampers required by the balancing contractor at no additional cost.

Q. In addition to SMACNA requirements, all round ductwork, if used in lieu of rectangular supply and/or return/exhaust systems shall conform to SMACNA.

1. Round duct shall be manufactured of spiral lock seam. Ductwork up to 12"ø and 2" w.g. pressure class can be manufactured with longitudinal lock seams. All fittings seams shall be continuously-welded or spot-welded and sealed All tees shall be conical.

2. All laterals shall be straight.

3. All taps through 10" diameter in size shall have a machine drawn entrance and all fittings shall have longitudinal seams, continuously-welded, or spot-welded and continuously sealed. Both sides of all welds shall be primed with zinc chromate.

4. All tap entrances shall be free of weld build-up.

5. Round elbows shall be constructed in one of the following manners:

   a. Round elbows of diameters 4” to 18” shall be Spiral Lockseam or fully welded seam. Spiral Lockseam elbows shall be equal to those manufactured by Northeastern Sheet Metal, Goffstown, NH or approved equal. Elbows larger than 18” diameter to have a fully welded seam or a gore-locked seam that should be sealed in the factory to meet ASHRAE 90.1-2010. **OR**

   b. Round elbows of diameters 3" through 14" shall be 2-section stamped or pleated elbows. Larger elbows shall be gored construction. Elbows shall be fabricated to a centerline radius of 1.5 times the diameter. All fittings seams (including gore) shall be continuously-welded, or spot-welded and sealed. All gored longitudinal seams shall be staggered. All gored elbows shall be fabricated according to the following schedule:

Elbows	# of Gores
Up to 35°	2
36° to 71°	3
Over 71°	5

6. All field joints in diameters through 48" shall be made with a 2" long slip-fit or sleeve coupling provided assembly is not hindered. Ductwork over 48", and for all sizes where disassembly and removal is required, shall be joined with Vanstone or shop fabricated flanges.

7. All flanges and taps into spiral ducts shall be factory or shop fabricated and installed as hereinbefore specified. Shipment of loose flanges or taps for field installation shall be avoided.

8. All access doors for round duct shall be furnished by the access door manufacturer. Round duct access doors shall be of low leakage sandwich type suitable for systems up to 8” pressure, positive or negative. Round duct access doors shall be insulated and shall be equivalent to Ruskin model ARDD.

9. Unless specifically noted otherwise or required by special constraints, all elbows on ductwork changing direction from vertical to horizontal shall be 1.5 times radius.

2.4 SPECIAL EXHAUST SYSTEMS SHOP APPLIED DUCT LINER

A. Interior supply and return ducts and plenums (other than outside air plenums), as hereinbefore specified to have internal duct insulation shall be lined with 1" thick fiberglass duct liner equal to Manville Permacote Linacoustic R300.

B. Liner shall meet the requirements of UL 181, ASTM C665 Bacteriological Standards, UL 723 Flamespread and NFPA 90A for flamespread and smoke developed ratings as borne out by tests and ratings of UL. Liner shall have an NRC no less than 0.80, based on Type A mounting as tested in accordance with ASTM C423-90 "k" factor not to exceed 0.25 (1") at 75°F mean temperature in accordance with ASTM C-518.

C. Maximum air friction in straight 24" diameter duct conveying 6200 cfm airflow at 2000 fpm velocity shall be 0.36" per 100'-0"

D. No erosion of insulation material shall occur below 5000 fpm duct velocity. Rigid board liner shall be constructed of strong glass fibers bonded with thermosetting resin.

E. All surfaces shall be protected with an acrylic coating.

F. Liner shall be applied with 100% coverage of approved fire resistant adhesive. Ducts over 20" in size in any direction shall be secured with mechanical fasteners ("stick-clips") on 12" centers and within 3" of ends.

G. Leading and exposed edges of liner joints shall be coated with fire resistant adhesive. Permacote-coated surface shall face the airstream.

H. The ductwork system shall be lined/sealed and installed in a manner to allow for low temperature air operation.

I. Care shall be exercised to ensure that no gaps or bare sheet metal exist, which might create condensation.

J. Acoustical liner installed in medium pressure ductwork and wherever lining starts abruptly from unlined ductwork shall be "nosed" with sheet metal flanging at all joints in accordance with SMACNA liner nosing details.

K. Liner shall be coated with a surface coating that does not support the growth of fungus or bacteria as determined by tests in accordance with ASTM C1071 and ASTM G21 and G22. Liner shall be sound absorptive.

L. The smooth black surface of the liner shall face the airstream and top pieces shall support the side pieces.

M. Lining on double wall duct systems may be completely covered with a layer of perforated minimum 24 gauge sheet metal (3/16 sq.in. holes on 7/16" staggered centers). The perforated sheet metal inner liner shall be secured with rivets and washers at intermediary points maximum 12" on center on all spans greater than 12" in width or height. Sheet metal nosing shall be provided to cover all insulation exposed-to-airstream edges, by bending of the sheet metal liner. Other methods of nosing, if different than the one specified, shall be submitted for review by the Architect prior to installation.

2.5 ACCESS DOORS

A. Provide access doors and frames in all supply, exhaust and return ductwork as required, to permit access to:

1. Automatic dampers
2. In-box heating coils
3. Fire dampers
4. In-duct coils
5. All plenums
6. In-duct humidifiers
    a. Provide sight doors
7. Other similar equipment
8. Fan Bearings enclosed in ducts.
9. Duct smoke Detectors
    a. Provide sight doors
10. For cleaning and inspection purposes
11. Where indicated on the drawings

B. Door Size

1. Ductwork
    a. Minimum 16” x 12”
    b. In ducts smaller than 12”, they shall be 10” x 6” less than duct width except:
        1) Terminal Box heating coil door may be 10” x 6”
    c. Vacuum cleaning access door shall be 12” round.
2. Plenums
    a. Shall be 20” x 56”
        1) 18” x 45” door may be used only when 20” x 56” will not fit.
    b. Larger door shall be provided if required for equipment removal. Coordinate with equipment.

C. Door Construction

1. Doors shall match material type and gauge of the duct system in which they are installed. This includes hardware such as bolts.

2. Minimum gauge shall be 20.

3. Pressure tested to ±15”w.c.

   a. Leakage shall be zero at ±10”w.g.

4. Provide a neoprene gasketed around their entire perimeter.

5. Where sight doors are required, a wire reinforced safety glass shall be utilized.

   a. All humidifiers

6. Insulated or lined ductwork shall have insulated door

7. Insulated plenums shall have insulated door

8. Insulated doors shall be double wall.

9. Insulation between the metal panels shall be of the same thickness as the duct or panel adjacent to the access doors.

10. Plenum access doors shall be hung on heavy hinges and shall be secured in the closed position by means of latches.

11. Ductwork access doors shall be clamp type with a retaining chain or cable.

12. Ductwork access doors shall be similar to Ductmate Sandwich access door.

13. All plenum hinge doors shall be submitted with test (provide E leakage) data before approval.

14. All fire damper access doors in all positive pressure supply ductwork of +3"w.g. or greater construction:

    a. Shall be of the pressure relief (negative pressure) spring loaded type. Design shall incorporate self-closing spring latch or be complete with secure retainer chain and "D" handle.

    b. These doors shall be mounted downstream (after shutoff) of fire dampers, fire/smoke dampers or smoke dampers or similar automatic shutting devices.

    c. These doors shall be of the automatic reset type and similar to Ruskin model ADHP-3.

2.6 FLEXIBLE CONNECTIONS (AHUS, EMERGENCY GENERATORS, FANS)

A. Provide flexible connections of 4" minimum fabric width

1. Between ductwork and the inlets and outlets of all fans **except**:

a. Hazardous exhausts
b. Lab exhaust fans located indoors.

2. Equipment equipped with fans

3. All ductwork that crosses building expansion joints

B. The connections shall be placed as close to the equipment as practical except at fan suction connections and the clear gap at rest shall be not less than 3". At fan suction connections, locate flexible duct connection at least 3 duct diameters away from fan inlet connection.

C. There shall be no tension of the fabric under static or dynamic loads

D. All fabric for flexible duct connections to equipment shall be a minimum of 22 oz. glass fabric, double coated with neoprene, fire retardant, waterproof, airtight, and approved by UL, similar to Ventfabrics or Ventglass.

E. Exterior flexible connection shall be insulated type similar to Duro Dyne.

F. Flexible connections shall be fabricated from approved flameproofed fabric conforming to NFPA 90A. Asbestos shall not be acceptable.

G. Flexible connections shall be installed further upstream from fan powered equipment (in the main duct size) to prevent obstruction of the fan inlet due to suction of the fabric into the airstream.

H. Ductwork shall be increased in size where the flexible connections are located to prevent fully drawn in connections from blocking any duct area. Submit detail for review.

2.7 BLANK OFF PANELS FOR UNUSED LOUVER AREAS (Not used)

2.8 FLEXIBLE DUCTWORK (Not used)

2.9 DAMPERS

A. General

1. The minimum damper requirements shall be as indicated in the following table:

Damper Construction Table					
Type	**Approach Velocity (FPM)**	**Pressure Rating**	**UL555S Leakage Class**	**Blade Type**	**Listing**
Fire dampers in ducts greater than +2" w.g. or less than -2" w.g. (FD)	2,000	4”w.g.	N/A	OBD 3V	UL555 Dynamic
Other fire dampers (FD)	2,000	4"w.g.	N/A	Curtain or OBD	UL555 Dynamic
Fire smoke dampers in ducts greater than +2" w.g. or less than -2" w.g. and at all shafts (FSD)	3,000	4"w.g.	I	Air Foil	UL555, UL555S Dynamic
Other fire smoke dampers (FSD or HFD)	2,000	4"w.g.	I	OBD 3V	UL555, UL555S Dynamic
Smoke dampers (SD)	3,000	4"w .g.	I	Air Foil	UL555S Dynamic
Isolation dampers (at units)	4,500	8"w .g.	I	Air Foil	
Automatic dampers (AD)	4,500	6"w .g.	I	Air Foil	N/A
Balancing dampers in ducts wider than 48" and/or deeper than 12" (VD or as specified)	2,500	4"w .g.	N/A	OBD	N/A
Balancing damper in ducts less than 48" by 12" (VD or as specified)	2,500	2”	N/A	OBD	N/A
Smoke control damper (SCD)	3,000	4"		OBD	UL555S Dynamic

2. Dampers in stainless steel ducts shall be stainless steel.

3. Automatic dampers in aluminum duct shall be aluminum construction.

4. All curtain type fire damper assemblies shall be 100% face area type with the blade package and all frame components out of the air stream.

B. Automatic Dampers

1. See Automatic Temperature Control Specification.

C. Fire Dampers, Ceiling Radiation Dampers, Smoke Dampers, and Combination Smoke/Fire Dampers

1. Fire dampers, smoke dampers and combination smoke/fire dampers shall be provided as shown on the drawings and wherever Architectural drawings indicate fire and/or smoke rated partitions. Devices shall be of the appropriate service for the partition class into which they are installed. Exact requirements and type of partition shall be coordinated with the

Architect.

2. All dampers shall meet the requirements of NFPA 90A and further shall be tested, rated and labeled in accordance with UL 555 (7th Edition), UL555S (4th Edition) and UL555C (3rd Edition).

   a. All dampers shall be field tested upon the completion of installation as required per NFPA 90 A, NFPA 80 and NFPA 105 (latest editions).

   b. All damper testing shall be documented as outlined per the above NFPA references and submitted to the Architect/Engineer for review prior to project closeout.

   c. All damper testing documentation shall be submitted as part of the project closeout for Owner record.

3. All dampers shall be tested, rated and labeled as "Dynamic Rated" for closure against airflow in the following configuration:

   a. Vertical mount (horizontal airflow): Ducted and unducted.
   b. Horizontal mount (airflow up): Ducted and unducted.
   c. Horizontal mount (airflow down): Ducted and unducted.

   Note: Static rated dampers shall not be allowed.

4. Each damper shall be rated to close against maximum design airflow at its installed location, with 400 fpm and .5”w.g. safety factors and against 4"w.g. maximum pressure across the closed damper.

5. All dampers shall include the required oversize enclosures which shall be sealed by the damper manufacturer for the appropriate duct pressure class into which they are installed. All such dampers shall have appropriate rectangular, flat oval or round duct collars to facilitate connection of mating ductwork. The Contractor shall be responsible for any additional sealing of duct collars and connections required to maintain the duct seal class requirements but shall not jeopardize the UL breakaway connection when utilized.

6. The Contractor shall indicate the location and rating of all dampers on his shop drawings and shall provide access doors at each location of sufficient size and type to permit access to the damper components. A detailed list of fire dampers, smoke dampers and fire/smoke dampers shall be included as part of the shop drawing/submittal process for review. The list shall include damper size, damper type, location, material, rating, access door size, velocity, pressure drop, etc. The Contractor shall be solely responsible to coordinate all locations of duct access doors and dampers of all types. All duct access doors for all dampers shall be labeled in accordance with the herewith in NFPA references.

7. Contractor shall include damper manufacturer's installation instructions as part of the damper submittal. These instructions shall describe the applicable requirements for damper sleeve thickness; retaining angles; sealing; duct-to-sleeve connections; preparation of wall, floor or ceiling openings; and all other requirements to provide an installation equivalent to that tested by the damper manufacturer during the UL 555, UL555S and UL555C qualification procedures. Contractor shall detail any proposed installations that deviate from these manufacturer's instructions and explain the needed deviations. All fire, smoke and ceiling radiation damper installations shall comply with the manufacturer's installation instructions. Any submitted deviations must be acceptable to the appropriate authority having jurisdiction.

8. Fire Dampers

a. Fire dampers shall be provided as shown on the drawings and wherever Architectural drawings indicate fire-rated partitions to the following schedule:

Partition Assembly Fire Rating	Penetration Type	Damper Rating
1 Hour	Continuously ducted and sprinklered with ducted steel sheet metal, with all portions of sheet metal not thinner than 26 ga steel, is not constructed of non-steel materials (i.e. aluminum), nor, has any portion of the entire duct system constructed of flexible ductwork.	No damper required; duct sleeved and packed with fireproofing only at the fire-rated assembly.
1 Hour	Ducted and Non-Sprinklered	1.5 Hour
1 Hour	Open (Transfer) or open-ended above the ceiling (termination not made with a register/diffuser)	1.5 Hour
1 Hour	Ducted steel sheet metal with any portion of sheet metal that is thinner than 26 ga steel; or, is constructed of non-steel materials; or, has any portion of the entire duct system constructed of flexible ductwork.	1.5 Hour
1.5 to 2 Hours	Ducted or Open	1.5 Hour
3 Hour	Ducted *	3.0 Hour
4 Hour	Ducted *	3.0 Hour
*No open transfer will be permitted through these partitions.		

b. Fire damper sleeves shall be manufactured with a metal sleeve of appropriate length and thickness for the required damper installation as shown in the table below:

Maximum Duct I.D.	Sleeve Gauge (U.S.)
Up to 84”	20 gauge
85” & Up	18 gauge

c. Heat Release temperature rating for all fire dampers shall be 212°F or 50°F above the highest system temperature, whichever is greater.

d. Dampers in stainless steel ducts shall be stainless steel.

e. Dampers located in welded systems shall be rigidly connected with welded connections (not breakaway). Damper size and metal thickness must be confirmed per the manufacturer to coordinate with the rigid welded connection requirements.

f. Large fire dampers may require motor operator to comply with code if this is required. Mechanical Contractor shall provide power and connections from electrical panel.

9. Smoke Dampers and Combination Fire/Smoke Dampers

a. Smoke dampers and combination fire/smoke dampers shall be provided as shown on the drawings and wherever architectural drawings indicate smoke/fire rated partitions. Combination fire/smoke dampers shall be dynamically rated for 1.5 or 3 hours as determined by the Architect.

b. Smoke dampers and combination fire/smoke dampers and actuators shall meet the requirements of NFPA 92A and NFPA 92B and further shall be tested, rated and labeled as a "Leakage Rated Damper for Use in Smoke Control Systems" in accordance with the 4th edition of UL 555S. All smoke dampers shall be of low leakage design qualified to UL 555S Leakage Class I (8 cfm/sq. ft. at 4"w.g.) and shall have a UL 555S elevated temperature rating of 350°F.

1) Each smoke damper/actuator combination shall be UL 555S rated to operate at maximum design airflow at its installed location with 400 fpm and .5”w.g. safety factors.

2) Each smoke damper and combination assembly shall bare an AMCA certification.

c. Each smoke damper and combination fire/smoke damper shall be supplied with an appropriate damper actuator installed by the damper manufacturer at the time of damper fabrication. Combination fire/smoke dampers shall be manufactured with a metal sleeve of appropriate length and thickness for the required damper installation, and the damper actuator shall be installed on the sleeve exterior. Smoke dampers may be installed in ductwork up to 24” from wall with no openings between the wall and the smoke damper.

1) Damper actuators shall be electric type for 120 volt operation.

2) Power wiring, including interlocking to smoke detectors and fire alarm system, and panels to affect the sequence of operation shall be by the Electrical Contractor.

3) Dampers shall be fail closed as follows:

a) Power to Damper: Open
b) No Power to Damper: Closed

d. Damper frame shall be galvanized steel formed into a structural hat channel shape with reinforced corners. The smoke and combination fire/smoke damper blades shall be airfoil type with Class 1 leakage rating. Bearings shall be stainless steel sleeve turning in an extruded hole in the frame. Blade edge seals shall be silicone rubber designed to withstand 450ºF (232ºC) and jamb seals shall be stainless steel flexible metal compression type.

e. Each combination fire/smoke damper shall also be equipped with a temperature limited re-openable feature equivalent to Greenheck model TOR providing the following operational sequence:

1) Temperature at damper heat release reaches 165°F or 50°F above highest system temperature, whichever is greatest, and primary heat sensing device closes damper. Remote or local override command panel can then re-open damper.

2) If temperature at damper heat release reaches 350°F, secondary heat sensing device will close the damper. Override and re-opening above this secondary temperature is not permitted. Both primary and secondary heat responsive devices shall incorporate a manual reset feature allowing restoration of normal operation after fire emergency has been cleared.

f. If utilizing system operation for smoke control purposes during the early phase of a fire emergency, each combination fire/smoke damper shall be equipped with a 212°F primary heat release and 350°F minimum rated damper actuator.

g. Dampers in stainless steel ducts shall be stainless steel.

h. Dampers located in welded systems shall be rigidly connected with welded connections (not breakaway). Damper size and metal thickness must be confirmed per the manufacturer to coordinate with the rigid welded connection requirements.

10. Smoke Isolation Dampers at Air Handling Units

a. Provide smoke isolation dampers at air handling units as shown on drawings. Smoke isolation dampers shall comply with NFPA 90A, UL 555S and the aforementioned requirements with a minimum of (1) actuator for every 16 sq. ft. of damper or portion thereof.

11. Smoke Control Dampers shall be the same as specified for smoke dampers.

12. All fire/smoke damper access doors in all positive pressure supply ductwork of +3"w.g. or greater construction:

a. Shall be of the pressure relief (negative pressure) spring loaded type. Design shall incorporate self-closing spring latch or be complete with secure retainer chain and "D" handle.

b. These doors shall be mounted downstream (after shutoff) of fire dampers, fire/smoke dampers or smoke dampers or similar automatic shutting devices.

Device	Furnished By	Installed By	Actuator By	Actuator Type	End Switches	Control Wires	Power	UL Assembly
Motorized Damper (MD)	Div. 23	Div. 23	Div. 23	Electric	Div. 23	N/A	Div. 26	No
Fire Smoke Damper (FSD)	Div. 23	Div. 23	Damper Manufacturer	Electric	Damper Manufacturer	Div. 28	Div. 26	Yes
Smoke Damper (SD)	Div. 23	Div. 23	Damper Manufacturer	Electric	Damper Manufacturer	Div. 28	Div. 26	Yes
Smoke Dampers in or at AHUs (SD)	Div. 23	Div. 23	Damper Manufacturer	Electric	Damper Manufacturer	Div. 28	Div. 26	Yes
Fire Damper (FD)	Div. 23	Div. 23	N/A	N/A	N/A	N/A	N/A	Yes

PART 3 - EXECUTION

3.1 SHEET METAL INSTALLATION

A. All ductwork shall be installed to true alignment, generally parallel or perpendicular to adjacent building walls, floors and ceilings, so as to present a neat and workmanlike appearance. All fabricated, stored and installed ductwork shall be protected with removable caps, plastic or other means to prevent dirt, water and debris from entering duct system. The Sheet Metal Contractor shall be responsible for maintaining a clean duct system and shall clean and/or replace any ductwork identified by the Owner or Architect as being deficient or dirty. The Sheet Metal Contractor shall be responsible for all costs associated with the temporary protection cleaning and/or replacement of ductwork. All fabrication labels shall be applied to the exterior of the duct. The Sheet Metal Contractor shall be responsible for the removal of all internal labels if such labels were incorrectly applied.

B. Care shall be paid to the exact locations of all sheet metal work with respect to equipment, ducts, conduits, piping, slabs, beams, columns, ceiling suspension systems, lighting fixtures and electrical, plumbing and fire protection systems in the building. Close coordination and cooperation shall be exercised with other Trades in locating the piping and equipment in the best interests of the Owner. The drawings and specifications covering other work to be done in the building shall be carefully studied and arrangements shall be made to avoid conflict.

C. The drawings shall be followed where theyare definite and provided such procedures do not cause objectionable conditions for equipment provided installed under this Contract. The drawings are intended to indicate the sizes of ductwork and if certain sizes are omitted or unclear, obtain additional information before proceeding.

D. Locate and size all openings for ductwork in the building construction. Provide all sleeves as hereinbefore specified.

E. Provide access doors in ductwork at the following locations:

1. Both sides of all coils
2. Fire dampers
3. Smoke dampers
4. Fire/Smoke dampers

5. Both sides of automatic dampers
6. Humidifiers
7. Both sides of filters
8. At a maximum of 20'-0" and at every change in direction in kitchen exhaust system and/or as required by code.
9. At all exhaust and intake plenums, doors shall allow full body access in all plenums over 4'-0" tall.
10. Otherwise indicated or specified

F. Provide labels with a minimum of 1" high red letters on white background. Each access door shall be labeled as follows (or worded as required by Code):

1. Fire Damper
2. Fire/Smoke Damper
3. Smoke Damper
4. Kitchen Exhaust Cleanout - Keep Access Clear
5. Automatic Damper
6. Humidifier
7. Filter Access
8. Coil Access

G. The installation of special items of equipment in the duct systems, including automatic dampers, thermostats, thermometers, duct airflow measuring devices and other related controls, shall be done by this Contractor under the direct supervision of the manufacturer of such controls.

H. All elbows, tees and branch takeoffs in round ductwork shall be made of the same materials as the ductwork.

I. Duct connections to equipment shall be in no case smaller than the equipment openings.

J. All openings for pitot tube traverses shall be fitted with neat removable plugs or caps. As a minimum, such openings shall be provided at every fan inlet and at such other points as may be required for airflow measuring and balancing. Coordinate the location of plugs and caps with the Balancing Contractor.

K. All internally lined duct sections and joints shall be closely inspected by the contractor before and after each piece is erected. Loose edges, open joints, damaged areas and other defects shall be sealed securely so as to insulate all metal surfaces and so as to endure without falling in the presence of moving air. All liner applications shall comply with SMACNA "Duct Liner Application Standard".

L. Provide other miscellaneous sheet metal work shown on the drawings including blanking off portions of louvers not required for the specific usage and diffusion plates or mixing air scoops to allow for air mixing where job conditions require the provision of same. All above work shall be provided as part of this Contract at no extra cost to the Owner.

M. Where applicable and as approved by the Architect, all exposed ductwork shall be installed in a workmanlike manner to result in a neat appearance with no visible penetrations, screws, or other sheet metal imperfections.

N. Install all UL classified devices in accordance with their UL approved installation sheets.

O. Counterflashing of duct penetrations through roof shall be provided under this Contract.

3.2 DUCT HANGERS AND SUPPORTS

A. Provide suitable angle iron/strap hangers and supports inside the mechanical shafts, mechanical rooms and in ceilings of the buildings, and on the roof(s) as shown on the drawings (Architectural/HVAC). This work shall be performed as required by job conditions and as instructed by the Architect in the field to support all air distribution ductwork and devices in both horizontal and vertical planes.

B. When hanging and supporting the ductwork, the following shall be complied with:

1. Except as otherwise noted, ductwork up to 42" in greatest dimension shall be hung by using sheet metal bands secured as a minimum at (2) locations to the vertical sides of the ductwork and at (1) location under the duct. All support systems shall be compatible with the building structure and roofing system as approved by the Architect.

2. Where ductwork major axis dimension is larger than 42", ductwork shall be hung by using rods of not less than 3/8" soft steel secured to angle iron/unistrut trapeze support frame around ductwork with threaded nuts for securement and adjustment. All rods used on ductwork exposed in finished spaces shall be plain smooth rods threaded only at the ends

3. Round low pressure ductwork (2” pressure class) sizes 10” and smaller may be supported with Gripple cable hanging duct support system, or approved equal. Cable hangers shall be spaced as required by the support system manufacturer, but no further apart than 6’-0”

4. Ductwork shall be securely attached to the building construction. The hanger design and spacing shall be governed by the major duct dimension and shall be in accordance with SMACNA Duct Manual, except as modified hereinbefore. Vertical ductwork shall be supported at each floor level in an approved manner using angles or channels attached to the ducts. The installation, when complete and under operating conditions, shall be free from chatter or vibration. If necessary to achieve this, additional supports and/or bracing shall be furnished without extra cost to the Owner. Supports and bars and similar items shall be primed and painted structural steel. Touch up with aluminum paint any surfaces where galvanizing is destroyed on indoor ductwork, zinc primer on exposed ductwork with a final coat of aluminum paint. Provide vibration isolation hangers where specified under Vibration Isolation Section of these specifications. Explosive powder studs or detonator assisted studs or anchors will not be permitted.

5. The Sheet Metal Contractor shall provide all supplemental steel required to support the ductwork in shafts, mechanical rooms or on the floor where structural steel is not properly positioned. Beam clamps shall be double sided.

6. The maximum hanger spacing shall be 10'-0" on centers and additionally on each side of an elbow or change-in-direction fitting.

7. In addition to the above, provide supports on each side of any duct mounted device, fans, coils, flow measuring stations, framed dampers, etc., to permit removal of the device without disconnecting adjacent duct sections.

8. Provide angle sway bracing to the structure wherever lateral loads would be imposed on the ductwork, including but not limited to:

a. Elbows downstream of fan discharges.
b. Ductwork exposed to the weather subject to wind loads.

9. Ductwork mounted on the roof or otherwise exposed to the elements shall be supported with frames constructed of galvanized steel angles and channels regardless of duct size.

    a. Coordinate all roof supports with General Contractor/Construction Manager.

    b. Provide diagonal cross bracing between supports as required to sustain maximum area wind loads as dictated by the Architect.

    c. Refer to Specification Section 230548 for vibration and seismic restraint requirements.

10. The Sheet Metal Contractor shall provide expansion compensators, anchors and guides on all high temperature ductwork (breeching, high temperature supply/exhaust) as required.

3.3 SHEETMETAL TESTING

A. General

1. All ductwork that is required to be tested shall be tested on regular intervals as the job proceeds and shall be completed prior to enclosure in shafts, above ceilings or behind walls.

2. The Sheet Metal Contractor shall keep an up-to-date log of the ductwork tested for review by the Architect. The test records shall include marked drawings showing the system/area tested. The testing system/area shall be designated with unique naming. Testing documentation shall include pressure class, system, dates, calculations, allowable leakage, tested leakage and signatures. Testing results shall be Pass or Fail. The Sheet Metal Contractor shall notify all other Contractors when the testing is completed and accepted to permit enclosure of ducts. All test documentation shall be submitted as part of the project close out documentation package.

3. The Sheet Metal Contractor shall furnish and install all blank off plates, blind flanges, safing, etc., necessary to isolate each section of duct being tested for leakage.

4. The Sheet Metal Contractor shall submit for review all proposed testing procedures, sample report, and equipment to the Engineer prior to proceeding. Additionally, the Sheet Metal Contractor shall notify the Engineer when testing is to occur so that the test can be witnessed at the Engineer's option.

5. All test equipment shall be calibrated per ANSI Standards prior to testing. Certified test reports shall be submitted to the Architect prior to commencement of the testing.

6. Testing Procedure

    a. The testing procedure shall be in accordance with SMACNA "HVAC Air Duct Leakage Test Manual".

    b. The test pressure shall be the specified construction pressure of the duct system.

7. Scope of Testing

    a. All ductwork (regardless of pressure class) that will be in inaccessible areas including, but not limited to, all ducts within shafts, above hard ceilings, and those that will be made inaccessible by the work of other Trades. (This shall include ±2"w.g. construction.)

b. All ductwork constructed to greater than +2"w.g. or less than -2"w.g.

c. All other sheet metal in duct systems constructed to ±2"w.g. shall be tested under normal fan pressure and shall not leak sufficiently to cause audible leaks or blowing detectable by hand. If, in the opinion of the Architect, the ductwork does not appear to be constructed and/or sealed to the approved shop standards, the Architect may request any or all of this ductwork to be tested at the specified construction pressure.

d. Allowable Leakage

1) The total allowable leakage shall be less than specified leakage class with no audible leaks.
2) If no leakage class is listed elsewhere, the system shall meet leakage Class 4.
3) All duct risers shall be tested with branch takeoffs, fire dampers and access doors installed. Duct leakage shall be calculated based on duct surface area per SMACNA Test Manual. The duct surface area method shall include all seams, joints and other duct surface connections for take-offs, fire dampers and access doors, etc.

3.4 DUCT CLEANING

A. Clean dust and debris from interior and exterior of all ducts using wet rags and vacuums.

B. Cover open ends of ductwork when installation does not proceed for more than one day. This requirement shall apply to each individual run of duct, such that no duct section shall remain open or unconnected for more than 8 hours.

C. Supply Ductwork Cleanliness Requirements

1. The cleanliness requirements of the Isolation & Patient Rooms supply duct shall be in addition to the specified protection requirements of all other ductwork and shall include the following:

a. Upon fabrication, each duct section shall be cleaned with alcohol wipes and made oil-free.

b. Following cleaning, each duct section shall be shrink-wrapped for shipment.

c. On-site storage of Isolation & Patient Rooms supply ductwork, prior to installation, shall be in an enclosed, clean, dry space dedicated to storage of Isolation & Patient Rooms supply ductwork only.

d. Upon installation, the protection requirements as specified for all ductwork shall apply.

END OF SECTION 23310

SECTION 233700 – REGISTERS, GRILLES AND DIFFUSERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Section 230500, apply to this Section.

1.2 WORK INCLUDED

A. Furnish and install all registers, grilles and diffusers including opposed blade dampers, frames and other accessories to make a complete system of air distribution.

B. All materials shall be new and manufactured for the specific purpose of distributing and controlling air flow.

1.3 RELATED SECTIONS

A. Examine all drawings and criteria sheets and all other Sections of the Specifications for requirements which affect work under this Section whether or not such work is specifically mentioned in this Section.

1.4 REFERENCES

A. Applicable provisions of the following Codes and Trade Standard Publications shall apply to the work of this Section, and are hereby incorporated into, and made a part of the Contract Documents.

B. Material standards shall be as specified or detailed hereinafter and as following:

1. ADC 1062: GRD – Test Code for Grilles, Registers and Diffusers; 1984.
2. AMCA 500 – Test Method for Louvers, Dampers and Shutters; 1989.
3. ASHRAE 70 – Method of Testing for Rating the Air Flow Performance of Outlets and Inlets.
4. NFPA 90A – Installation of Air Conditioning and Ventilating Systems; 1993.
5. SMACNA (DCS) – HVAC Duct Construction Standard – metal and Flexible; 1995.

1.5 SUBMITTALS

A. See Section 230500 and General Conditions for additional requirements.

B. Product Data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish and type of mounting prior to submission. Submit schedule of outlets and inlets showing type, size, location, application and noise level.

C. Project Record Documents: Record actual locations of air outlets and inlets.

D. Submit air terminal performance data including static pressure, throw, velocity, airflow and acoustical performance. Data must indicate compliance with referenced Codes and Standards specified herein.

E. Manufacturer shall review requirements of outlets as to size, finish and type of mounting before submitting shop drawings and schedule of outlets.

F. Manufacturer shall check location of outlets and make necessary adjustments in position to conform with architectural features, symmetry and lighting arrangement before submitting shop drawings.

1.6 QUALITY ASSURANCE

A. Manufacturer shall certify cataloged performance and ensure correct application of air outlet types.

B. Manufacturer shall be responsible for examining application of each outlet and shall guarantee that each will provide comfortable space conditions without drafts at noted capacity.

PART 2 - PRODUCTS

2.1 GENERAL

A. Acceptable manufacturers contingent on compliance with specifications.

1. Anemostat
2. Krueger
3. MetalAire
4. Nailor
5. Price
6. Titus
7. Tuttle & Bailey

B. All air distribution devices shall be of steel or aluminum construction unless otherwise specified herein or scheduled on the drawings.

C. Distribution devices, except where such devices are specified or scheduled to be steel extruded aluminum, shall be factory primed and finish painted by the manufacturer in a color as approved by the Architect during shop drawing review, unless otherwise noted.

D. All diffusers, grilles and registers must be compatible with the designed ceiling/wall type. Refer to architectural drawings for exact details of ceiling/wall construction.

2.2 DIFFUSERS, REGISTERS AND GRILLES SHALL BE OF TYPE AS HEREIN SPECIFIED

A. Ceiling Supply

1. Ceiling or sidewall supply air diffusers of the above types shall be of the restricted multi-orifice jet induction and air mixing type, consisting of louvered sections with built-in diffusing vanes, similar to Tuttle & Bailey Type RCLT.

2. The vanes shall be arranged to discharge air from adjacent channels at a 45° angle in opposite directions to the plane of discharge to ensure rapid mixing of primary and room air. Each individual diffusing vane shall be welded in (2) places to the adjacent louver sections to make a rigid integral unit. The vanes shall extend to the discharge edges of the louvers.

3. Where louver sections abut core frame, the louver ends shall be welded to core frame. The louver ends shall be rounded and hemmed before welding to core frames.

4. Diffusers shall be square or rectangular, as shown on the drawings. Diffusers shall be

assembled in patterns which provide 1-way, 2-way, 3-way or 4-way air discharge with each side delivering a quantity of air proportional to the area served. Diffusers shall be fabricated of steel welded or aluminum construction. The diffusers shall be provided with a removable core permitting easy access to the neck connection.

5. The diffusers shall be constructed with an integral collar extending at least 1" above the core to accommodate an internal duct connection. Collar corners shall have welded angles on the outside to prevent leakage and ensure that internal duct connection can be made secure.

B. Return and Exhaust

1. General return/exhaust registers shall be similar to Tuttle & Bailey Model T77D and shall be made of steel or aluminum with (1) set of fixed blades, 42° deflection. Provide with countersunk holes and suitable frame to match ceiling or wall construction.

2. All return and exhaust registers installed in all toilet rooms, laundry rooms, showers and other areas subject to moisture shall be similar to above except constructed of all aluminum, equal to Tuttle & Bailey Model A77D.

C. Sidewall Adjustable Supply

1. Sidewall supply registers shall be similar to Tuttle & Bailey Model T547 and shall be made of steel or aluminum, with mitered corners, double adjustable deflection core, and horizontal front louvers. Frames shall be suitable for construction adjacent to where registers are to be installed. Registers shall have countersunk screw holes.

D. Air Screens/Wire Mesh

1. Mesh shall be 3/4" square pattern, 1/16" galvanized wire, interwoven, welded or secured to frame.

2. Frames shall be 1" by 1" by 1/8" galvanized steel angles for duct sizes through 24"; 1 1/2" x 3/16" for duct sizes between 25" and 48"; and, 2" by 2" by 3/16" for ducts larger than 48", continuous around perimeter of screen.

PART 3 - INSTALLATION

3.1 INSTALLATION

A. Install in accordance with manufacturer’s instruction.

B. Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry and lighting arrangement.

C. Install diffusers to ductwork with air tight connections.

D. Provide balancing dampers on duct take-off to diffusers, and grilles and registers, despite whether dampers are specified as part of the diffuser, or grille and register assembly.

E. Paint ductwork visible behind air outlets and inlets matte black.

END OF SECTION 23370

SECTION 233900 – FANS AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Section 230500, apply to this Section.

1.2 WORK INCLUDED

A. Furnish and install all fans of the various types, arrangement and sizes specified herein and as scheduled on the drawings.

B. Fans shall include all motors, drives, curbs, flashing, special coatings and accessories.

C. Furnish and install backdraft dampers with all fans.

D. Furnish and install all roof curbs and automatic dampers.

1.3 RELATED SECTIONS

A. Examine all drawings and criteria sheets and all other Sections of the Specifications for requirements which affect work under this Section whether or not such work is specifically mentioned in this Section.

1.4 REFERENCES

A. Applicable provisions of the following Codes and Trade Standard Publications shall apply to the work of this Section, and are hereby incorporated into, and made a part of the Contract Documents.

B. Material standards shall be as specified or detailed hereinafter and as following:

1. AMCA 99 – Standards Handbook;.

2. AMCA 210 – Laboratory Methods of Testing Fans for Rating Purposes.

3. AMCA 261 – Directory of Products Licensed to Bear the AMCA Certified Ratings Seal;.

4. AMCA 260 – Laboratory Certified ratings for induced flow fans.

5. AMCA 300 – Test Code for Sound Rating Air Moving Devices;.

6. AMCA 301 – Method of Publishing Sound Rating Air Moving Devices;.

7. NEMA MG 1 – Motors and Generators; 1993 (and Revision 1).

8. NFPA 96 – Installation of Equipment for the Removal of Smoke and Grease Vapors from Commercial Cooking Equipment;.

9. UL 705 – Power Ventilators

1.5 SUBMITTALS

A. See Section 230500 and General Conditions for additional requirements.

B. Submit certified curves showing fan performance with system operating points plotted on curves.

C. Submit motor data sheets including motor efficiency and power factor at various loadings of nameplate horsepower. Motor efficiency and power factor shall be shown for 100%, 75% and 50% of nameplate horsepower. Submit data on efficiency and power factor required for motors 1 HP and above only. Motors shall have premium efficiency motors with minimum efficiency on motors listed in specification.

D. Submit bearing sizing calculations for each similar size and type of fan. Fan bearing calculations shall be based on fan at maximum operating conditions including belt pull. Calculations shall be done for both fan bearings and motor bearings. Calculations required on centrifugal fans, vent sets in-line fans, wall mounted propeller fans and vane axial fans only.

E. Submit sound power levels for each size and type of fan. Sound levels shall be in all (8) octave bands for discharge of fan, inlet to fan, and radiated noise through casing.

F. Submit certified shop drawings indicating all dimensional data, and operating and maintenance clearances.

1.6 QUALITY ASSURANCE

A. Fans shall conform to most recent AMCA Bulletins regarding construction and testing. Fans shall be tested and rated per AMCA and shall be selected in proper operating range without motor overloading and fan surge.

B. Manufacturers must prove experience in the production of similar products of this type for at least ten (10) years prior.

C. Fans shall be air and sound certified in accordance with AMCA 210 and 300 and shall bear the AMCA seal.

D. Kitchen Range Hood Exhaust Fans: Comply with requirements of NFPA 96.

E. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. and other testing firm acceptable to the authority having jurisdiction and all suitable for the purpose specified and indicated.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Do not operate fans for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings have been lubricated and fan has been test run under observation.

PART 2 - PRODUCTS

2.1 GENERAL

A. Manufacturers acceptable contingent upon product's compliance with the specifications are as follows:

1. Centrifugal Fans

    a. Loren Cook Co.
    b. Buffalo Forge Co.
    c. Greenheck Fan Corp.
    d. Twin City Fan

2. Plenum Fans

    a. Greenheck Fan Corp.
    b. Loren Cook Co.
    c. Twin City Fan

3. Belted Fan Vent Sets

    a. Loren Cook Co.
    b. Buffalo Forge Co.
    c. Greenheck Fan Corp.
    d. Twin City Fan

4. Roof Mounted Centrifugal Fans

    a. Greenheck Fan Corp.
    b. Loren Cook Co.
    c. ACME Fan Co.
    d. Twin City Fan

B. Selection and Balancing

1. Provide and install items as listed in equipment schedules, as shown on drawings, and as specified, complete in all respects to the functions intended.

2. Provide fans capable of accommodating static pressure variations of ±10%.

3. Provide balanced variable sheaves for motors 15 HP and under, and fixed sheaves for 20 HP and over.

4. Statically and dynamically balance fans in the field to eliminate vibration or noise transmission to occupied areas of the building. Provide certificate of compliance from manufacturer.

5. Provide OSHA and ANSI approved belt guards on interior mounted belt driven fans. Provide weatherproof ventilated housing for exterior mounted fans.

6. Provide special construction fans such as sparkproof, explosionproof, or coated fans as required by the schedule.

7. Provide safety, bird or insect screen where inlet or outlet is exposed.

8. All fans shall be manufactured in accordance with this specification even where techniques are required which are not considered standard by that manufacturer.

9. Verify fan arrangement with the Contractor including motor location for servicing and discharge arrangements for proper airflow.

10. Where fixed speed sheaves are specified for a particular fan, provide (2) additional sheaves (one motor and one drive) as necessary for final air balancing.

C. Painting

1. Each fan component shall be thoroughly cleaned, degreased and deburred before the application of a rust preventive primer.

2. Two (2) coats of a rust preventive primer shall be applied under a topcoat of air-dried epoxy or enamel. Minimum coating thickness shall be 5 to 6 mils. The final coat shall be applied after final assembly to all surfaces.

3. Special coatings shall be provided for corrosive exhaust systems as specified under the fan specification.

D. Additional Corrosion Protection

1. Fans serving laboratory fume hoods, or as scheduled on the drawings, shall have all components in contact with the airstream provided with a minimum of (2) coats of 5 mil thick air-dried Heresite VR500 coating or approved equal.

E. Inlet Vanes

1. Variable volume inlet vane control with modulating inlet dampers shall be provided as required by control sequence or as scheduled on the drawings. The inlet vanes shall consist of at least (7) blades per slide, each adequately supported with pivot bearings on each blade. Blades shall be center supported or cantilevered. Both sets of inlet vanes shall be operated by (1) lever mounted on the fan housing with connecting shaft between fan inlets. The inlet vane control operating mechanism and linkage may be center located or located inside the fan housing. The inlet vane control must be mounted in the inlet cone. Bolt-on type controls do not provide smooth inlet airflow and are not acceptable. Pneumatic operator shall be provided and installed by others. Fan shall have stable operation over the entire variable inlet vane operating range from shut-off to free delivery.

F. Special Fan Construction

1. Fans serving laboratory fume hoods, paint spray booth, or scheduled on the drawings, shall be constructed in accordance with AMCA 99-0401 Type "A" or "B" spark resistant construction.

2.2 CENTRIFUGAL FANS

A. General

1. Fan selection and ratings shall be based on tests made in accordance with ASHRAE 51 and AMCA 210 and shall be licensed to bear the AMCA seal.

2. Fans shall be Class I construction and labeled UL 705.

3. Fans shall be backwardly inclined, airfoil, or flat blade type with a minimum of (10) blades.

4. Fans shall have sharply rising pressure characteristics at the operating point specified and shall be quiet and stable in operation. Horsepower characteristics shall be self-limiting and at peak value at the specified operating point.

5. The specified fan RPM, outlet velocity, and tip speed are the maximum acceptable. The motor horsepower, CFM, and static pressure are the minimum acceptable.

6. Fan arrangements shall be minimum AMCA pressure class, single-width, single-inlet or double-width, double-inlet, clockwise or counter-clockwise rotation, shall be as scheduled on the drawings and as coordinated by the Contractors in the field.

7. Each fan shall be fully assembled with motor and drive on a structural steel base and run tested at the factory prior to shipment of the unit. Testing shall be conducted at the operating speed or maximum fan class speed. The total fan assembly shall be checked for balance and compared against the acceptable levels on the Rathbone Chart. The amplitude of vibration (displacement in mils) at operating speed measured at each unit fan bearing shall not exceed the values given in the following table:

Fan RPM	Displacement Mils
500	4.2
800	3.0
1100	2.3
1400	1.9
1700	1.6

Note: Displacement shall be peak-to-peak in X, Y and Z directions.

B. Fan Base

1. Fan with motor and drive shall be mounted on a structural steel base having a minimum 6" depth.

2. The base shall be electrically welded, and after welding, the base shall be cleaned, primed and painted to match fan coating.

3. Base steel sizing and construction shall be sufficient to allow the entire assembly to withstand the rigors of shipping and rigging.

4. Base shall be provided with lifting lugs and motor slide rails.

5. Fans with inertia bases as indicated in equipment schedules on mechanical drawings shall have structural bases constructed to accommodate concrete after installation. Bases shall be in accordance with Vibration Isolation Section.

6. All bases shall be constructed with gussetted brackets to accommodate field installed spring isolators as specified under Vibration Isolation Section.

C. Fan Housing

1. Fan housing shall be heavy gauge continuous welded steel construction with fan scroll and bearings supported from a structural steel framework. Minimum gauge construction shall be as indicated in the material construction schedule.

2. Fan housing shall be suitably braced to prevent vibration and pulsation.

3. Fans having wheel diameters 36" and larger shall have horizontally flanged split housings as required for installation.

4. Fan housing and inlet shall be constructed to allow the fan wheel(s) to be removed through the inlet opening when the inlet cone is removed.

5. A quick opening clean out door, shaped to conform with the scroll contour shall be provided with heavy-duty latches.

6. A 1/2" tapped 3/4" diameter pipe coupling drain connection shall be welded to the fan scroll at the lowest point.

7. Fans shall be convertible to a minimum of (8) standard discharge arrangements.

8. All fans shall be provided with a flanged discharge. The Sheet Metal Contractor shall provide the matching companion flange.

9. Fan cut-off shall be provided to deliver good pressure distribution.

10. A weatherproof housing shall be provided with ventilation grilles to cover motor and drive assembly for exterior mounted fans.

11. Exhaust fans serving kitchen hoods shall be so designed to satisfy NFPA 96, UL 762 and any other local codes required for kitchen hood exhaust system with cleanout door and grease drain with grease containment container.

D. Fan Inlet and Wheel Cone

1. Precision die spun or formed, and matched inlet and wheel cones shall be provided for streamlined airflow into the wheel to ensure full loading of the blades.

2. Inlet and wheel cones shall be hyperbolic. Radial side sheets are not acceptable.

3. Inlet cone shall be heavy gauge steel bolted to fan housing to allow for removal.

4. Fans having duct-connected inlets shall be provided with a flanged inlet collar with matching companion flange.

5. Fans which are not duct connected shall be provided with inlet screen(s). Inlet screen(s) shall be a nominal 1" by 1" mesh fabricated 10-gauge steel.

6. Hubs shall be straight bored, keyed and set screwed to shaft for positive attachment. Hubs shall be securely riveted to the backplate or center plate.

7. Bushed hubs are not acceptable.

8. Double width double inlet fans shall be a single wheel of the common center plate design or (2) single-width single-inlet wheels back to back, each keyed and set screwed to a common shaft.

9. Fan blades shall be continuously welded to the inlet hub and the backplate.

10. Wheel center plate or backplate shall be heavy gauge steel construction with a minimum gauge as indicated in material construction schedule.

11. The fan shaft shall be solid AISI C-1018, 1040 or 1045 hot rolled steel, accurately turned, ground and polished, and ring gauged for accuracy.

12. Recommended bearing manufacturer tolerances must be met in the contact area for bearings.

13. All shafts must be dial indicator inspected for straightness after the keyways are cut.

14. Fan shaft shall be coated with a rust inhibitive coating.

15. Fan wheel shall be statically and dynamically balanced prior to fan assembly.

16. The entire rotating assembly shall be designed so the first critical speed is a minimum of 25% greater than the fan design speed.

E. Fan Shaft Bearings

1. Fan bearings shall be foot-mounted type, bolted on a rigid welded steel framework integral with the housing.

2. Bearings shall be sized for a minimum L-10 life of 200,000 hours at maximum fan class operating conditions including belt pull. Bearings shall be selected in accordance with standards set forth by the Anti-Friction Bearing Mfrs. Assn.

3. The bearings shall be double-row spherical, self-aligning, grease lubricated, roller bearings housed in a horizontally split pillow block housing.

4. Bearings shall be SKF-SAF Series 22500 or Linkbelt P-B22400H or approved equal.

5. Extruded copper grease leads shall be provided to an easily accessible location.

F. Fan Drive

1. Fans shall be belt driven unless otherwise specified. The drive shall be a multiple V-belt type sized for 1.65 times the fan motor horsepower. Sheaves shall be fixed or adjustable based on fan motor horsepower as specified hereinbefore. The fan sheave shall have a tapered lock, split and keyed hub.

2. Motors shall meet requirements specified in Special Conditions Section.

3. Motors shall be 1800 rpm for all belt driven fans and 1200 RPM or 900 rpm for all direct driven fans.

4. An OSHA approved type fan drive guard shall be provided with provision for RPM measurement, without removing the guard. The guard shall be made of 1/2" 16 gauge flattened expanded steel, wrapped around a 16 gauge channel frame suitably braced to prevent vibration. Paint guard with coating similar to fan.

5. Fan belts shall be oil resistant 24,000-hour non-static belts.

G. Fan Material Construction Schedule

1. The following schedule indicates minimum allowable steel gauge thicknesses for construction:

Housing				Wheel			
Wheel Size	AMCA Pressure Class	Side Sheet	Scroll	Blades	Wheel Cone	Back-Plate	Center-Plate (DWDI)
12	1	12	14	16	10	8	8
thru	2	10	12	16	10	8	8
22	3	10	10	16	10	8	8
24	1	12	14	16	10	8	8
thru	2	12	14	16	10	8	8
33	3	8	10	16	10	8	1/4
36	1	12	14	16	10	8	8
	2	12	14	16	10	8	8
	3	8	10	16	10	8	1/4
40¼	1	12	12	14	10	8	8
thru	2	12	12	14	10	1/4	1/4
44½	3	8	10	14	10	1/4	1/4
49	1	12	12	12	10	8	8
	2	12	12	12	10	1/4	1/4
	3	8	10	12	10	1/4	1/4
54¼	1	12	12	12	8	8	1/4
	2	12	12	12	8	1/4	5/16
	3	8	10	12	8	1/4	3/8
60	1	12	12	12	8	3/16	1/4
	2	12	12	12	8	3/8	3/8
	3	8	10	12	8	3/8	3/8
66	1	8	8	10	1/4	3/16	5/16
	2	8	8	10	1/4	3/8	3/8
	3	8	8	10	1/4	3/8	3/8
73	1	8	8	8	1/4	1/4	5/16
	2	8	8	8	1/4	3/8	3/8
	3	8	8	8	1/4	3/8	3/8

2. Manufacturers shall use their standard gauges if heavier than those indicated above. Information on standard construction shall be made known if requested by the Architect/Engineer.

2.3 PLENUM FAN ASSEMBLIES (Not used)

2.4 BELTED VENT SETS

A. May not be used in place of centrifugal fan.

B. Similar to centrifugal fans above except:

1. When scheduled on the drawings, fume hood exhaust fans shall, in lieu of topcoat of enamel, modify paint scheme to provide a more corrosive resistant finished product using epoxies or vinyl. Minimum thickness shall be 5 mils.

2. All fans are single-width single-inlet.

3. Statically and dynamically balance fans and delete vibration run test.

4. When fans are mounted exposed-to-weather, in lieu of OSHA guard specified above,

provide a weatherproof cover over entire drive assembly to ensure protection from weather.

5. Fans without inlet vanes unless otherwise specified on drawing schedule.

6. Motors shall be total enclosed fan cooled (TEFC) meeting requirements of the Motor Section of the Special Conditions.

2.5 ROOF MOUNTED CENTRIFUGAL FANS

A. Provide belt driven centrifugal type roof mounted fans with capacities as indicated in the equipment schedules on the mechanical drawings. Fans complete with curb cap suitable for curb mounting. Roof curbs shall be provided by the HVAC Contractor.

B. Fans housing shall be heavy gauge spun aluminum with gauges as listed in the following schedule, mounted to a rigid support network constructed of galvanized or epoxy coated steel. Fan housing shall have a rigid wire bird screen mounted to the unit discharge.

C. Drive frame, bearing support, and motor support shall be heavy gauge galvanized steel.

D. Fan inlet cone shall have a die spun hyperbolic shape, matched to the wheel cone to ensure full loading of fan blades to maximize efficiency.

E. Fan wheel shall have single thickness backward inclined blades or true hollow airfoil shaped blades. Wheel characteristics shall be non-overloading.

F. Fan inlet cone, wheel cone, blades and backplate shall be constructed of heavy gauge aluminum.

G. Blades shall be welded, riveted or bolted to wheel cone and backplate.

H. Wheel shall be statically and dynamically balanced.

I. Drive shaft shall be ground and polished high grade steel supported by permanently lubricated sealed ball bearings housed in a cast iron flanged mounted housing.

J. Bearings shall be sized for a minimum L-10 life of 100,000 hours at maximum fan operating conditions including belt pull. Bearings shall be selected in accordance with standards set forth by the Anti-Friction Bearing Mfrs. Assn.

K. Drives shall be sized for a minimum of 1.65 times the fan motor horsepower. Sheaves shall be adjustable and have a tapered split and keyed hub. Belts shall be oil resistant 24,000-hour non-static type.

L. Motor and drive assembly shall be mounted on neoprene vibration isolators.

M. Motor, drive, and bearings shall be out of the exhaust airstream and housed to facilitate ease of maintenance. Motor cooling shall be through the fan drive and motor housings.

N. Motor shall be wired to a factory installed disconnect switch. All wiring and electrical components shall comply with the National Electric Code and be UL listed.

O. Motors shall be TEFC in accordance with the Motor Section of the Special Conditions.

P. Provide automatic damper. Damper to open when fan is energized and close when fan is de-energized. See Sheet Metal Section for damper specification.

Q. Damper to be field installed in duct at fan inlet.

R. All fasteners shall be stainless steel.

S. Refer to Roof Curbs Section.

2.6 UP-BLAST ROOF MOUNTED CENTRIFUGAL FANS

A. Fans shall be identical construction to roof mounted centrifugal fans above, except for the following:

1. Fan discharge arranged to discharge the air vertically, away from the roof, using a wind band housing constructed of heavy gauge aluminum.

2. Motor drive compartment shall be ventilated using outside air. A direct connected breather tube shall be used ensuring contaminated air is not induced.

3. A grease trough shall provide single-point drainage of grease or residue for kitchen exhaust applications. Refer to Roof Curb Section herein.

2.7 IN-LINE TUBULAR CENTRIFUGAL FANS

A. Provide belt driven centrifugal type in-line fans with capacities as indicated in the equipment schedules on the mechanical drawings.

B. AMCA pressure Class I or Class II as indicated in the equipment schedule.

C. Fan housing shall be heavy gauge galvanized steel welded to a rigid galvanized structural steel framework or steel coated with an epoxy finish. Minimum thickness of epoxy finish shall be 5 mils. Fan housing shall be provided with mounting brackets at both inlet and discharge suitable for hanger rods or bolting directly to structure.

D. Fan housing shall have inlet and outlet connections flanged.

E. Fan inlet cone shall have a die spun hyperbolic shape and be matched to the wheel cone to ensure full loading of fan blades and to maximize efficiency.

F. Fan wheel shall have single thickness backward inclined blades or true hollow airfoil shaped blades. Wheel characteristics shall be non-overloading.

G. Fan inlet cone, wheel cone, blades and backplate shall be constructed of heavy gauge aluminum or steel. Steel construction shall be coated with an epoxy coating having a minimum thickness of 5 mils.

H. Blades shall be welded to wheel cone and backplate.

I. Wheel shall be statically and dynamically balanced.

J. Drive shaft shall be ground and polished high grade steel supported by permanently lubricated sealed ball bearings housed in a cast iron pillow block housing.

K. Bearings shall be sized for a minimum of L-10 life of 200,000 hours at maximum fan operating conditions including belt pull. Bearings shall be selected in accordance with standards set forth by the Anti-Friction Bearing Mfrs. Assn.

L. Drives shall be sized for a minimum of 1.65 times the fan motor horsepower. Sheaves shall be adjustable and have a tapered lock, split and keyed hub. Belts shall be oil resistant, 24,000-hour non-static type.

M. Fan shall be suitable for horizontal or vertical mounting.

N. Motor, drive, and bearings shall be out of the exhaust airstream and housed to facilitate ease of maintenance. Motor cooling shall be through the fan drive and motor housing. Housing for motor drive and bearings shall be of the same construction as the fan housing.

O. Motors shall be in accordance with Motors Section of the Special Conditions.

P. Fans shall be constructed in accordance with AMCA 99-0401 Type A, B or C.

Q. Provide with 1/2" by 1/2" galvanized wire mesh attached to a galvanized structural steel frame. Frame shall be bolted to the flanged housing construction.

R. Provide thrust arrestors as required to limit movement of the fan upon start-up.

2.8 WALL MOUNTED PROPELLER FANS (Not used)

2.9 VANE AXIAL FAN (Not used)

2.10 CEILING MOUNTED CABINET FANS (Not used)

2.11 HIGH PLUME DILUTION BLOWER (Not used)

PART 3 - FAN INSTALLATION REQUIREMENTS

3.1 INSTALLATION

A. Fans shall be installed in accordance with manufacturer recommendations, Contract Drawings and reviewed submittals.

B. Fans shall be installed so as to ensure easy accessibility for service or removal or replacement of all components such as, but not limited to, fans, motors, belts, drives, bearings, dampers, actuators, isolators, and field connections.

C. The HVAC Contractor shall install all motors and drives shipped loose. Fans shall be installed and tested, and shall be made fully operational by the HVAC Contractor.

D. Provide fixed sheaves as necessary for final air balancing. The Contractor shall install the fixed sheave after balancing with the Contractor to adjust the fans.

E. Manufacturer shall include the adjustment of pitch for adjustable pitch fans as required by balancing.

F. Set roof mounted fans on sound absorbing insulated curbs. Coordinate installation with Roofing Contractor. Curbs shall be provided by the HVAC Contractor. The HVAC Contractor shall provide all counter flashing.

G. Mount vent sets and vane axial fans located on roof to inertia bases as required under Vibration Isolation Section.

H. Make all penetrations through roof or vertical walls watertight. Submit methods of sealing to Architect/Engineer for review and approval.

I. All fans shall have flexible inlet and outlet couplings to prevent vibration transmission to ductwork.

J. The Contractor shall assemble all loose parts including motors and drive assemblies on site and shall vibration balance the fans in the field. Field adjustment including belt alignment, wheel balancing, belt tension, greasing of bearings, installation of belt guards, and other loose parts shall be provided by the HVAC Contractor.

3.2 COORDINATION

A. The Contractor shall coordinate the fan arrangement with the coordinated ductwork layout prior to ordering the fan. The Contractor shall provide all labor and materials necessary to change fan arrangement in the field when fan arrangement does not match ductwork.

B. The inlet and discharge ductwork shall have a minimum straight run of (2) fan diameters upstream and downstream of the fan. The Contractor shall notify the Engineer in writing if these conditions cannot be achieved. Installation of improper inlet/discharge conditions without the review of the Engineer shall be corrected in the field at no cost to the Owner.

C. The discharge duct arrangement shall comply with AMCA recommended layouts for elbows after fans.

D. The Contractor shall provide all supplemental steel, supports, rods and hangers necessary to hang or mount fans. Supports shall include thrust restraint as required by the fan manufacturer.

E. The fan manufacturer and Contractor shall coordinate the fan orientation for tubular centrifugal fans and shall verify that the fan support and bearings are supplied for the coordinated fan orientation (horizontal or vertical). The Contractor shall revise the fan in the field if job conditions require changing of orientation, at no cost to the Owner.

F. The Contractor shall receive and inspect all fans and motors to make sure that all fans are received without defect. All defective or damaged fans shall be returned to the manufacturer by the Contractor for replacement.

G. The Contractor shall properly protect all equipment to prevent damage from water, dirt, etc. Protection shall include temporary plastic wrap to keep equipment in original factory condition. Fans used for temporary ventilation during construction shall be totally cleaned and refurbished prior to turnover to the Owner.

H. The HVAC Contractor shall mount and vibration balance all fans. The Electrical Contractor shall furnish and install power wiring to the fan motor and verify proper fan rotation. The HVAC and Electrical Contractors shall coordinate the starter requirements to ensure that the proper starter is installed for non-standard motors. The ATC Contractor shall wire all interlocking wiring to the fan including smoke detector wiring for fan shutdown.

I. The HVAC Contractor shall mount all automatic control dampers on the fan either shipped loose or provided by the ATC Contractor.

J. The HVAC Contractor shall mount all field mounted flow measuring devices on the inlet or discharge of the fan prior to fan installation.

END OF SECTION 233900

SECTION 237323 – FACTORY BUILT-UP AIR HANDLING UNITS

PART 1 - GENERAL

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Applied Air Handling Units.

1.02 REFERENCES

A. AMCA Publication 99 - Standards Handbook.

B. AMCA Publication 611 - Certified Ratings Program - Airflow Measurement Performance

C. AMCA Standard 500-D - Laboratory Methods of Testing Dampers for Rating.

D. ANSI/ABMA Standard 9 - Load Ratings and Fatigue Life for Ball Bearings.

E. ANSI/AMCA Standard 204 - Balance Quality and Vibration Levels for Fans.

F. ANSI/AMCA Standard 610 - Laboratory Methods of Testing Airflow Measuring Stations for Rating.

G. ANSI/AHRI Standard 410 - Forced Circulation Air-Cooling and Air-Heating Coils.

H. ANSI/AHRI Standard 430 - Central Station Air Handling Units.

I. ANSI/ASHRAE Standard 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.

J. ANSI/ASHARE Standard 62.1 - Ventilation for Acceptable Indoor Air Quality.

K. ANSI/ASHARE Standard 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings.

L. ANSI/NEMA MG 1 - Motors and Generators.

M. ANSI/UL 900 - Standard for Safety Air Filter Units.

N. AHRI Standard 260 - Sound rating of Ducted Air Moving and Conditioning Equipment.

O. ASHRAE Standard 111 - Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems.

P. ASTM B117 - Standard Practice for Operation Salt Spray Apparatus.

Q. ASTM C1071 - Thermal and Acoustic Insulation (Mineral Fiber, Duct Lining Material).

R. ASTM C1338 - Standard Test Method for Determining Fungi Resistance of Insulation Material and Facings.

S. ASTM E477 - Standard Test Method for Measure Acoustical and Airflow Performance of Duct Liner

T. NFPA 70 - National Electrical Code

U. NFPA 90A - Standard for the Installation of Air Conditioning and Ventilation Systems.

V. UL 1995 - Standard for Safety Heating and Cooling Equipment

1.03 QUALITY ASSURANCE

A. Air Coils: Certify capacities, pressure drops and selection procedures in accordance with current AHRI Standard 410.

B. Air handling units shall be rated in accordance with AHRI Standard 430 for airflow, static pressure, and fan speed performance.

1.04 SUBMITTALS

A. No equipment shall be fabricated or delivered until the receipt of approved shop drawings from the Owner or Owner's approved representative.

B. AHU manufacturer shall provide the following information with each shop drawing/product data submission:

1. Dimensioned arrangement drawings for each AHU including a plan and elevation view of the assembled unit with overall dimensions, lift points, unit shipping split locations and dimensions, installation and operating weights, and installation, operation and service clearances.
2. All electrical, piping, and ductwork requirements, including sizes, connection locations, and connection method recommendations.
3. Each component of the unit shall be identified and mechanical specifications shall be provided for unit and accessories describing construction, components, and options.
4. All performance data, including capacities and airside and waterside pressure drops, for components.

5. Fan curves shall be provided for fans with the design operating points indicated. Data shall be corrected to actual operating conditions, temperatures, and altitudes.
6. For units utilizing multiple fans in a fan section, a fan curve shall be provided showing the performance of the entire bank of fans at design conditions. In addition, a fan curve shall be provided showing the performance of each individual fan in the bank of fans at design conditions. Also a fan curve shall be provided showing the performance of the bank of fans, if one fan is down. The percent redundancy of the bank of fans with one fan down shall be noted on the fan curve or in the tabulated fan data.
7. A filter schedule must be provided for each air handling unit supplied by the air handling unit manufacturer. Schedule shall detail unit tag, unit size, corresponding filter section location within the AHU, filter arrangement (e.g. angled/flat), filter depth, filter type (e.g. pleated media), MERV rating, and filter quantity and size.
8. A schedule detailing necessary trap height shall be provided for each air handling unit. Schedule shall detail unit tag, unit size, appropriate trap schematic with recommended trap dimensions, and unit supplied base rail height. Contractor shall be responsible for additional trap height required for trapping and insulation beyond the unit supplied base rail height by adequate housekeeping pad.
9. A coil valve coordination schedule shall be provided for each air handling unit supplied by the air handling unit manufacturer. Schedule shall detail unit tag, coil type and corresponding section location within the AHU, valve style (e.g. global, ball), valve type (e.g. electronic 2-way/3-way), valve position (e.g. normally open/closed), size, flow coefficient (CV), and close-off pressure.
10. An electrical MCA - MOP schedule shall be provided for each electrical circuit to which field-power must be supplied. Schedule to detail unit tag, circuit description, voltage/phase/hertz, Minimum Circuit Ampacity (MCA), and calculated Maximum Overcurrent Protection (MOP).

11. Sound data shall be provided using AHRI 260 test methods. Unit discharge, inlet, and radiated sound power levels in dB shall be provided for 63, 125, 250, 500, 1000, 2000, 4000 and 8000Hz.

C. The AHU manufacturer shall provide appropriate sets of submittals as referenced in the General Conditions and shall submit to the Owner electronic copies of the IOM.

D. The AHU manufacturer shall list any exceptions to the specification.

1.05 REGULATORY REQUIREMENTS

A. Agency Listings/Certifications

1. Unit shall be manufactured to conform to UL 1995 and shall be listed by either UL/CUL or ETL. Units shall be provided with listing agency label affixed to the unit. In the event the unit is not UL/CUL or ETL approved, the contractor shall, at his/her expense, provide for a field inspection by a UL/CUL or ETL representative to verify conformance. If necessary, contractor shall perform modifications to the unit to comply with UL/CUL or ETL as directed by the representative, at no additional expense to the owner.

2. Certify air handling units in accordance with AHRI Standard 430. Units shall be provided with certification label affixed to the unit. If air handling units are not certified or fans are not rated in accordance with AHRI Standard 430 contractor shall be responsible for expenses associated with testing of units after installation to verify performance of fan(s). Any costs incurred to adjust fans to meet scheduled capacities shall be the sole responsibility of the contractor.

3. Certify air handling coils in accordance with AHRI Standard 410. Units shall be provided with certification label affixed to the unit. If air handling coils are not certified in accordance with AHRI Standard 410, contractor shall be responsible for expenses associated with testing of coils after installation to verify performance of coil(s). Any costs incurred to adjust coils to meet scheduled capacities shall be the sole responsibility of the contractor.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.

B. Units shall ship fully assembled up to practical shipping and rigging limitations. Units not shipped fully assembled shall have tags and airflow arrows on each section to indicate location and orientation in direction of airflow. Shipping splits shall be clearly defined on submittal drawings. Cost associated with non-conformance to shop drawings shall be the responsibility of the manufacturer. Each section shall have lifting lugs for field rigging, lifting and final placement of AHU section(s). AHU's less than 100-inches wide shall allow for forklift transport and maneuverability on the jobsite.

C. Unit shall be stretch or shrink wrapped to protect unit from in-transit rain and debris per ASHRAE 62.1 recommendations.

D. Installing contractor shall be responsible for storing AHU in a clean, dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.

1.07 START-UP AND OPERATING REQUIREMENTS

A. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters in place, bearings lubricated (if applicable), condensate properly trapped, piping connections verified and leak-tested, belts aligned and tensioned, all shipping braces removed, bearing set screws torqued, and fan has been test run under observation.

1.08 WARRANTY

A. AHU manufacturer shall provide, at no additional cost, a standard parts warranty that covers a period of one year from unit start-up or 18 months from shipment, whichever occurs first. This warrants that all products are free from defects in material and workmanship and shall meet the capacities and ratings set forth in the equipment manufacturer's catalog and bulletins.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Approved manufacturer shall be Trane, with pre-approved alternates considered. Manufacturers not pre-approved, must obtain pre-approval in writing from consulting

engineer prior to bid day. Alternates must comply with all performance and features as called for in this specification. Job awarded on basis of specified equipment. Alternate will be evaluated and considered after job is awarded.

B. Manufacturer must clearly define any exceptions made to Plans and Specifications. Any deviations in layout or arrangement shall be submitted to consulting engineer prior to bid date. Acceptance of deviation(s) from specifications shall be in the form of written approval from the consulting engineer. Mechanical Contractor is responsible for expenses that occur due to exceptions made.

2.02 GENERAL

A. Unit layout and configuration shall be as defined in project plans and schedule.

B. Manufacturer to provide a full perimeter integral base frame for either ceiling suspension of units or to support and raise all sections of the unit for proper trapping. Base frame will either be bolted construction or welded construction. Refer to schedule for base height and construction type. Contractor will be responsible for providing a housekeeping pad when unit base frame is not of sufficient height to properly trap unit. Unit base frames not constructed of galvanized steel shall be chemically cleaned and coated with both a rust-inhibiting primer and finished coat of rust-inhibiting enamel. Unit base height to be included in total height required for proper trap height.

2.03 UNIT CASING

A. Unit manufacturer shall ship unit in segments as specified by the contractor for ease of installation in tight spaces. The entire air handler shall be constructed of galvanized steel. Casing finished to meet ASTM B117 125-hour salt-spray test. The removal of access panels or access doors shall not affect the structural integrity of the unit. All removable panels shall be gasketed. All doors shall have gasketing around full perimeter to prevent air leakage. Contractor shall be responsible to provide connection flanges and all other framework that is needed to properly support the unit.

B. Casing performance - Casing air leakage shall not exceed leak class 6 (CL = 6) per ASHRAE 111 at specified casing pressure, where maximum casing leakage (cfm/100 ft2 of casing surface area) = CL X P0.65.

C. Air leakage shall be determined at 1.00 times maximum casing static pressure up to 8 inches w.g. Specified air leakage shall be accomplished without the use of caulk. Total estimated air leakage shall be reported for each unit in CFM, as a percentage of supply air, and as an ASHRAE 111 Leakage Class.

D. Under 55F supply air temperature and design conditions on the exterior of the unit of 81F dry bulb and 73F wet bulb, condensation shall not form on the casing exterior. The AHU manufacturer shall provide tested casing thermal performance for the scheduled supply air temperature plotted on a psychrometric chart. The design condition on the exterior of the unit shall also be plotted on the chart. If tested casing thermal data is not available, AHU manufacturer shall provide, in writing to the Engineer and Owner, a guarantee against condensation forming on the unit exterior at the stated design conditions above. The guarantee shall note that the AHU manufacturer will cover all expenses associated with modifying units in the field should external condensate form on them. In lieu of AHU manufacturer providing a written guarantee, the installing contractor must provide additional external insulation on AHU to prevent condensation.

E. Unit casing (wall/floor/roof panels and doors) shall be able to withstand up to 1.5 times design static pressure, or 8-inch w.g., whichever is less, and shall not exceed 0.0042 per inch of panel span (L/240).

F. Floor panels shall be double-wall construction and designed to support a 300-lb load during maintenance activities and shall deflect no more than 0.0042 per inch of panel span.

G. Unit casing panels shall be 2-inch double-wall construction, with solid galvanized exterior and solid galvanized interior, to facilitate cleaning of unit interior.

H. Unit casing panels (roof, walls, floor) and doors shall be provided with a minimum thermal resistance (R-value) of 13 Hr*Ft2*ºF/BTU.

I. Unit casing panels (roof, walls, floor) and external structural frame members shall be completely insulated filling the entire panel cavity in all directions so that no voids exist. Panel insulation shall comply with NFPA 90A.

J. Casing panel inner liners must not extend to the exterior of the unit or contact the exterior frame. A mid-span, no-through-metal, internal thermal break shall be provided for all unit casing panels.

K. Access panels and/or access doors shall be provided in all sections to allow easy access to drain pan, coil(s), motor, drive components and bearings for cleaning, inspection, and maintenance.

L. Access panels and doors shall be fully removable without the use of specialized tools to allow complete access of interior surfaces.

2.04 ACCESS DOORS

A. Access doors shall be 2-inch double-wall construction. Interior and exterior shall be of the same construction as the interior and exterior wall panels.

B. All doors shall be provided with a thermal break construction of door panel and door frame.

C. Gasketing shall be provided around the full perimeter of the doors to prevent air leakage.

D. Door hardware shall be surface-mounted to prevent through-cabinet penetrations that could likely weaken the casing leakage and thermal performance.

E. Handle hardware shall be designed to prevent unintended closure.

F. Access doors shall be hinged and removable without the use of specialized tools.

G. Hinges shall be interchangeable with the door handle hardware to allow for alternating door swing in the field to minimize access interference due to unforeseen job site obstructions.

H. Door handle hardware shall be adjustable and visually indicate locking position of door latch external to the section.

I. All doors shall be a 60-inch high when sufficient unit height is available, or the maximum height allowed by the unit height.

J. A single door handle shall be provided for each door linking multiple latching points necessary to maintain the specified air leakage integrity of the unit.

K. An optional shatterproof window shall be provided in access doors where indicated on the plans. Window shall either be single pane, or thermal dual pane, as defined

on schedule. Window shall be capable of withstanding unit operating pressures and shall be safe for viewing UV-C lamps.

2.05 PRIMARY DRAIN PANS

A. All cooling coil sections shall be provided with an insulated, double-wall, galvanized drain pan.

B. The drain pan shall be designed in accordance with ASHRAE 62.1 being of sufficient size to collect all condensation produced from the coil and sloped in two planes, pitched toward drain connections, promoting positive drainage to eliminate stagnant water conditions when unit is installed level and trapped per manufacturer's requirements.

C. The outlet shall be located at the lowest point of the pan and shall be sufficient diameter to preclude drain pan overflow under any normally expected operating condition.

D. All drain pan threaded connections shall be visible external to the unit. Threaded connections under the unit floor shall not be accepted.

E. Drain connections shall be of the same material as the primary drain pan and shall extend a minimum 2-1/2-inch beyond the base to ensure adequate room for field piping of condensate traps.

F. The installing contractor is responsible to ensure the unit is installed level, trapped in accordance with the manufacturer's requirements, and visually inspected to ensure proper drainage of condensate.

G. Coil support members inside the drain pan shall be of the same material as the drain pan and coil casing.

H. If drain pans are required for heating coils, access sections, or mixing sections they will be indicated in the plans.

2.06 FANS

A. Fan sections shall have a minimum of one hinged and latched access door located on the drive side of the unit to allow inspection and maintenance of the fan, motor, and drive components.

B. Provide fans of type and class as specified on the schedule. All fans shall be statically and dynamically tested by the manufacturer for vibration and alignment as

an assembly at the operating RPM to meet design specifications. Fans that are selected with inverter balancing shall first be dynamically balanced at design RPM. The fans then will be checked in the factory from 25% to 100% of design RPM to insure they are operating within vibration tolerance specifications, and that there are no resonant frequency issues throughout this operating range. Inverter balancing that requires lockout frequencies inputted into a variable frequency drive to in order to bypass resonant frequencies shall not be acceptable. If supplied in this manner by the unit manufacturer, the contractor will be responsible for rebalancing in the field after unit installation. Fans selected with inverter balancing shall have a maintenance free grounding assembly installed on the fan motor to discharge both static and induced shaft currents to ground.

C. Direct drive plenum fans with integral frame motors, shall be mounted on isolation bases. Fan shall be dynamically balanced throughout the operating range to a BV-3 (0.20 in/s) per AMCA 204 test standard. Fan and motor shall be internally isolated with spring isolators. A flexible connection shall be installed between fan and unit casing to ensure complete isolation. Flexible connection shall comply with NFPA 90A and UL 181 requirements. If fans and motors are not internally isolated, then the entire unit shall be externally isolated from the building, including supply and return duct work, piping, and electrical connections. External isolation shall be furnished by the installing contractor in order to avoid transmission of noise and vibration through the ductwork and building structure.

D. Fan airflow measurement systems shall be provided as indicated on the schedule and drawings to measure fan airflow directly or to measure differential pressure that can be used to calculate airflow. The accuracy of the devices shall be no worse than +/- 5 percent when operating within stable fan operating conditions. Devices shall not affect the submitted fan performance and acoustical levels. Devices that obstruct the fan inlet or outlet shall not be acceptable. Devices shall be connected to transducers with selectable 4-20 mA or 2-10 VDC output. Signal shall be proportional to air velocity.

E. MOTORS AND DRIVES

1. Motors shall meet or exceed all NEMA Standards Publication MG 1 - 2006 requirements and comply with NEMA Premium efficiency levels when applicable. Motors shall comply with applicable requirements of NEC and shall be UL Listed.
2. Fan Motors shall be heavy duty, open drip-proof operable at scheduled voltage. If applicable, motor efficiency shall meet or exceed NEMA Premium efficiencies.
3. Direct driven fans utilizing integral frame motors shall use 2-pole (3600 rpm), 4-pole (1800 rpm) or 6-pole (1200 rpm) motors, NEMA Design B, with Class B insulation capable to operate continuously at 104 deg F (40 deg C) without tripping overloads.
4. Motors shall have a +/- 10 percent voltage utilization range to protect against voltage variation.

2.07 COILS

A. Coils section header end panel shall be removable to allow for removal and replacement of coils without impacting the structural integrity of the unit.

B. Install coils such that headers and return bends are enclosed by unit casing to ensure that if condensate forms on the header or return bends, it is captured by the drain pan under the coil.

C. Coils shall be manufactured with plate fins to minimize water carryover and maximize airside thermal efficiency. Fin tube holes shall have drawn and belled collars to maintain consistent fin spacing to ensure performance and air pressure drop across the coil as scheduled. Tubes shall be mechanically expanded and bonded to fin collars for maximum thermal conductivity. Use of soldering or tinning during the fin-to-tube bonding process is not acceptable due to the inherent thermal stress and possible loss of bonding at that joint.

D. All coils shall be completely cleaned prior to installation into the air handling unit. Complete fin bundle in direction of airflow shall be degreased and steam cleaned to remove any lubricants used in the manufacturing of the fins, or dirt that may have accumulated, in order to minimize the chance for water carryover.

E. When two or more cooling coils are stacked in the unit, an intermediate drain pan shall be installed between each coil. The intermediate drain pan shall be designed being of sufficient size to collect all condensation produced from the coil and sloped to promote positive drainage to eliminate stagnant water conditions. The intermediate drain pan shall be constructed of the same material as the sections primary drain pan.

F. The intermediate drain pan shall begin at the leading face of the water-producing device and be of sufficient length extending downstream to prevent condensate from passing through the air stream of the lower coil.

G. Intermediate drain pan shall include downspouts to direct condensate to the primary drain pan. The intermediate drain pan outlet shall be located at the lowest point of the pan and shall be sufficient diameter to preclude drain pan overflow under any normally expected operating condition.

H. Refrigerant Cooling Coils

1. Coils shall be proof tested to 450 psig and leak tested to 300 psig air pressure under water. After testing, insides of tubes shall be air dried, charged with dry nitrogen or dry air, and sealed to prevent contamination.
2. Refrigerant suction and liquid headers shall be constructed of copper tubing. Suction and liquid connections shall penetrate unit casings to allow for sweat connections to refrigerant lines.
3. Tubes shall be 1/2-inch with aluminum fins.
4. Coils shall have equalizing type vertical distributors sized in conjunction with capacities of coils.

2.08 FILTERS

A. Provide factory-fabricated filter section of the same construction and finish as unit casings. Filter section shall have side access filter guides and access door(s) extending the full height of the casing to facilitate filter removal. Construct doors in accordance with Section 2.04. Provide fixed filter blockoffs as required to prevent air bypass around filters. Blockoffs shall not need to be removed during filter replacement. Filters to be of size, and quantity needed to maximize filter face area of each particular unit size.

B. Filter type, MERV rating, and arrangement shall be provided as defined in project plans and schedule.

2.09 DAMPERS

A. All dampers, with the exception of external bypass and multizones (if scheduled), shall be internally mounted. Dampers shall be premium ultra low leak and located as indicated on the schedule and plans. Blade arrangement (parallel or opposed) shall be provided as indicated on the schedule and drawings. Dampers shall be Ruskin CD60 double-skin airfoil design or equivalent for minimal air leakage and pressure drop. Leakage rate shall not exceed 3 CFM/square foot at one inch water gauge complying with ASHRAE 90.1 maximum damper leakage and shall be AMCA licensed for Class 1A. All leakage testing and pressure ratings shall be based on AMCA Standard 500-D. Manufacturer shall submit brand and model of damper(s) being furnished, if not Ruskin CD60.

2.10 ACCESS SECTIONS

A. Access sections shall be provided where indicated in the schedule and plans to allow additional access for inspection, cleaning, and maintenance of unit components. The unit shall be installed for proper access. Procedure for proper access, inspection and cleaning of the unit shall be provided in the AHU manufacturer's maintenance manual.

2.11 MARINE LIGHTS

A. Marine lights shall be provided throughout AHUs as indicated on the schedule and plans. Lights shall be instant-on, light-emitting diode (LED) type to minimize amperage draw and shall produce lumens equivalent to a minimum 75W incandescent bulb (1200 lumens). LED lighting shall provide instant-on, white light and have a minimum 25,000 hr life.

B. Light fixture shall be weather-resistant, enclosed and gasketed to prevent water and dust intrusion.

C. Fixtures shall be designed for flexible positioning during maintenance and service activities for best possible location providing full light on work surface of interest and not being blocked by technician.

D. All lights on a unit shall be wired in the factory to a single on-off switch.

E. Installing contractor shall be responsible for providing 115V supply to the factory-mounted marine light circuit (unless single-point power is specified to be provided by AHU manufacturer).

2.12 CONVENIENCE OUTLETS

A. A 15-amp, 115V GFCI convenience outlet shall be provided by the AHU manufacturer. The outlet shall be separate from the load side of the equipment per NEC requirements. Installing contractor shall be responsible for providing 115V supply to the factory-mounted GFCI outlet circuit per NEC (even when single-point power is specified to be provided by AHU manufacturer).

2.13 VFD per Fan

A. Multiple VFDs on a common panel, shall be provided for each fan array to provide redundancy in case of loss of function of one of the VFDs or motors. Individual VFD shall be sized based on motor FLA to reduce overall panel input current. In the event of a VFD failure, the remaining VFDs must be capable of compensating and maintaining normal fan array operation.

B. VFD panel shall have a common disconnect that is accessible from the outside of the unit. Disconnect shall open input power to all VFDs simultaneously. Disconnect shall be lockable in the off position. Disconnect shall utilize circuit breaker to provide overcurrent and short circuit protection.

C. VFD panel shall be provided with a common point connection for speed input signal, start/stop signal, fault status, and field interlock connection.

D. VFD panel shall be provided with a single point of field connection for field input power. Each VFD shall be supplied with independent input fusing, as required. Panel shall be provided with short circuit current of 5kA RMS symmetrical.

E. VFD panel shall be provided with a single point of field connection for field input power. Each VFD shall be supplied with independent input fusing, as required. Panel shall be provided with short circuit current of 65kA RMS symmetrical.

F. Externally mounted VFDs shall be provided with independent keypad.

2.14 Factory Wiring of Lights, VFDs, Motorized Impeller Control Panels, and Combination Starters/Disconnects

A. VFDs shall be wired per NEC, UL, and NFPA 90A requirements. Units with factory-mounted controls shall also include power wiring from the VFD or starter/disconnect control transformer to the control system transformers. Units with VFDs and factory-mounted controls shall have a binary start-stop signal and an analog speed signal wired from the direct digital controller to the VFD.

B. All power wiring for voltages greater than 24V and traveling through multiple unit sections shall be contained in an enclosed, metal, power-wiring raceway or EMT. Sections less than 6-inch in length may be contained in FMC.

C. After mounting and wiring of VFDs, on the AHUs, trained factory personnel shall ensure proper operation of each VFD, through a thorough factory test. Testing shall include a Hypot test of unit wiring to ensure that no weaknesses exist in wiring or motor. Each VFD shall be energized and the fan run to ensure the VFD will operate throughout the usable range of the drive and that the fan rotation is correct. Each VFD with bypass shall also be tested in the bypass position to ensure the bypass is operational.

D. On units provided with factory mounted and wired supply fan starter, MICP or VFD and DDC controls, the manufacturer shall provide a single point of power. Line-to-24v transformers shall be provided with sufficient vA to power the unit mounted controller and factory installed control points.

2.15 FACTORY-ENGINEERED AUTOMATIC TEMPERATURE CONTROLS

A. Unit shall be provided with a factory wired, installed and tested unit controller, capable of standalone unit control, or tied into a building automation system through Bacnet communication. All control points in unit shall be tested at the unit manufacturers facility prior to shipment.

B. On variable volume units, a discharge temperature sensors shall be provided and mounted on the fans by the AHU manufacturer. Temperature sensors mounted within the AHU shall have sensor material selected to integrate with the BAS controller.

C. Averaging temperature sensors shall be provided by the AHU manufacturer. Sensors shall be factory engineered to accurately measure mixed air temperatures. Capillary radius clips shall be used at capillary bends to ensure no crimping or wear

of the tube. Temperature sensors mounted within the AHU shall have sensor material selected to integrate with the BAS controller.

D. Valves shall be provided by the AHU manufacturer. Valves shall be shipped from the valve manufacturer directly to the job site or Mechanical Contractor for installation. Electrical connections shall be provided on the valves and at the AHU coil section for field connection.

2.16 Unit DDC Controller

A. One programmable DDC controller shall be provided by the AHU manufacturer for each AHU as indicated on the schedule and drawings. Control of multiple units from a single controller is not acceptable. Each programmable DDC controller shall use the LonTalk protocol and shall be LonMark certified to ensure open communication with other open BASs. Complete communications and diagnostics including all AI, BI, AO, BO, set points and alarms shall only require a twisted pair of wires between the unit controller and the BAS. Each unit controller shall be factory wired to the unit end devices. For indoor units, each controller shall have a user display touch screen for user interface. The display on indoor units shall be unit mounted in the factory. For outdoor units, one portable user display touch screen for user interface shall be provided for all controllers. Displays shall give user access to AHU status, set points and alarms.

B. The programmable DDC controller and the control components shall be selected, mounted, wired and tested by the AHU manufacturer to ensure delivery of specified performance and to minimize jobsite startup time. Testing shall be performed to ensure wiring continuity between the controller and all devices, and to ensure proper operation of the end devices. DDC controllers shall be located on unit as indicated on the drawings.

C. Factory mounted controller shall be preprogrammed at the factory to minimize startup delay of the unit(s) at the job site. Controller shall be programmed with manufactures preferred standard basic programming based on unit configuration and options. Any additional programming or custom programming shall be provided at the job site by the unit manufacturer or controls contractor.

PART 3 - EXECUTION

3.01 SHIPPING

A. Paper copies of the IOM shall also be shipped with each AHU.

B. The AHU manufacturer shall identify all shipments with the order number. Enough information shall be provided with each shipment to enable the Mechanical Contractor to confirm the receipt of units when they are received. For parts too small to mark individually, the AHU manufacturer shall place them in containers.

C. To protect equipment during shipment and delivery, all indoor units shall be completely stretch or shrink wrapped. Wrap shall be a minimum of 7 mil plastic. Pipe ends and pipe connection holes in the casing shall be capped or plugged prior to shipment

D. After loading the equipment for shipment, the AHU manufacturer shall contact the shipping contact on the order and provide the name of the carrier, description of equipment, order number, shipping point, and date of shipment.

3.02 ON-SITE STORAGE

A. If equipment is to be stored for a period of time prior to installation, the Mechanical Contractor shall remove all stretch or shrink wrap from units upon receipt to prevent unit corrosion and shall either place the units in a controlled indoor environment or shall cover the units with canvas tarps and place them in a well-drained area. Covering units with plastic tarps shall not be acceptable.

3.03 FIELD EXAMINATION

A. The Mechanical Contractor shall verify that the mechanical room and/or roof are ready to receive work and the opening dimensions are as indicated on the shop drawings and contract documents.

B. The Mechanical Contractor shall verify that the proper power supply is available prior to starting of the fans.

3.04 INSTALLATION

A. The Mechanical Contractor shall be responsible to coordinate ALL of his installation requirements with the Owner and the Owner's selected Mechanical Contractor to ensure that a complete installation for each unit is being provided. Coordination efforts shall include such items as unloading and hoisting requirements, field wiring requirements, field piping requirements, field ductwork requirements, requirements

for assembly of field-bolted or welded joints, and all other installation and assembly requirements.

B. The AHU manufacturer shall provide all screws and gaskets for joining of sections in the field.

C. The Mechanical Contractor shall verify that the following items have been completed prior to scheduling the AHU manufacturer's final inspection and start up:

1. All spring-isolated components have had their shipping restraints removed and the components have been leveled.
2. On all field-joined units, that all interconnections have been completed, i.e., electrical and control wiring, piping, casing joints, bolting, welding, etc.
3. All water and steam piping connections have been completed and hydrostatically tested and all water flow rates have been set in accordance with the capacities scheduled on the Drawings.
4. All ductwork connections have been completed and all ductwork has been pressure tested for its intended service.
5. All power wiring, including motor starters and disconnects, serving the unit has been completed.
6. All automatic temperature and safety controls have been completed.
7. All dampers are fully operational.
8. All shipping materials have been removed.
9. All (clean) filter media has been installed in the units.

3.05 LEVELING

A. The Mechanical Contractor shall level all unit sections in accordance with the unit manufacturer's instructions. The Mechanical Contractor shall provide and install all necessary permanent shim material to ensure individual sections and entire assembled units are level.

3.06 FINAL INSPECTION AND START UP SERVICE

A. After the Mechanical Contractor has provided all water and steam piping connections, ductwork connections, and field control wiring, and Electrical Contractor has provided all the field power wiring, the Mechanical Contractor shall

inspect the installation. The Mechanical Contractor shall then perform startup of the equipment.

B. The Automatic Temperature Control (Building Direct Digital Control) Contractor shall be scheduled to be at the job site at the time of the equipment start up.

C. The Mechanical Contractor, shall perform the following tests and services and submit a report outlining the results:

1. Record date, time, and person(s) performing service.
2. Lubricate all moving parts.
3. Check all motor and starter power lugs and tighten as required.
4. Verify all electrical power connections.
5. Conduct a start up inspection per the AHU manufacturer's recommendations.
6. Record fan motor voltage and amperage readings.
7. Check fan rotation and spin wheel to verify that rotation is free and does not rub or bind.
8. Check fan for excessive vibration.
9. Remove all foreign loose material in ductwork leading to and from the fan and in the fan itself.
10. Disengage all shipping fasteners on vibration isolation equipment.
11. Check safety guards to insure they are properly secured.
12. Secure all access doors to the fan, the unit and the ductwork.
13. Switch electrical supply "on" and allow fan to reach full speed.
14. Physically check each fan at start up and shut down to insure no abnormal or problem conditions exist.
15. Check entering and leaving air temperatures (dry bulb and wet bulb) and simultaneously record entering and leaving chilled water temperatures and flow, steam pressures and flow, and outside air temperature.
16. Check all control sequences.

END OF SECTION 237323

SECTION 238126 - SPLIT SYSTEM AIR CONDITIONING UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Section 230500 and other Division 1 Specification Sections, apply to this Section.

1.2 WORK INCLUDED

A. Furnish and install split system air conditioning units. This shall include all piping, ducts and supports specified in this Division and as shown on the drawings

B. All units shall be new and manufactured for the specific purpose of providing conditioned air (heating and cooling) to the systems indicated.

C. All system components shall be installed in accordance with local codes including seismic isolation.

D. Secure all permits and local/state approval for the components as specified and included under this Section.

1.3 RELATED SECTIONS

A. Examine all drawings and criteria sheets and all other Sections of the Specifications for requirements which affect work under this Section whether or not such work is specifically mentioned in this Section.

1.4 REFERENCES

A. Applicable provisions of the following Codes and Trade Standard Publications shall apply to the work of this Section, and are hereby incorporated into, and made part of the Contract Documents.

1. ABMA STD 9 – Load Ratings and Fatigue Life for Ball Bearings.
2. ABMA STD 11 – Load Ratings and Fatigue Life for Roller Bearings.
3. AMCA 99 – Standards Handbook.
4. AMCA 210 – Laboratory Methods of Testing Fans for Rating.
5. AMCA 300 – Reverberant Room Method for Sound Testing of Fans.
6. AMCA 301 – Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
7. AMCA 500 – Test Methods for Louvers, Dampers and Shutters.
8. ARI 410 – Standard for Forced-Circulation Air-Cooling and Air-Heating Coils.
9. NEMA MG 1 – Motors and Generators (1).
10. NFPA 70 – National Electrical Code.
11. SMACNA (DCS) – HVAC Duct Construction Standards – Metal and Flexible.
12. UL 900 – Standard for Air Filter Units.

1.5 SUBMITTALS

A. See Section 230500 and General Conditions for additional submittal requirements.

B. The unit manufacturer shall submit without delay after receipt of notice of award, shop drawings for approval which shall indicate, but not be limited to, the following information in detail:

1. Detailed drawings and data of all proposed components.

2. To scale dimensional drawings (plans and sections) of the entire air handling unit showing all component locations, equipment arrangements, piping connections and sizes, duct connections and sizes, and all safing required.

3. Casing and hoisting details including floor structures, internal structures, panel fabrication, insulation material and equipment supports. Location of drains and method of piping penetration and sealing of penetrations through the casings.

4. The sound power levels on all fans, fan and motor efficiency, horsepower, RPM and fan size.

5. Fan curves shall be submitted. Fan curves shall be prepared and submitted indicating performance of the fans.

6. ARI certified calculations for coil selections.

7. List of proposed component manufacturers and models, such as fans, casing, coils, humidifiers, filters, dampers, controls, door hinges, disconnect switches, controls, etc.

8. Pressure drop calculation indicating losses of all components, plenums, contractions, expansions at rated flow of unit. Pressure drop calculations are to be submitted in tabular form and shall indicate the total of all unit-associated losses plus the scheduled external static pressure. Calculations are to be based upon wet cooling coils and filters at recommended dirty change out pressure drop.

C. Manufacturer’s Instructions: Indicate assembly, support details, connection requirements and include start-up instructions.

D. Operation and Maintenance Data: Include manufacturer’s descriptive literature, operating instructions, installation instructions, maintenance and repair data and parts listing.

E. Warranty: Submit manufacturer’s warranty and ensure forms have been filled out in Owner’s name and registered with manufacturer.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, as pre-qualified and in accordance with technical specifications herein.

B. Products Requiring Electrical Connection: Listed and classified by Underwriters’ Laboratories, Inc. as suitable for the purpose specified and indicated.

C. The units shall be UL or ETL or equivalently labeled.

1.7 DELIVERY, STORAGE AND HANDLING

A. Cleanliness

1. The intent of this Section is to ensure the Owner that the split system air conditioning units are manufactured, shipped, stored, field reconnected and started-up while maintaining a high degree of cleanliness. Once the units are received by the contractor, it shall be the contractor’s responsibility to take whatever steps are necessary to deliver

the units in like new condition upon start-up and turn-over to the Owner, whichever occurs the latest.

B. Shipping

1. Shipping protection shall be provided such that both the interior and the exterior of each unit is protected from road dirt exposure during shipment. This protection shall remain on the unit until unit start-up is performed.

2. Any units damaged in shipment shall be returned to the factory for all corrective work.

C. On-Site Storage

1. If equipment is to be stored before use, the unit manufacturer shall have provided adequate protection at the factory to ensure that Cleanliness Standards for both the unit interior and unit exterior are met. This protection shall remain on the unit until such time as unit start-up is performed.

D. Rigging

1. The Contractor shall be responsible for rigging in accordance with the requirements of the unit manufacturer.

1.8 WARRANTY

A. The unit manufacturer shall be responsible for and warranty the proper operation and performance of the units, all unit components, leak tightness and non-condensation of the unit casing, structural integrity of the unit including all provisions required for rigging, trucking and installation of units in the areas indicated on the drawings. Units shall be guaranteed for 5 years from date of acceptance of project by Owner.

PART 2 - PRODUCTS

2.1 GENERAL

A. Acceptable manufacturers subject to compliance with the specification:

1. Mitsubishi
2. Daikin

2.2 OUTDOOR UNIT DESIGN

A. General

1. The outdoor unit shall be equipped with an electronic control board that interfaces with the indoor unit to perform all necessary operation functions.

2. The outdoor unit shall be capable of operating at 100% capacity at 0°F ambient temperature without additional low ambient controls.

3. The outdoor unit shall be able to operate with a maximum height difference of 100 feet between indoor and outdoor units.

4. System shall operate at up to a maximum refrigerant tubing length of 100 feet for the 12,000 and 165 feet for the 24,000 BTU/h units between indoor and outdoor units without the need for line size changes, traps or additional oil.

5. The outdoor unit shall be completely factory assembled, piped, and wired. Each unit must be test run at the factory.

6. Outdoor unit sound level shall not exceed: 48dB(A).

B. Cabinet

1. The casing shall be constructed from galvanized steel plate, finished with an electrostatically applied, thermally fused acrylic or polyester powder coating for corrosion protection.

2. Mounting feet shall be provided and shall be welded to the base of the cabinet and be of sufficient size to afford reliable equipment mount and stability.

3. Easy access shall be afforded to all serviceable parts by means of removable panel sections.

4. Fan cage shall be provided.

5. Cabinet mounting and construction shall be sufficient to withstand 155 MPH wind speed conditions. Mounting, base support, and other installation to meet Hurricane Code Conditions shall be by Contractor.

C. Fan

1. Units shall be furnished with a single DC fan motor.

2. The fan blade(s) shall be of aerodynamic design for quiet operation, and the fan motor bearings shall be permanently lubricated.

3. The outdoor unit shall have horizontal discharge airflow. The fan shall be mounted in front of the coil, pulling air across it from the rear and dispelling it through the front. The fan shall be provided with a raised guard to prevent external contact with moving parts

D. Coil

1. The condenser coil shall be of copper tubing with flat aluminum fins to reduce debris build up and allow maximum airflow. The coil shall be protected with an integral metal guard.

2. Refrigerant flow from the condenser shall be controlled by means of an electronic linear expansion valve (LEV) metering device. The LEV shall be controlled by a microprocessor controlled step motor.

3. All refrigerant lines between outdoor and indoor units shall be of annealed, refrigeration grade copper tubing, ARC Type, meeting ASTM B280 requirements, individually insulated in twin-tube, flexible, closed-cell, CFC-free (ozone depletion potential of zero), elastomeric material for the insulation of refrigerant pipes and tubes with thermal conductivity equal to or better than 0.27 BTU-inch/hour per Sq Ft / °F, a water vapor transmission equal to or better than 0.08 Perm-inch and superior fire ratings such that insulation will not contribute significantly to fire and up to 1” thick insulation shall have a -

Flame-Spread Index of less than 25 and a Smoke-development Index of less than 50 as tested by ASTM E 84 and CAN / ULC S-102.

E. Compressor

1. The compressor shall be a DC twin-rotor rotary compressor with Variable Speed Drive Technology.

2. The compressor shall be driven by inverter circuit to control compressor speed. The compressor speed shall dynamically vary to match the room load for significantly increasing the efficiency of the system which shall result in significant energy savings.

3. To prevent liquid from accumulating in the compressor during the off cycle, a minimal amount of current shall be automatically, intermittently applied to the compressor motor windings to maintain sufficient heat to vaporize any refrigerant. No crankcase heater is to be used.

4. The outdoor unit shall have an accumulator and high pressure safety switch. The compressor shall be mounted to avoid the transmission of vibration.

F. Electrical

1. Power for the indoor unit shall be supplied from the outdoor unit via Mitsubishi Electric A-Control using three (3) fourteen (14) gauge AWG conductors plus ground wire connecting the units.

2. The outdoor unit shall be controlled by the microprocessor located in the indoor unit. The control signal between the indoor unit and the outdoor unit shall be pulse signal 24 volts DC.

3. The unit shall have Pulse Amplitude Modulation circuit to utilize 98% of input power supply.

2.3 CEILING SUSPENDED TYPE EVAPORATOR UNIT

A. The Ceiling Suspended type indoor unit shall be factory assembled, wired and tested. Contained within the unit shall be all factory wiring and internal piping, control circuit board and fan motor. The unit, in conjunction with the remote shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, and a test run switch. Indoor unit and refrigerant pipes shall be purged with dry nitrogen before shipment from the factory.

B. Cabinet: The casing shall have a white finish. Cabinet shall be designed for suspension mounting from above and horizontal operation. Indoor unit shall have removable mounting brackets. A mounting template with suspension bolt locations shall be furnished with indoor unit. Mounting bolts or threaded rod of 3/8” diameter shall be used to suspend unit and unit shall not require direct contact with ceiling or panel for proper operation. Mounting support shall be of sufficient strength and design to support full weight of indoor unit. The rear cabinet panel shall have knock-out provisions for a field installed filtered 4-5/16 diameter ventilation air intake connection.

C. Fan: The indoor unit fan shall have multiple high performance, double inlet, forward curve sirocco fans driven by a single motor. The fans shall be statically and dynamically balanced and run on a motor with permanently lubricated bearings. The indoor fan shall consist of four (4) speeds: Low, M1, M2, and Hi plus AUTO fan setting. The fan shall have a selectable Auto

fan setting that will adjust the fan speed based on the difference between controller set-point and sensed space temperature.

D. Vane: There shall be a motorized horizontal vane to automatically direct air flow in a horizontal and downward direction for uniform air distribution. The horizontal vane shall provide a choice of five (5) vertical airflow patterns selected by remote control: 100% horizontal flow, 80% horizontal flow (plus 20% downward airflow), 60% horizontal airflow (plus 40% downward airflow), 40% horizontal airflow (plus 60% downward airflow), and swing. The horizontal vane shall significantly decrease downward air resistance for lower sound levels, and shall close the outlet port when operation is stopped. There shall also be a set of vertical vanes to provide horizontal swing airflow movement selected by remote control.

E. Filter Return air shall be filtered by means of an easily removable washable filter.

F. Coil The evaporator coil shall be of nonferrous construction with pre-coated aluminum strake fins on copper tubing. The multi-angled heat exchanger shall have a modified fin shape that reduces air resistance for a smoother, quieter airflow. All tube joints shall be brazed with PhosCopper or silver alloy. The coils shall be pressure tested at the factory. A condensate pan and drain shall be provided under the coil. An optional drain pan level switch (DPLS1), designed to connect to the control board, shall be provided and installed on the condensate pan to prevent condensate from overflowing.

G. System Control: The control system shall consist of a minimum of two (2) microprocessors, one on each indoor and outdoor unit, interconnected by control wiring. The microprocessor located in the indoor unit shall have the capability of monitoring return air temperature and indoor coil temperature, receiving and processing commands from a wired or wireless controller, providing emergency operation and controlling the outdoor unit. The control signal between the indoor and outdoor unit shall be pulse signal 24 volts DC. Indoor units shall have the ability to control supplemental heat via connector CN24 and a 12 VDC output.

1. For control, a three (3) conductor 14 gauge AWG wire with ground shall provide power feed and bi-directional control transmission between the outdoor and indoor units.

2. The system shall be capable of automatic restart when power is restored after power interruption. The system shall have self-diagnostics ability, including total hours of compressor run time. Diagnostics codes for indoor and outdoor units shall be displayed on the wired controller panel.

2.4 WALL MOUNTED TYPE EVAPORATOR UNIT

A. The indoor unit shall be factory assembled, wired and tested. Contained within the unit shall be all factory wiring and internal piping, control circuit board and fan motor. The unit, in conjunction with the wired wall-mounted controller, wireless wall-mounted controller or wireless handheld controller, shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, and a test run switch. Indoor unit and refrigerant pipes shall be purged with dry nitrogen before shipment from the factory.

B. Unit Cabinet: The cabinet shall be formed from high strength molded plastic with smooth finish, flat front panel design with access for filter. Cabinet color shall be white. The unit shall be wall mounted by means of a factory supplied, pre-drilled, mounting plate.

C. Fan: The indoor unit fan shall be high performance, double inlet, forward curve, direct drive sirocco fan with a single motor. The fans shall be statically and dynamically balanced and run on a motor with permanently lubricated bearings. The indoor fan shall consist of three (3) speeds: Low, Mid, and Hi and Auto. The fan shall have a selectable Auto fan setting that will adjust the fan speed based on the difference between controller set-point and space temperature.

D. Vane: There shall be a motorized horizontal vane to automatically direct air flow in a horizontal and downward direction for uniform air distribution. The horizontal vane shall significantly decrease downward air resistance for lower sound levels, and shall close the outlet port when operation is stopped. There shall also be a set of vertical vanes to provide horizontal swing airflow movement.

E. Filter: Return air shall be filtered by means of an easily removable washable filter.

F. Coil: The evaporator coil shall be of nonferrous construction with pre-coated aluminum strake fins on copper tubing. The multi-angled heat exchanger shall have a modified fin shape that reduces air resistance for a smoother, quieter airflow. All tube joints shall be brazed with PhosCopper or silver alloy. The coils shall be pressure tested at the factory. A condensate pan and drain shall be provided under the coil. An optional drain pan level switch (DPLS1), designed to connect to the control board, shall be provided and installed on the condensate pan to prevent condensate from overflowing.

G. System Control: The control system shall consist of a minimum of two (2) microprocessors, one on each indoor and outdoor unit, interconnected by a single non-polar two-wire cable. The microprocessor located in the indoor unit shall have the capability of monitoring return air temperature and indoor coil temperature, receiving and processing commands from a wireless or wired controller, providing emergency operation and controlling the outdoor unit. The control signal between the indoor and outdoor unit shall be pulse signal 24 volts DC. Indoor units shall have the ability to control supplemental heat via connector and a 12 VDC output.

PART 3 - EXECUTION

3.1 GENERAL

A. Install unit in accordance with manufacturer’s installation instructions. Install unit plumb and level, firmly anchored in location indicated, and maintain manufacturer’s recommended clearances.

B. Complete system refrigerant charge shall be provided by the Contractor.

3.2 ELECTRICAL WIRING

A. Install and connect electrical devices furnished by manufacturer but not specified to be factory mounted. Furnish copy of manufacturer’s electrical connection diagram submittal to the electrical contractor.

3.3 PIPING CONNECTIONS

A. Install and connect devices furnished by the manufacturer but not specified to be factory mounted. Furnish a copy of manufacturer’s piping connection diagram submittal to the piping contractor.

3.4 SUPPLY AND DRAIN WATER PIPING

A. Connect water supply and drain connections to the air conditioning unit. Provide pitch and trap per manufacturer's instructions and local codes.

3.5 START UP

A. Start up air conditioning unit in accordance with manufacturer's start up instructions. Test controls and demonstrate compliance with requirements.

END OF SECTION 238126

SECTION 250500 – BASIC MATERIALS AND METHODS

PART 1 – GENERAL

1.1 PROVISIONS INCLUDED

A. Include General Conditions, Supplementary General Conditions Division 0 and applicable parts of Division 01 for conditions and requirements which may affect the work of this Section.

B. Examine all other Sections of the specifications for requirements which affect work under this Section whether or not such work is specifically mentioned in this Section.

C. Coordinate work with that of all other Trades affecting, or affected by work of this Section. Cooperate with such Trades to ensure the steady progress of all work under the Contract.

1.2 DEFINITIONS

A. Words in the singular shall also mean and include the plural, wherever the context so indicates and words in the plural shall mean the singular, wherever the context so indicates.

B. Wherever the terms "shown on drawings" are used in the specifications, they shall mean "noted", "indicated", "scheduled", "detailed", or any other diagrammatic or written reference made on the drawings.

C. Wherever the term "provide" is used in the specifications it will mean "furnish" and "install", "connect", "apply", "erect", "construct", or similar terms, unless otherwise indicated in the specifications.

D. Wherever the term "material" is used in the specifications it will mean any product", "equipment", "device", "assembly", or "item" required under the Contract, as indicated by trade or brand name, manufacturer's name, standard specification reference or other description.

E. The terms "approved", or "approval" shall mean the written approval of the Architect.

F. The term "specification" shall mean all information contained in the bound or unbound volume, including all "Contract Documents" defined therein, except for the drawings.

G. The terms "directed", "required", "permitted", "ordered", "designated", "prescribed" and similar words shall mean the direction, requirement, permission, order, designation or prescription of the Architect. The terms "approved", "acceptable", "satisfactory" and similar words shall mean approved by, acceptable or satisfactory to the Architect. The terms "necessary", "reasonable", "proper", "correct" and similar words shall mean necessary, reasonable, proper or correct in the judgment of the Architect.

H. "Piping" includes in addition to pipe or mains, all fittings, flanges, unions, valves, strainers, drains, hangers and other accessories relative to such piping.

I. Algorithm: A logical procedure for solving a recurrent mathematical problem; A prescribed set of well-defined rules or processes for the solution of a problem in a finite number of steps.

J. Analog: A continuously varying signal value (e.g., temperature, current, velocity etc.

K. BACnet: Building Automation Control Network Protocol, ASHRAE Standard 135.

L. Baud: It is a signal change in a communication link. One signal change can represent one or more bits of information depending on type of transmission scheme. Simple peripheral communication is normally one bit per Baud. (e.g., Baud rate = 78,000 Baud/sec is 78,000 bits/sec, if one signal change = 1 bit).

M. BIBB's: BACnet Interoperability Building Block.

N. Binary: A two-state system where a high signal level represents an "ON" condition and an "OFF" condition is represented by a low signal level.

O. "Concealed" means hidden from sight in chases, furred spaces, shafts, hung ceilings, embedded in construction or in crawl spaces.

P. Deadband: A temperature range over which no heating or cooling is supplied, i.e., 22-25 degrees C (72-78 degrees F), as opposed to a single point change over or overlap).

Q. Diagnostic Program: A software test program, which is used to detect and report system or peripheral malfunctions and failures. Generally, this system is performed at the initial startup of the system.

R. Direct Digital Control (DDC): Microprocessor based control including Analog/Digital conversion and program logic. A control loop or subsystem in which digital and analog information is received and processed by a microprocessor, and digital control signals are generated based on control algorithms and transmitted to field devices in order to achieve a set of predefined conditions.

S. Distributed Control System: A system in which the processing of system data is decentralized and control decisions can and are made at the subsystem level. System operational programs and information are provided to the remote subsystems and status is reported back to the Engineering Control Center. Upon the loss of communication with the Engineering Control center, the subsystems shall be capable of operating in a stand-alone mode using the last best available data.

T. Download: The electronic transfer of programs and data files from a central computer or operation workstation with secondary memory devices to remote computers in a network (distributed) system.

U. Electrical Control: A control circuit that operates on line or low voltage and uses a mechanical means, such as a temperature sensitive bimetal or bellows, to perform control functions, such as actuating a switch or positioning a potentiometer.

V. Electronic Control: A control circuit that operates on low voltage and uses a solid-state components to amplify input signals and perform control functions, such as operating a relay or providing an output signal to position an actuator.

W. Ethernet: A trademark for a system for exchanging messages between computers on a local area network using coaxial, fiber optic, or twisted-pair cables.

X. "Exposed" means not installed underground or "concealed" as defined above.

Y. "Invert Elevation" means the elevation of the inside bottom of the pipe.

Z. "HVAC, Plumbing, and/or Fire Protection Contractor" shall refer to the Contractor or his Subcontractors responsible for furnishing and installation of all work indicated on the HVAC,

Plumbing, and/or Fire Protection drawings and specifications, as applicable and or referenced to each Trade in the Architectural and/or Structural documents.

AA. I/O Unit: The section of a digital control system through which information is received and transmitted. I/O refers to analog input (AI, digital input (DI), analog output (AO) and digital output (DO). Analog signals are continuous and represent temperature, pressure, flow rate etc, whereas digital signals convert electronic signals to digital pulses (values), represent motor status, filter status, on-off equipment etc.

BB. I/P: Internet Protocol-global network, connecting workstations and other host computers, servers etc. to share the information.

CC. Local Area Network (LAN): A communication bus that interconnects operator workstation and digital controllers for peer-to-peer communications, sharing resources and exchanging information.

DD. LonMark: An association comprising of suppliers and installers of LonTalk products. The Association provides guidelines for the implementation of the LonTalk protocol to ensure interoperability through Standard implementation.

EE. LonWorks: Network technology developed by the Echelon Corporation.

FF. NAC – Network Application Controller: This controller shall have all the functions of a Network Automation Controller but shall also have direct input/output capabilities for operating large equipment in a stand alone fashion.

GG. NAN – Network Automation Node: A stand-alone, multi-tasking, multi-user, real-time digital processor complete with all hardware, software, and communications interfaces to manage network traffic between Tier 1 and Tier 2 controllers.

HH. Network: A set of computers or other digital devices communicating with each other over a medium such as wire, coax, fiber optics cable etc.

II. "Mechanical Contractor" shall refer to the Fire Protection, Plumbing, HVAC and ATC Contractors, as applicable.

JJ. MS/TP: Master-slave/token-passing.

KK. Operating system (OS): Software, which controls the execution of computer application programs.

LL. Peer-to-Peer: A networking architecture that treats all network stations as equal partners.

MM. PICS: BACnet Protocol Implementation Conformance Statement.

NN. UAC: Unitary Application Controller, digital controller, dedicated to a specific piece of terminal equipment, such as VAV boxes, fan coil units, etc.

1.3 CODES, STANDARDS AND REFERENCES

A. All materials and workmanship shall comply with all applicable Codes, Specifications, Local and State Ordinances, Industry Standards and Utility Company Regulations, latest editions.

B. In case of difference between Building Codes, State Laws, Local Ordinances, Industry Standards and Utility Company Regulations and the Contract Documents, the Mechanical Contractor, as applicable, shall promptly notify the Architect in writing of any such difference.

C. In case of conflict between the Contract Documents and the requirements of any Code or Authorities having jurisdiction, the most stringent requirements of the aforementioned shall govern for budgetary purposes. However, no work will proceed until the Architect determines the correct method of installation.

D. Should any Contractor, as applicable, perform any work that does not comply with the requirements of the applicable Building Codes, State Laws, Local Ordinances, Industry Standards and Utility Company Regulations, he shall bear all costs arising in correcting the deficiencies, as approved by the Architect.

E. Applicable Codes and Standards shall include all State Laws, Local Ordinances, Utility Company Regulations and the applicable requirements of the following accepted Codes and Standards, without limiting the number, as follows:

1. National Electrical Code (NEC)

2. Environmental Protection Agency (EPA)

3. STATE -- Environmental Air Quality Protection Agency

4. STATE -- Energy Code

5. STATE -- Building Code/IBC (Latest Adopted Edition), including all adopted -- STATE -- Supplements

6. STATE -- Fire Prevention Regulations and Elevator Regulations

7. Local Ordinances, Regulations of the Local Building Department and Fire Department

8. (Applies only to Hospitals) Guidelines for Construction and Equipment of hospital and Medical Facilities, as published by A.I.A. Press, ISBN 1-57165-002-4, U.S. Dept. of Health and Human Services

9. Recommendations of the National Fire Protection Association (NFPA), latest applicable edition adopted, in general and in particular:

a. Life Safety, NFPA 101

b. HVAC, NFPA 90A, 90B

c. Removal of Smoke and Grease Laden Vapors from Commercial Cooking Equipment, NFPA 96

10. Recommendations of ASHRAE (American Society of Heating, Refrigeration and Air Conditioning Engineers), including:

a. ASHRAE 90.1

b. ANSI/ASHRAE 62-Ventilation for Acceptable Indoor Air Quality

c. ANSI/ASHRAE 15-Safety Code for Mechanical Refrigeration

d. ANSI/ASHRAE 110-Method of Testing Performance of Laboratory Fume Hoods

e. ANSI/ASHRAE 55-Thermal Environmental Conditions for Human Occupancy

F. Each Contractor for the work under his charge, shall give all necessary notices, obtain and pay for all permits, pay all governmental taxes, fees and other costs in connection with his work; file for necessary approvals with the jurisdiction under which the work is to be performed. Each Contractor shall obtain all required Certificates of Inspection for his work and deliver same to the Architect before request for acceptance of his portion of work and before final payment is made.

G. All equipment shall be installed per manufacturer’s recommendations and requirements. The Contractor shall notify the Engineer in writing when they intend to deviate from manufacturer's installation guidelines. The Engineer shall advise if the installation is acceptable prior to installation.

1.4 SUBMITTALS

A. Submit detailed shop drawings or brochures for approval of equipment and material proposed to be used on this project. Furnish the number of copies required by General Conditions.

B. Documents submitted shall show the following:

1. Principal dimensions and details of construction.

2. Operating and maintenance clearances.

3. Weights of principal parts and total weights with information required for the design of supports and foundations.

4. Sizes and location of piping and connections.

5. Performance data, including pump and fan curves; sound data including sound power dB levels in 1/3 octave bands.

6. Data on electric motors, including brake horsepower of driven equipment, nameplate ratings and classes, sound data, starting and running full load currents, required starter size and recommended overload heater ratings.

7. Approval stamp of Underwriters' and other authorities having jurisdiction of Contract Drawings requiring such approval.

8. Certified performance guarantees.

9. Calculations and details for refrigeration for field assembled systems including description of specialties and pressure drops, layout of piping with lengths fittings, and refrigerant specialties, and capacity curves for evaporator and compressor showing balance points.

10. Minimum scale for sheet metal plans and piping plans shall be 3/8 inch equal 1 foot.

C. Submit brochures that contain only that information which is relative to the particular equipment or materials to be furnished. Do not submit catalogs that describe several different items other than those items to be used unless irrelevant information is marked out and relevant material is clearly marked.

D. Specifications Compliance Statement

1. The manufacturer shall submit a point by point statement of compliance with the specifications.

2. The statement of compliance shall consist of a list of all paragraphs (line by line).

3. Where the proposed system complies fully, such shall be indicated by placing the word "comply: opposite the paragraph number.

4. Where the proposed system does not comply, or accomplishes the stated function in a manner different from that described, a full description of the deviation shall be provided.

5. Where a full description of a deviation is not provided, it shall be assumed that the proposed system does not comply with the paragraph in question.

6. Submissions which do not include a point by point statement of compliance as specified shall be disqualified.

1.5 GUARANTEE

A. Attention is directed to provisions of the General Conditions and Supplementary General Conditions regarding guarantees and warranties for work under this Contract.

B. Manufacturers shall provide their standard guarantees for work under this Contract, unless specified otherwise. However, such guarantees shall be in addition to and not in lieu of all other liabilities which the manufacturer and GC / CM may have by Law or by other provisions of the Contract Documents. In any case, such guarantees and warranties shall commence when the Owner accepts the various systems, as applicable and as determined by the Architect. The guarantees and warranties will remain in effect for a minimum period of (1) year thereafter except where longer periods are specifically stated and specified.

C. All materials, items of equipment and workmanship furnished under HVAC, shall carry the warranty against all defects in material and workmanship. Any fault due to defective or improper material, equipment, workmanship or design which may develop shall be made good, forthwith, by and at the expense of the Contractor responsible, including all other damage done to areas, materials and other systems resulting from this failure.

D. Each Contractor shall guarantee that all elements of the systems provided under his Contract, are of sufficient capacity to meet the specified performance requirements as set forth herein or as indicated on the drawings.

E. Upon receipt of notice from the Owner of failure of any part of the systems or equipment during the guarantee period, the affected part or parts shall be replaced by the responsible Contractor.

F. Each Contractor shall furnish, before the final payment is made, a written guarantee covering the above requirements.

1.6 COMMISSIONING

A. The TBA Contractor must also include sufficient man-hours within their bids, for their participation with the Commissioning Team and the rebalancing/readjusting/resetting all device setpoints, as required. For additional work, refer to Division 23 and Section 019113.

1.7 THE CONTRACTOR

A. Each Contractor shall base his bid on site examinations performed by him. This requirement is mandatory. Each Contractor shall visit the proposed site where work is scheduled to be performed and ascertain for himself the amount of work required to fulfill the intent of his Contract and the complexity of the installation. Each Contractor shall not hold the Architect, his Consultants, agents or employees responsible for or bound by, any schedule, estimate or for any plan thereof. Each Contractor shall study all Contract Documents (HVAC, Plumbing, Fire Protection, Electrical, Communications, Architectural, Structural), etc., included under each Contract, to determine exactly the extent of work to be provided under each Section, and in installing new equipment and systems and coordinating the work with the other Trades and existing conditions.

B. Each Contractor shall faithfully execute his work according to the terms and conditions of the Contract and specifications and shall take all responsibility for and bear all losses resulting to him in the execution of his work.

C. Each Contractor shall be responsible for the location and performance of work provided under his Contract as indicated on the Contract Documents. All parties employed directly or indirectly by each Contractor shall perform their work according to all the conditions as set forth in these specifications.

D. Each Contractor shall furnish all materials and perform all work in accordance with the project specifications and any supplementary documents provided by the Architect. The work shall include every item shown on the drawings and/or required by the specifications as interpreted by the Architect. All work and materials furnished and installed shall be new and of the best quality and workmanship. Each Contractor shall cooperate with the Architect so that no error or discrepancy in the Contract Documents shall cause defective materials to be used or poor workmanship to be performed.

1.8 COORDINATION OF WORK

A. Each Contractor shall compare his drawings and specifications with those of other Trades and report any discrepancies between them to the Architect and obtain from the Architect written instructions for changes necessary in the mechanical or electrical work, to ensure that all work is installed in coordination and cooperation with other Trades installing interrelated work. Before installation, each Contractor shall make proper provisions to avoid interferences in a manner approved by the Architect. All changes required in the work of each Contractor caused by his negligence, shall be corrected by him at his own expense, to the Architect's satisfaction.

B. Locations of piping, ductwork, conduits and equipment shall be adjusted to accommodate the new work with interferences anticipated and encountered during installation. Each Contractor shall determine the exact routing and location of his systems prior to fabrication or installation of any system component. Accurate measurements and coordination drawings will have to be completed to verify dimensions and characteristics of the various systems' installations.

C. Lines which pitch shall have the right-of-wayover those which do not pitch. For example, waste piping shall normally have the right-of-way. Lines whose elevations cannot be changed shall have the right-of-way over lines whose elevations can be changed.

D. Offsets, transitions and changes of direction in all systems shall be made as required to maintain proper headroom and pitch of sloping lines whether or not indicated on the drawings. Each Contractor shall provide manual air vents and drains as required for his work to affect these offsets, transitions and changes in direction, as applicable.

E. All work shall be installed in a way to permit removal (without damage to other parts) of coils, filters, control appurtenances, fan shafts and wheels, filters, belt guards, sheaves and drives and all other system components provided under this Contract requiring periodic replacement or maintenance. All piping shall be arranged in a manner to clear the openings of swinging overhead access doors, ceiling tiles and cleaning access doors in ductwork.

1. Access to any and all components requiring servicing, adjustment, calibration, maintenance or periodic replacement shall be provided so that the Owner's operations personnel can freely gain access without removal of any materials other than the access panel or ceiling tile. Access shall be understood to mean free, clear and unobstructed from the floor up to the device and/or component being serviced. Access panels for VAV/CV boxes shall be 24" x 24" minimum.

2. Fire rated access doors with closers shall be provided for all rated assemblies.

F. The Contract Drawings are diagrammatic only intending to show general runs and locations of piping, ductwork, equipment, terminals and specialties and not necessarily showing all required offsets, details and accessories and equipment to be connected. All work shall be accurately laid out with other Trades to avoid conflicts and to obtain a neat and workmanlike installation which will afford maximum accessibility for operation, maintenance and headroom.

G. Where discrepancies in scope of work as to what Trade provides items, such as starters, disconnects, flow switches, electric control components, etc., exist, such conflicts shall be reported to the Architect prior to signing of the Contract. If such action is not taken, each Contractor, as applicable, shall furnish such items as part of his work, for complete and operable systems and equipment, as determined by the Architect.

H. Where drawing details, plans and/or specification requirements are in conflict and where pipe or duct sizes of same pipe or duct run are shown to be different between plans and/or between plans and sections or details, the most stringent requirement will be included in the Contract. HVAC systems and equipment called for in the specification and/or shown on the drawings shall be provided under this Contract as if it were required by both the drawings and specifications. However, prior to ordering or installation of any portion of work which appears to be in conflict, such work shall be brought to Architect's attention for direction as to what is to be provided.

I. Final location of all air distribution devices, thermostats, heaters, control devices, sprinkler heads, etc., shall be coordinated with the Architectural reflected ceiling plans and/or other Architectural details, as applicable. (**Note**: Sprinkler head locations shall provide the specified coverage rating and water flow density, and shall be in accordance with all applicable Codes and in full compliance with the requirements of the Owner's insurance carrier.) Offsets of

ductwork, added sheet metal, fittings, elbows, flexible connections, etc., shall be provided as required to comply with the Architectural reflected ceiling plans and/or installation details. Obtain approval of locations of all devices from Architect in the field, prior to installation.

1.9 COORDINATION DRAWINGS

A. Before materials are purchased, fabricated or work is begun, each Contractor shall prepare coordination drawings for all floors/areas, including buried systems/services (all-Trade-composite at 3/8" scale), showing the size and location of his equipment and lines, in the manner described herein under General Requirements.

B. Coordination drawings are for the GC / CM and Architect's use during construction and shall not be construed as shop drawings or as replacing any shop drawings. The coordination drawings, when corrected for actual "as-built" conditions, will be reviewed by the Architect, corrected and become the Record Drawings to be submitted to the Owner for his use.

C. The cost of producing and reproducing the drawings will be included under the Contract of each Trade, including the cost or preparation of the Architectural building outlines. This process may include multiple revisions to these drawings which will be included in the cost. The intent is to provide a fully coordinated set of documents between trades no matter how many times they may have to be redone. The HVAC Contractor shall take the lead to produce the Architectural backgrounds, show all ductwork, piping, etc., and circulate the drawings to any of his Subcontractors and the other Trades (Plumbing, Fire Protection, Electrical), so that they can indicate all their work as directed by the GC / CM and Architect as required, to result in a fully coordinated installation.

D. In addition to the regular coordination drawing review, the mechanical work will also be reviewed by the Architect/Engineer to ensure that the system and equipment arrangements are suitable to provide maintenance access and service as follows:

1. Valves and instrumentation should be grouped where possible and positioned in accessible locations.

2. Valves on pipes of 6" and larger, positioned above 7'-0" in height from the operating level, will be provided with chain operated valve wheels and be located where chains will not interfere with primary access through the mechanical room.

3. Location of control/diagnostic panels shall be shown and identified on the mechanical room coordination drawings.

E. Prepare a complete set of computer based AutoCAD (Latest Version) drawings at scale not less than 3/8" scale equals 1'-0", showing basic layout for the structure and other information as needed for preparation of Coordination Drawings. The drawings shall indicate the layout of all specialty tradework as indicated herein and shall be designated as Coordination Drawings. The Contractors can purchase a copy of the floor plans on disk from the Engineer, **at the cost of**

$35.00/drawing, to assist in the preparation of Coordination Drawings. The Contractor shall provide a minimum of two (2) weeks' notice to the Engineer for preparation of the disk. A signed liability release form will be required from the Contractor prior to the release of the disk from the Engineer.

F. Highlight all smoke and fire rated partitions on the Coordination Drawings for appropriate coordination.

G. The main paths for the installation or removal of equipment from mechanical and electrical rooms shall be clearly indicated on the Coordination Drawings.

H. Each of the specialty trades shall add its work to the base drawings with appropriate elevations and grid dimensions. Specialty trade information shall be required for fan rooms and mechanical rooms, horizontal exits from duct shafts, crossovers and for spaces it the above ceilings where congestion of work may occur such as corridors and, where required, entire floors. Drawings shall indicate horizontal and vertical dimensions to avoid interference with structural framing, ceilings, partitions and other services. Indicate elevations relative to finish floor for bottom of ductwork and piping and conduit 6" greater in diameter.

1. Specialty Trade shall include:

    a. Plumbing system.
    b. HVAC piping and associated control systems.
    c. Electrical.
    d. Sheet Metal Work.
    e. Fire Protection system.
    f. Automatic Temperature Control
    g. Fire Alarm
    h. Security
    i. Telecommunications
    j. Pneumatic Tube
    k. Commissioning

I. Upon completing their portion of the Coordination Drawings, each specialty trade shall sign, date and return Coordination Drawings to the Contractor.

J. Where conflicts occur with placement of materials of various trades, the General Contractor shall be responsible to coordinate the available space to accommodate all trades. Any resulting adjustments shall be initialed and dated by the affected specialty trade Subcontractor. The General Contractor shall then final date and sign each drawing.

K. Fabrication shall not start until Coordination Drawings have been distributed to all parties as indicated herein.

L. Format: Coordination Drawings (plans only) shall be done using CAD in AutoCAD (Latest Version), in either IBM or Mac Format. Disks shall be given to the Architect for future transfer to Owner. Coordination Drawings will be used as base for as-built drawings.

M. Distribution of Coordination Drawings:

1. The General Contractor shall provide one print of each Coordination Drawing to:

    a. Each specialty trade Subcontractor.
    b. Owner.
    c. General Contractor.

d. Architect (for record purposes).

N. After distribution:

1. Resolve all interference's not previously identified.

O. Coordination Drawings include but are not necessarily limited to:

1. Structure.

2. Partition/room layout, including indication of smoke and fire resistance rated partitions.

3. Ceiling layout and heights.

4. Light fixtures.

5. Access panels.

6. Sheet metal, heating coils, heat pumps, grilles, diffusers, etc.

7. All heating piping and valves.

8. Smoke and fire dampers.

9. Soil, waste and vent piping.

10. Major water and gases.

11. Major electrical conduit runs, panelboards, feeder conduit and racks of branch conduit. Motor control centers, starters and disconnects.

12. Sprinkler piping and heads.

13. All equipment, including items in the Contract as well as O.F.C.I. and O.F.I. items.

14. Equipment located above finished ceiling requiring access for maintenance and service. In locations where acoustical lay-in ceilings occur indicate areas in which the required access area may be greater than the suspected grid systems.

15. Rainwater Piping.

16. Existing conditions, including, but not limited to, Mechanical, Plumbing, Fire Protection and Electrical items.

17. ATC panels.

18. Pneumatic tube system.

P. The Architect’s response to all requests for information (RFI’s) generated by the trade contractors shall be distributed to all other affected trades as if this information was contained in the original contract documents. In other words, the party that issues an RFI is responsible for distributing the information to all affected parties.

1.10 RECORD DRAWINGS

A. Each Contractor shall maintain, current at the site, a set of Contract Drawings for his portion of the work on which he shall accurately show the actual installation of all work provided under his Contract indicating any variation from the Contract Drawings, in accordance with the General Conditions and Supplementary General Conditions. Changes whether resulting from formal change orders, requests for information, or other instructions issued by the Architect shall be recorded. Include changes in sizes, location and dimensions of piping, ducts, equipment, etc.

B. Each Contractor shall indicate progress by coloring-in various pipes, ducts and associated appurtenances exactly as they are erected. This process shall incorporate both the changes noted above and all other deviations from the original drawings whether resulting from job conditions encountered or from any other causes.

C. The marked-up and colored-up prints will be used as a guide for determining the progress of the work installed. They shall be inspected periodically by the Architect and Owner's representatives and they shall be corrected if found either inaccurate or incomplete. This procedure is mandatory. Marked up drawings shall include all flow diagrams, schedules, details and control diagrams.

D. Each Contractor shall meet at a minimum on a monthly basis, with the Owner's representative to transfer the information from his HVAC, Plumbing, Fire Protection, etc., marked-up and colored-up prints to a set which will become the basis for preparation of as-built drawings.

E. Upon completion of the project, each Contractor shall submit his marked-up drawings to the Architect for review and comment. After the Architect reviews and comments on this set of documents, each Contractor shall prepare as-built drawings on CAD using AutoCAD (Latest Version). When the work is completed, each Contractor shall provide 2 hard copies to the Architect for submittal to the Owner and disks with all documentation and a set of reproducible drawing plots marked "As-Built" drawings. The Contractor shall bear all costs of producing the CAD "As-Built" drawings, providing all necessary drawing changes and printing the reproducible drawings for the work under his charge.

1.11 GIVING INFORMATION

A. Each Contractor shall keep himself fully informed as to the shape, size and position of all openings required for his apparatus and shall give information to the Architect and other Contractors [or Subcontractors] sufficiently in advance of the work so that all openings may be built in advance.

B. The manufacturers listed within this specification have been preselected for use on this project. No submittal will be accepted from a manufacturer other than those specified. Should any Contractor wish to propose a substitution during the bid period, such request shall be made in writing to the Architect, at least (15) working days, prior to bid date. If substitutions are deemed acceptable, such items shall be issued as an Addendum, prior to bid due date. The above requirement is mandatory.

1.12 EQUIPMENT AND MATERIALS

A. Equipment and materials shall be delivered to the site and stored in original sealed containers, suitably sheltered from the elements, but readily accessible for inspection by the Architect until installed. All items subject to moisture damage such as controls, filters, etc., shall be stored in dry, heated spaces.

B. Each Contractor shall have his equipment tightly covered and protected against dirt, water and chemical or mechanical injury and theft. At the completion of the work, equipment and materials

shall be cleaned, polished thoroughly and turned over the Owner in a condition satisfactory to the Architect. Damage or defects developing before acceptance of the work shall be made good at each Contractor's [or Subcontractor's] expense as applicable.

C. Each Contractor shall make necessary field measurements to ascertain space requirements, for equipment and connections to be provided under his Trade and shall furnish and install such sizes and shapes of equipment to allow for the final installation to conform to the drawings and specifications.

D. Manufacturers' directions shall be followed completely in the delivery, storage, protection and installation of any equipment. Promptly notify the Architect in writing of any conflict between any requirements of the Contract Documents and the manufacturer's directions and obtain the Architect's written instructions before proceeding with the work. Should any Contractor perform any work that does not comply with the manufacturer's directions or written instructions from the Architect, he shall bear all costs arising in correcting any deficiencies that should arise.

E. Each Contractor shall furnish and install all equipment, accessories, connections and incidental items necessary to fully complete the work under his Contract for use, occupancy and operation by the Owner.

F. Where equipment of the acceptable manufacturers requires different arrangement or connections from those shown, it shall be the responsibility of each Contractor to install the equipment to operate properly and in harmony with the original intent of the drawings and specifications. When directed by the Architect, each Contractor shall submit drawings showing the proposed installation. If the proposed installation is approved, each Contractor shall make all necessary changes in all effected related work provided under other Sections including location of roughing-in connections by other Trades, electrical requirements, piping, supports, insulation, etc. All changes shall be made at no increase in the Contract amount or additional cost to the other Trades and/or Owner.

G. Testing Agency Labeling Requirements

1. All equipment and materials required for installation under these specifications shall be new and without blemish or defect.

2. All equipment shall meet OSHA standards.

3. Equipment and materials shall be products which will meet with the acceptance of the Authorities Having Jurisdiction (AHJ) over the work and as specified hereinbefore and below.

a. Where such acceptance by the AHJ of any given product is contingent upon having the FM Global, it shall be provided with an FM Global label and be constructed in compliance with FM Global’s standards and guidelines.

b. All products shall be listed and labeled by UL or other national testing laboratories such as ETL and the products shall be so labeled.

1) Label of Underwriter’s Laboratories, ETL or other nationally recognized testing agency acceptable to the Authorities Having Jurisdiction.

2) This Labeling shall include not just the control panel and/or motor but all wiring and devices included in the package as a complete package. Note: Providing a series of individually labeled electrical devices that are then assembled into a package does not meet this requirement, the whole

assembly must be labeled as an assembly. The manufacturers have the option of having the equipment inspected and Labeled at the factory or at the site after installation. This requirement shall supersede any other specification language hereinbefore or hereinafter that requires only portions of the equipment to be labeled.

3) Some examples of packaged equipment requiring Labeling:

a) Sump pumpsets
b) Ejector pumpsets
c) Laboratory waste ejector pumpsets
d) Fuel oil transfer pump skids
e) Steam condensate pumpsets
f) Duplex air compressor system
g) Air handling units (packaged and custom built-up)
h) Cooling towers
i) Chillers
j) Boilers
k) Feed water equipment
l) pH Neutralization system skids
m) High purity water system skids (such as RODI units)
n) Laboratory and/or Medical Air compressor skids
o) Vacuum pumpsets
p) Water pressure booster systems
q) Animal watering system skids
r) Cooling tower water filtration system
s) Cooling coil condensate water collection and discharge systems

4. HVAC/Smoke Control System Operation

a. On/Auto/Off switches and status indicators (LEDS) shall be provided for monitoring and manual control of each fan, damper, HVAC control unit, stairwell pressurization fan, space pressurization and smoke exhaust fan. To ensure compliance, the units supplied shall meet the following **UL categories: UUKL, PAZX, UDTZ, QVAX** as well as the requirements of NFPA 90A, HVAC, and NFPA 92A & 92B, Smoke Control. The control system shall be field programmable for either 90A operation or 92A/B operation to allow for future use and system expansion.

b. All devices shall be UUKL listed.

H. All equipment of one type (such as valves, fans, air handling units [packaged or custom built], air terminals, heat pumps, plumbing fixtures, etc.), shall be the product of one manufacturer.

I. Equipment prepurchased on behalf of the Owner or by the Owner himself, if assigned to any of the Contractors, shall be received, inspected, installed, etc., as if it was purchased by the Contractors as applicable. All guarantees, service contracts, etc., shall be the same as for all other equipment provided under this Contract.

1.13 CUTTING AND PATCHING

A. Each Contractor shall be responsible for all core drilling, as required for work under his Contract, but in no case shall he cut into any structural elements without the written approval of the Architect.

B. All cutting, rough patching and finish patching, shall be provided under this Contract.

C. All concrete and masonry equipment bases shall be provided under this Contract.

1.14 USE OF PREMISES

A. Each Contractor shall confine all of his apparatus, storage of materials and construction to the limits indicated on the drawings and directed by the Architect and he shall not encumber the premises with his materials.

B. In storing materials within areas (structure or ground), or when used as a shop, each Contractor shall consult with the General Contractor/Construction Manager and shall restrict his storage to space designated for such purposes. Each Contractor will be held responsible for repairs, patching or cleaning arising from any unauthorized use of premises.

C. Notwithstanding any approvals or instructions which must be obtained by each Contractor from the Architect in connection with use of premises, the responsibility for the safe working conditions at the site shall remain each Contractor's. The Architect or Owner shall not be deemed to have any responsibility or liability in connection therewith.

D. Air handling unit or cooling tower sections shall not be used for storage of materials. The HVAC Contractor will be responsible for securing, and maintaining the equipment clean. The above requirement is mandatory.

1.15 PROTECTION/CLEANLINESS

A. All materials such as valves, fittings, piping, ductwork, plenums, grilles, registers, diffusers, etc., shall be properly protected from the accumulation of dirt, dust, debris or any other contaminants. All ductwork and piping openings shall be temporarily closed by each Contractor [or Subcontractor] installing same, so to prevent obstruction and damage, as a minimum at the end of each working day or more often if required by job conditions. Each Contractor shall take precautions to protect his materials from damage and theft.

B. Each Contractor shall furnish, place and maintain proper safety guards for the prevention of accidents that might be caused by the workmanship, materials, equipment or electrical systems provided under his Contract.

1.16 DAMAGE CORRECTION AND EXTRA WORK

A. Each Contractor shall be held responsible and shall pay for all damages caused by his work to the new and existing building structures and new and existing equipment, piping, duct systems, etc., and all work and finishes installed under this Contract in the new or in existing building. Repair of such damage shall be done as herein before specified, at the expense of each Contractor and to the Architect's satisfaction.

B. Each Contractor shall promptly correct all work provided under his Contract and rejected by the Architect as defective or as failing to conform to the Contract Documents whether observed before or after completion of work and whether or not fabricated, installed or completed. Each Contractor shall bear all costs of correcting such rejected work.

C. No claim for extra work will be allowed unless it is authorized by the Architect in writing before commencement of the extra said work.

1.17 TOUCH-UP PAINTING

A. Each Contractor shall thoroughly clean all equipment and systems provided under this Contract from rust, splatters and other foreign matter or discoloration, leaving every part of each system in an acceptable prime condition. Each Contractor, for the work under his Contract, shall refinish and restore to the original condition all equipment and piping which has sustained damage to the manufacturer's prime and finish coats of paint and/or enamel.

1.18 HOUSEKEEPING PADS

A. Coordinate housekeeping pads for:

1. All equipment indoors or outdoors

2. All floor supports or braces

B. Pads shall be 4" above the finished floor.

C. Each pad shall be a minimum of 6" larger than the equipment, support or isolation base in all directions.

D. Pads shall be formed, poured with concrete, and tooled by the General Contractor.

1.19 SEISMIC

A. Provide seismic restraints and seismic certified equipment in full compliance with ASCE Standard 7.

1. This shall be in compliance with Division 23 Specifications and provided by the Division 25 Contractor.

1.20 DUCT AND PIPE SLEEVES, PLATES AND ESCUTCHEONS, FIRESTOPPING AND SMOKEPROOFING

A. Where piping and/or ductwork pass through masonry or concrete walls or drywall partitions or floors, each Contractor shall provide and set individual sleeves for each pipe or duct and all other work under his charge, as necessary for passage of all pipes and/or ducts. Sleeves shall be of sufficient size to provide 1/2" air space around the pipe or duct passing through (including insulation where pipes or ducts are internally/externally insulated). All openings shall be sealed, smokeproofed and made tight. Each Contractor shall be responsible for the exact location of sleeves provided under his Contract and shall coordinate all requirements for piping and ductwork sleeves.

B. Each Contractor, for work under his charge, shall determine the required inside diameter of each individual wall opening or sleeve before ordering, fabrication or installation.

C. Sleeves and inserts shall not be used in any portions of the building, where their use would impair the strength or construction features of the building. Elimination of sleeves must be approved by the Architect.

D. Provide chrome plated brass escutcheons with set screw for exposed piping, in all areas except in mechanical rooms. In this area use plain brass or cast iron escutcheons suitable for painting. All escutcheons shall be sized to fit the bare pipe or insulation in a snug and neat manner. They shall be of sufficient size to cover sleeved openings for the pipes and of sufficient depth to cover

sleeves projecting above floors. Escutcheons shall be as manufactured by Beaton & Caldwell, Dearborn Brass, or Grinnell.

E. Pipe or duct sleeves shall be made of Schedule 40 pipe, 20 gauge galvanized steel or 16 gauge steel as follows:

1. Sleeves on pipes passing through masonry or concrete construction shall be Schedule 40 pipe.

2. Sleeves on ducts passing through concrete construction shall be 20 gauge steel unless required otherwise by item 4. below.

3. Sleeves on pipes or ducts passing through fire rated partitions shall be 16 gauge steel.

4. Sleeves on pipes or ducts passing through non-rated drywall construction shall be 20 gauge galvanized steel.

F. Pipe or duct sleeves shall be set as follows:

1. Set sleeves 1" above finish floor, (except set sleeves, 6" above finish floor at penthouses or mechanical rooms and 6” above finished roof) and flush on each side of walls. Coordinate roof penetrations with roof Subcontractor.

2. Sleeves shall be set securely in place before concrete is poured when placed in concrete construction.

3. Provide sheet metal sleeves for all duct penetrations and cover with sheet metal plates all penetrations after ductwork has been installed through walls/floors.

G. Each Contractor shall fire stop, smoke stop, and/or acoustically seal the space between the sleeves provided under his Contract and piping or ductwork as applicable, as follows:

1. See specification Section 230584 Through Penetration Firestopping System

H. Except as otherwise specified, underground piping passing through exterior walls or foundation slabs on grade, shall have penetration closures of the modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and wall opening. Links shall be loosely assembled with bolts to form a continuous belt around the pipe and with a pressure plate under each bolt head and nut. After the seal assembly is positioned in the sleeve, tightening of the bolts shall cause the rubber sealing elements to expand and provide an absolutely watertight seal between the pipe and wall, reducing chances of cathodic reaction between these members. Each Contractor for work under his charge shall determine the required inside diameter of each individual wall opening or sleeve before ordering, fabrication or installation. The inside diameter of the wall opening shall be sized to fit the pipe and ensure a watertight joint. Where applicable, when installing seals, take into account the pipe O.D. if non-standard due to coating or jacketing.

1.21 MISCELLANEOUS IRON AND STEEL

A. Each trade shall provide all primary and secondary steel supports and hangers as shown on the drawings and/or as required to support equipment, ductwork, piping, exhaust fans, or any other materials provided under the work of this Section.

B. The work of this Section of designing, furnishing and installing all miscellaneous metal work associated with the system, and related items as indicated on the drawings and/or as specified herein, and includes, but is not limited to the items listed herein below.

C. The scope of work shall include:

1. Control equipment support platforms including ship ladders, steel grating for decking, cross-bracing and floor stands.

2. Intermediate beams to hang equipment and piping from the roof. All piping and ductwork must be hung from beam or supported from the floor. Provide supplemental steel for support of equipment.

3. Support of equipment and piping in shafts in addition to support provided by structure.

4. Support via floor stands as required.

5. Seismic joint movements.

6. Piping support in underground concrete trench and manholes.

7. Seismic restraints.

8. Pipe anchors in the building.

9. Hangers, brackets, angel irons or rods required for the support and protection of control equipment.

10. Field prime painting of galvanized steel and field finish painting.

D. Shop Drawings for General Miscellaneous Items

1. Submit Shop Drawings of all miscellaneous metal items to Architect for approval, showing sizes and thickness of all members, types of materials, methods of connection and assembly, complete dimensions, clearances, anchorage, relationship to surrounding work by other Trades, shop paint, and other pertinent details of fabrication and installation.

E. The Subcontractor shall engage the services of a Professional Engineer registered within the state wherein the project is located to prepare complete Design Drawings and structural design computations based on, and closely following, the design and details on the Drawings. The Design Drawings and structural design computations, with the Engineer's seal affixed thereto, shall be submitted to the Architect for review. The structural design computations shall provide a complete structural analysis, including anchors and fastening devices, and shall certify as to conformation to governing laws and codes. These submittals, upon review, must be sufficient, when taken in conjunction with this Specification to provide the complete basis of the fabrication and erection.

F. Samples

1. Submit duplicate samples of all materials to be furnished under this Section if, and in size and form, requested by Architect.

G. Do not order materials or begin fabrication until Architect's approval of submittals has been obtained.

H. In addition to the governing laws and codes, the following Specifications and Codes form a part of this Specification:

1. American Iron and Steel Institute applicable standards.

2. American Institute of Steel Construction "Code of Standard Practice for Steel Buildings and Bridges" and "Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings".

3. American Welding Society Code: Standard Code for Arc and Gas Welding in Building Construction.

I. All materials shall be new stock, free from defects impairing strength, durability or appearance and of best commercial quality for each intended purpose.

1. Unless otherwise specifically called for, work of this Section shall be fabricated of structural steel conforming to ASTM Specification A36.

2. Steel pipe shall be seamless steel pipe conforming to ASTM Specification A53, Schedule 40.

3. Steel tubing shall be seamless steel tubing conforming to ASTM Specifications A500 to A501.

4. Construction specialties such as slotted inserts, wedge inserts, etc., shall be as manufactured by Hohmann and Barnard, Gateway Erectors, Inc., Richmond Screw Anchor Co. or equal approved by Architect.

5. Non-ferrous metals shall be as specified under descriptions of specific items, herein below.

J. Provide all anchors, bolts, sockets, sleeves, and other parts required for securing each item of work of this Section to the construction, including furnishing to concrete workers all required insets and sleeves for use at concrete.

1. All exposed fastenings shall be of the same material and finish as the metal to which applied, unless otherwise noted.

2. Welding rods shall conform to AWS Standards and the recommendation of the welding rod manufacturer.

3. Shop primer for other ferrous surfaces shall be a high-quality, lead-free, rust-inhibitive primer, Tnemec No. 10-99 Metal Primer or equivalent by Devoe and Raynolds Co., Carboline or equal.

K. Metal surfaces shall be clean and free from mill scale, flake, rust and rust pitting. metal work shall be well formed and finished to required shape and size, true to details, with straight, sharp lines and angles and smooth surfaces. Curved work shall be true radii. Exposed sheared edges shall be eased.

L. Weld all permanent connections. Welds shall be continuous on all exposed surfaces and where required for strength on concealed surfaces. Exposed welds shall be ground flush and smooth, with voids filled with metallic filling compound (metallic filling compound not permitted on surfaces to receive hot-dip galvanizing). Tack-welding will not be permitted unless specifically

called for. Do not use screws or bolts where they can be avoided. Where used, heads shall be countersunk, screwed up tight, and threads nicked to prevent loosening.

M. Fastenings shall be concealed where practicable. Thickness of metal and details of assembly and supports shall give ample strength and stiffness. Joints exposed to weather shall be formed to exclude water.

N. Do all cutting, punching, drilling and tapping required for attachment of anchor bolts and other hardware and for attachment of work by other Trades. All such cutting, punching, drilling, etc., shall be done prior to hot-dip galvanizing of the various components.

O. Live loads shall be not less than the minimum required by law. Where specific live load are not set forth in the laws and codes applicable to this work, and are not given on the Drawings or in this Specification, designs shall be such as to support the live loads which may normally be imposed without failure, without deflection of more than 1/360 of length of any member, and without permanent deformation, all with a factor of safety of not less than 2 1/2 to 1.

P. Shop Painting

1. All ungalvanized ferrous metals under this Section shall be given a shop coat of rust inhibitive primer of type specified above.

a. Immediately before shop painting, remove all rust, loose mill scale, dirt, weld flux, weld spatter, and other foreign material with wire brushes and/or steel scrapers. Power tool clean in accordance with SSPC SP-3 (Power Tool Cleaning). Remove all grease with oil by use of solvent recommended by paint manufacturer. Sandpaper exposed surfaces as required to produce smooth, even finishes.

b. Apply paint by spray process in strict accordance with manufacturer's printed instructions to uniform thickness(es) recommended by manufacturer. Apply thoroughly and evenly and work well into corners and joints taking care to avoid sags and runs.

c. Do not paint surfaces to be embedded in concrete, or to be welded in the field. After field welds are complete, grind smooth and flush, thoroughly clean and then apply specified primer over all unprimed in the field by brush roller.

d. After erection, sand smooth and retouch all portions of the shop coats chipped or damaged during erection, and coat all field welds and connections with primer equivalent to that used for the shop coat.

Q. Installation

1. All materials shall be carefully handled and stored under cover in manner to prevent deformation and damage to the materials and to shop finishes, and to prevent rusting and the accumulation of foreign matter on the metal work. All such work shall be repaired and cleaned prior to erection.

2. Work shall be erected square, plumb and true, accurately fitted, and with the tight joints and intersections. All anchors, inserts and other members to be set in concrete or masonry shall be furnished loose by this Trade to be built-into concrete and masonry and by those Trades as the work progresses. Later cutting or drilling shall be avoided wherever possible.

3. All metal work shall be rigidly braced and secured to surrounding construction, and shall be tight and free of rattle, vibration, or noticeable deflection after installed.

4. Where members, other than expansion bolts or inserts, are fastened into concrete, set such members in holes formed as specified below, and secure permanently in place by installation of proprietary-type expanding grout manufactured specifically for such purpose, used strictly in accordance with manufacturer's directions. Holes to receive members shall be formed with galvanized sheet metal sleeves, expanded polystyrene foam, or other approved method to provide at least 1/2 inch clearance around entire perimeter. At exposed applications, hold expanding grout back 1/2 inch from finish surface and fill voids with Portland cement grout to match color and texture of surrounding concrete surface.

5. Electrolytic Isolation

   a. Where dissimilar metals are to come into contact with one another, isolate by application of a heavy coating of bituminous paint on contact surfaces in addition to shop coat specified above. Do not permit the bituminous paint in any way to remain on surfaces to be exposed or to receive sealant.

R. Description of Major Items

1. The items described below constitute the major part of the work of this Section, but are not intended or implied to cover each and every item that may be required to properly complete the work. Carefully review the Drawings to determine the full extent of the miscellaneous metal work required.

S. Steel Ladders/Platforms

1. Fabricate and install interior steel ladder at fans, air handling units, filter racks and all equipment requiring service. Ladders shall have a safety cage as required by OSHA regulations.

2. Except as may be otherwise indicated on the Drawings, ladder shall be minimum 16 inches wide, fabricated of minimum 3/8 inch by 2 1/2 inches hot rolled steel rails and minimum 3/4 inches outside diameter steel pipe rungs. Rungs shall be spaced 12 inches on center and shall be continuously welded to the rails. Provide a pair of steel clip angles or wall brackets at bottom and steel anchor plates or wall brackets at top, welded to the rails, as indicated.

3. Exterior steel ladders shall be hot dip galvanized after fabrication as specified hereinbefore. Rungs are to have non-slip surfaces.

4. All shall be OSHA and ANSI compliant.

T. Gratings and Frames

1. Fabricated and install steel gratings and frames at fan platforms.

2. Steel grating frames shall consist of a steel angle perimeter frame constructed of steel angles, at least 4 inches by 4 inches by 3/8 inches carried around perimeter with coped or mitered, full-welded corners. Perimeter frames shall be anchored with 7/16 inch minimum diameter expansion bolts or other suitable devices of adequate capacity, at corners, two (2) per beam end, and spaced not more than 2 feet on center around full perimeter.

3. Steel Gratings shall be pressure-locked type, with bearing bars spaced 1 3/16 inch on center and cross-bars spaced 4 inches on center. Sizes of bars shall be as required by manufacturer's loading tables to limit deflection of any member across any span to 1/240th of the span at live load of 100 pounds per square foot. Gratings shall be as manufactured by Borden Metal Products, Co., Irving Subway Grating Co., Reliance Steel Products Co., approved by Architect.

4. All (gratings and) frames shall be hot-dip galvanized after fabrication as specified hereinbefore (aluminum, FRP).

U. Miscellaneous Items

1. Carefully review all Drawings for miscellaneous metal items required but not specifically listed above, such as miscellaneous steel clip angles, miscellaneous steel bracketing, and other miscellaneous metal items as indicated on the Drawings, reasonably implied therefrom, or reasonably necessary for the thorough completion of the work.

2. Provide rigid and secure anchorage of all components whether or not specifically described in complete detail on the Drawings.

V. Piping supports shall be coordinated with the building structure and shall span between roof beams as required.

1.22 WATERPROOFING, FLASHING AND COUNTERFLASHING

A. Unless specifically indicated otherwise on the drawings, each Contractor shall provide all counterflashing and waterproofing of all piping, ductwork and equipment provided by him, which pierce roofs, walls and other weatherbarrier surfaces. All work under this paragraph shall be coordinated with the (GC / CM).

B. All work shall be performed in a workmanlike manner to ensure weatherproof installation. Any leaks developed due to each Contractor's work shall be repaired at his expense, to the Architect's satisfaction.

C. Pipes passing through slabs shall have the sleeve extended above floors as hereinbefore specified to retain any water and the space between the pipe and sleeve caulked waterproof fire stopping. The top and the bottom shall be sealed with monolastic caulking compound.

D. All flashing required for ductwork and piping penetrations shall be provided by the (GC / CM).

1.23 ELECTRICAL WORK, MOTORS, MOTOR CONTROLLERS

A. See Section 230513.

B. See Division 22 for Plumbing.

C. See Divisions 26, 27 and 28 for Electrical.

1.24 IDENTIFICATION OF MATERIALS

A. See Section 230553.

1.25 VALVE TAGS, NAMEPLATES AND CHARTS

A. See Section 230553.

1.26 PARTS LIST AND INSTRUCTIONS FOR OPERATION AND MAINTENANCE

A. Each Contractor shall thoroughly instruct the representative(s) of the Owner, to the complete satisfaction of the Architect, in the proper operation of all systems and equipment provided by him. Each Contractor shall make arrangements, via the (GC / CM) as to whom the instructions are to be given in the operation of the basic and auxiliary systems and the periods of time in which they are to be given. The Architect shall be completely satisfied that the representative of the Owner has been thoroughly and completely instructed in the proper operation of all systems and equipment before final payment is made. If the Architect determines that complete and thorough instructions have not been given by each Contractor to the Owner's representative, then each Contractor shall be directed by the Architect to provide whatever instructions are necessary until the intent of this paragraph of the specification has been complied with. All time required for Owner's instruction to satisfy the above requirements shall be included in this Contract. No extra compensation for such instructions will be allowed.

B. Each Contractor, including but not limited to, the HVAC Contractor, shall submit to the Architect for approval, a total of (6) typed sets, bound neatly in loose-leaf binders, of all maintenance and operating instructions for the installation, operation, care and maintenance of all equipment and systems. All data and literature furnished shall be specific for the make and model of the equipment furnished. General non-specific catalog data will not be acceptable. Information shall indicate possible problems with equipment and suggested corrective action. The manuals shall be indexed for each type of equipment. Each section such as fans, valves, plumbing fixtures, hot water heaters, boilers, air handling units, etc., shall be clearly divided from the other sections. A sub-index for each section shall also be provided. The methodology of setting-up the manuals shall be submitted to the Architect and Owner through the General Contractor for approval prior to final submission of manuals.

C. The instructions shall contain information deemed necessary by the Architect and shall include, but not be limited to, the following:

1. Instructional classes on equipment and systems operation for Owner's representative and maintenance personnel, by engineering staff of each Contractor. Minimum of 48 hours of instruction for minimum of (6) people. Instruction shall include:

    a. Explanation of manual and its use.
    b. Summary description of the HVAC systems.
    c. Purpose of systems.

2. System

    a. Detailed description of all systems.
    b. Illustrations, schematics, block diagrams, catalog cuts and other exhibits.

3. Operations

    a. Complete detailed, step-by-step, sequential description of all phases of operation for all portions of the systems, including start-up, shutdown, adjusting and balancing. Include all posted instruction charts.

4. Maintenance

    a. Parts list and part numbers.

b. Maintenance, lubrication and replacement charts and manufacturer's recommendations for preventive maintenance, as applicable to his work.

c. Troubleshooting charts for systems and components.

d. Instructions for testing each type of part.

e. Recommended list of on-hand spare parts.

f. Complete calibration instructions for all parts and entire systems.

g. Instruction for charging, filling, draining and purging, as applicable.

h. General or miscellaneous maintenance notes.

5. Manufacturer's Literature

a. Furnish complete listing for all parts required for models actually furnished.

b. Names, addresses and telephone numbers of manufacturers and suppliers.

c. Describe and operation of all models actually furnished.

d. Furnish all and only pertinent brochures, illustrations, drawings, cuts, bulletins, technical data, certified performance charts and other literature with the model actually furnished to be clearly and conspicuously identified.

e. Internal wiring diagrams and engineering data sheets for all items and/or equipment furnished under each Contract.

f. Guarantee and warranty data.

6. Each Contractor shall furnish instructions for lubricating each piece of equipment installed by him. Instructions shall state type of lubricant, where and how frequently lubrication is required. Frame instructions under glass and hang in a location as directed by Architect.

1.27 MANUFACTURER'S REPRESENTATIVE AND COMMISSIONING OF SYSTEMS

A. Each Contractor shall provide, at appropriate time or as directed by the Architect, the on-site services of a competent factory trained Engineer or authorized representative of particular manufacturer of equipment provided under his Contract, such as for the air handling units, automatic temperature controls, building automation system (BAS), fire pump, domestic hot water heaters, boilers, etc., provided under this Contract, to instruct the Owner, inspect, adjust and place in proper operating condition any item provided by him, as applicable.

B. The HVAC Contractor, as applicable, shall commission and set in operating condition all major equipment and systems, such as the condenser water, hot water and all air handling systems, etc., in the presence of the applicable equipment manufacturer's representatives, and the Owner and Architect's representatives. In no case will major systems and equipment be commissioned by any of the Contractor's forces alone, without the assistance or presence of the equipment manufacturers.

C. A written report shall be issued by the particular equipment manufacturer and the Mechanical Contractor summarizing the results of the commissioning and performance of each system for

the Architect's record. No additional compensation will be allowed for any Contractor for such services.

D. The Contractor shall prepare and submit to the Architect for acceptance, a schedule of anticipated system commissioning. No system shall be commissioned without prior acceptance of the schedule by the Architect and Owner. No systems shall be commissioned prior to submittal and acceptance of Operation and Maintenance Manuals.

1.28 CONNECTIONS TO EQUIPMENT

A. Each Contractor shall provide all duct and/or pipe connections, condensate traps, drains, overflows, relief valves and vents, power connections, etc., to make equipment operable, as provided under other Sections of the specifications, as shown on the Architectural and/or each Trade's drawings and herein specified, including final connections to equipment to result in a complete system, fully operational. Coordinate location of all equipment with Architect. Obtain installation diagrams and methods of installation of all equipment from manufacturers. Follow instructions strictly. If additional information is required, obtain same from Architect. If equipment is indicated on the Architectural drawings, it shall also be construed and understood by the Mechanical Contractor to be constructed as shown on the HVAC drawings and shall be fully serviced and connected at no extra cost to the Owner.

1.29 SMOKE DETECTION AND FIRE SAFETY SYSTEMS

A. All duct or unit mounted smoke detectors shall be furnished and wired to the building fire alarm system by the Electrical Contractor. All smoke detectors required in units and ducts and for smoke barrier dampers shall be installed in the field by the HVAC Contractor. Refer to the Contractor Coordination Matrix contained under item 1.35 of this section.

B. All smoke dampers shall be furnished and by the HVAC Contractor with electric actuators and field wired by the ATC Contractor.

C. The Electrical Contractor, when providing smoke detectors, shall include additional contacts, as required and coordinated with the ATC Contractor, to allow for other control functions, as specified hereinafter. Close coordination must be exercised to allow for the provision of contacts.

D. All smoke detectors shall be installed as recommended by the smoke detection system manufacturer in sheet metal ducts or plenums to ensure that the sensing elements are effective and shall coordinate installation of smoke detectors with the Electrical Contractor and detector manufacturer.

E. The HVAC Contractor shall provide access doors to make all such detection heads accessible, and shall provide bracing for smoke detection sampling tubes, as recommended by the detector manufacturer, to properly and securely support such tubes.

F. If duct smoke detectors are required to be installed in ducts that are exposed to outside ambient conditions, they shall be installed in ventilated accessible weatherproof enclosures. See details on HVAC Drawings.

1.30 ELECTRICAL ROOM REQUIREMENTS

A. The HVAC Contractor [or Subcontractors] shall not install any piping, ductwork or equipment in or through electrical rooms, transformer rooms, electrical closets, telephone rooms or elevator machine rooms, unless piping, ductwork or equipment is intended to serve these rooms. If any

Contractor violates this requirement, he shall remove and/or relocate all items as required at his expense and to the satisfaction of the Architect.

1.31 HOISTING EQUIPMENT AND MACHINERY

A. All hoisting equipment and machinery required for the proper and expeditious prosecution and progress of the work under this Contract shall be furnished, installed, operated and maintained in safe condition by each Contractor for his material and/or equipment delivered to the designated hoisting area. All costs for hoisting operating services shall be borne by the Mechanical Contractor for all equipment and work under his charge.

1.32 STAGING

A. All staging, exterior and interior, required to be over 8'-0" in height shall be furnished and erected by each Contractor for work under his charge and maintained in safe condition by him for proper execution of his work.

1.33 PHASING DEMOLITION AND MAINTAINING EXISTING SERVICES

A. During the execution of the work, required relocation of existing equipment and systems in the existing areas where new work and connections are scheduled to be made shall be performed by each Contractor as indicated on the drawings, as required by the job conditions and as determined by the GC/CM in close cooperation with the Architect and Owner's designated representative to facilitate the installation of the new systems and completion of this Contract. Outages required for construction purposes shall be scheduled for the shortest practical periods of time, in coordination with the Owner's designated representative for specific, mutually agreeable periods of time after each of which the interruption shall cease and service shall be restored. This procedure shall be repeated to suit the Owner's working schedule as many times as required until all work is completed.

B. Prior to any deactivation and relocation, capping, valving, tie-in or demolition work, consult the drawings and arrange a conference with the Architect and the Owner's representative in the field to inspect each of the items to be deactivated, removed or relocated. Care shall be taken to protect all equipment designated to be relocated and reused. Give notice to all parties, with a minimum of (5) working days in advance.

C. All draining of existing systems, filling and venting required to remove and relocate existing piping systems shall be included and provided under this Contract as required to perform the various equipment or piping relocations or new tie-ins.

D. Except as otherwise noted, all deactivation, safe capping, valving, etc., of systems designated to be demolished shall be provided by each Trade, as applicable, and all demolition, removal and disposal of demolished materials shall be performed by the GC / CM. All equipment scheduled to be removed shall be inspected by the Owner, and, if he decides that such equipment is to be salvaged, each Contractor shall deliver said equipment to an area within the site boundaries as determined by the Owner and Architect.

E. The phasing of the work shall be performed in strict accordance with the GC / CM construction schedule. The new systems will be installed and completely commissioned prior to occupancy. Coordinate requirements for temporary heat or rerouting of existing services as required to accomplish the construction schedule.

1.34 CONTROL WIRING

A. The ATC Contractor shall provide all control and interlock wiring for all systems provided under the HVAC, plumbing and ATC Contracts.

B. All control wiring shall be installed in conduit and in accordance with the respective equipment manufacturer's requirements, and all connections shall be provided by the ATC Contractor. All conduit and wiring provided by these Contractors shall be installed in accordance with the requirements of Section 26 of the specifications.

1.35 COMPONENT COORDINATION

A. The HVAC, ATC and Electrical Contractors Scope of Work shallbe implements in accordance with the following matrix:

Device	Furnished By	Installed By	Power Wiring	Control Wiring	Fire Alarm Wiring
Smoke Detectors	26	23	26	25	26
Smoke Dampers at AHUs	23	23	N/A	N/A	N/A
Smoke Damper Actuators at AHUs	Damper Mfr	23	26	25	N/A
Smoke Control Dampers	23	23	N/A	N/A	N/A
Smoke Control Dampers (Floor) Actuators	23	23	26	25	N/A
Fire Dampers	23	23	N/A	25	N/A
Supply and Exhaust Boxes	23	23	25	25	N/A
Box Flow Pick-Up	Box Mfr	Box Mfr	N/A	Box Mfr	N/A
Box Damper Actuator	25	Box Mfr	25	25	N/A
Box DDC Controller	25	Box Mfr	25	25	N/A
Box Coil Valve	25	23	N/A	25	N/A
Supply/Exh. & Hood Valves	25	23	N/A	25	N/A
Valve Actuator	25	25	N/A	25	N/A
Supply Valve Reheat Coil	23	23	N/A	N/A	N/A
Reheat Coil Valve	25	23	N/A	25	
Laboratory Control Panel	25	25	26	25	N/A
Controls at Fume Hood	25	25	25	25	N/A
Sheet Metal Damper	23	23	N/A	N/A	N/A
Sheet Metal Damper Actuators	25	25	N/A	25	
Energy Meters	25	23	26	25	N/A
Flow Measuring Stations	25	23	N/A	25	N/A
DDC Panels	25	25	26	25	N/A
Air Compressor	25	25	26	25	N/A
Air Dryer	25	25	26	25	N/A
Fuel Oil System	23	23	26	25	N/A
Control Valves	25	23	25	25	N/A
Humidifiers	23	23	N/A	25	N/A
Humidifier Valve	23	23	N/A	25	N/A
Humidifier Airflow Switch	25	25	N/A	25	N/A
VSDs at EAHU	23	23	26	25	N/A

PART 2 – PRODUCTS

2.1 NOT USED

PART 3 – EXECUTION

3.1 NOT USED

END OF SECTION 250500

SECTION 251000 – DIRECT DIGITAL/AUTOMATIC TEMPERATURE CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Section 250500 and other Division 1 Specification Sections, apply to this Section.

1.2 WORK INCLUDED

A. Furnish and install a complete system of direct digital controls to make a fully operational and controllable building HVAC system.

B. The work shall include but not be limited to all labor, materials, special tools, equipment, enclosures, power supplies, software, software licenses, Project specific software configurations and database entries, interfaces, wiring, tubing, installation, labeling, engineering, calibration, documentation, submittals, testing, verification, training services, permits and licenses, transportation, shipping, handling, administration, supervision, management, insurance, Warranty, specified services and items required by the Contract for the complete and fully functional Controls Systems.

C. The system shall be all electric DDC (direct digital control).

D. All system components shall be installed in accordance with local and State codes.

E. Secure all permits and local/State approval for all components and installation as specified under this Section.

F. Provide complete commissioning for all control system components and sequences of operation.

G. Preparation and submission of shop drawings.

1.3 RELATED SECTIONS

A. Examine all drawings and criteria sheets and all other Sections of the Specifications for requirements which affect work under this Section whether or not such work is specifically mentioned in this Section.

B. Division 21

C. Division 22

D. Division 23

E. Division 25

F. Division 26

1.4 REFERENCES

A. Applicable provisions of the following Codes and Trade Standard Publications shall apply to the work of this Section, and are hereby incorporated into, and made a part of the Contract Documents.

B. Material standards shall be as specified or detailed hereinafter and as follows:

1. NFPA 70 – National Electric Code.
2. UL-916 – Energy Management Systems.
3. UL-873 – Temperature Indication and Regulating Equipment.
4. FCC; Part 15, Subpart J – Class A computing Equipment.
5. UL-864 – Fire and Smoke Control.

1.5 SYSTEM DESCRIPTION

A. Furnish and install, as hereinafter specified, a combination direct digital/ electric/electronic temperature control system and Building Automation System (BAS). The system shall be comprised of a network of various independent Stand-alone Direct Digital Controllers, electric/electronic control equipment, thermostats, sensors, controllers, valves, dampers, actuators, panels and related hardware, software and other accessory equipment, along with a complete system of electrical control wiring, and software generation to fill the intent of the specifications and provide for a complete and operable system.

B. The Building Automation System (BAS) shall be composed of PC-based setup and programming workstations, programming and configuration software tools, operator workstations, web server user interface software and hardware, and microcomputer-based controllers of modular design providing distributed processing capability, and allowing future expansion of both input/output points and processing/control functions.

C. The Building Automation System (BAS) shall be designed in accordance with ASHRAE's BACnet standard, 135-2010, to provide interoperability between different building subsystems. All physical controller components of the Building Automation System – network controllers, application controllers, unitary controllers, input output extension modules, network resident sensors, etc. shall be listed in conformance with the BACnet Testing Laboratories (BTL) established testing standards, as described for each component in this specification. Contractor shall provide manufacturer's Protocol Implementation Conformance Statement (PICS) for every controller model installed under this contract. BACnet over ARCNET shall not be accepted. No BACnet gateways shall be used for communication to Building Automation System controllers furnished under this section. BAS controllers which are not BTL listed are not acceptable.

D. The primary user interface for the Building Automation System shall be via standard PC web browser as described in this document. The Building Automation System shall include web server hardware and software to provide graphical, web-based operator interfaces for instant access to any system data through a standard PC web browser, such as Microsoft Internet Explorer, without the need for any added manufacturer's software installed loaded on the PC.

E. All Building Automation System server machines and appliances, PC workstations and notebook PCs, and all other user interface devices shall conform to IT (Information Technology) industry accepted standards and specific requirements as described in this document.

F. The BAS shall be engineered, programmed and installed by competent controls mechanics and electricians regularly employed by the manufacturer of the BAS control equipment. All BAS control equipment, user interface server software and configuration/programming software tools shall be the products of one (1) manufacturer and all components shall be capable of interfacing with the HVAC equipment using BACnet protocols. The Contractor must maintain adequate factory trained staff and offer standard services to fully support the owner in the timely

maintenance, repair, and operation of the control system. Contractors who do not maintain such staff and offer services or must develop some for this project are not acceptable.

G. Bids from franchised dealers or others whose principal business is not the manufacture, installation and service of the Building Automation Systems will not be acceptable.

H. The Contractor shall submit a copy of the manufacturer's standard software and firmware licensing agreement for the owner's signature. Such license shall grant use of all programs and application software to Owner as defined by the manufacturer's license agreement, but shall protect manufacturer's rights to disclosure of trade secrets constrained within such software.

I. All products of the Building Automation System shall be provided with the following agency approvals. With the submittal documents, verification that the approvals exist for all submitted products shall be provided. Systems or products not currently offering the following approvals are not acceptable.

1. UL-916; Energy Management Systems

2. UL-873; Temperature Indication and Regulating Equipment UL-864; Subcategories UUKL, QVAX, UDTZ; Fire and Smoke Control Systems

3. UL-864; Subcategories UUKL, QVAX, UDTZ; Fire and Smoke Control Systems where used for smoke control applications as described in this document and/or indicated on the drawings.

4. FCC; Part 15, Subpart J, Class A Computing Devices

J. All products shall be labeled with the appropriate approval markings. System installation shall comply with NFPA, NEMA, Local and National Codes.

K. HVAC/Smoke Control System Operation:

1. On/Auto/Off switches and status indicators (LEDS) shall be provided by the Fire Alarm Contractor for monitoring and manual control of each fan, damper, HVAC control unit, stairwell pressurization fan, space pressurization and smoke exhaust fan. To ensure compliance, where used for smoke control applications as described in this document and/or indicated on the drawings, the Building Automation Systems controllers supplied shall meet the following **UL categories: UUKL, PAZX, UDTZ, QVAX** as well as the requirements of NFPA 90A, HVAC, and NFPA 92A & 92B, Smoke Control. The control system shall be field programmable for either 90A operation or 92A/B operation to allow for future use and system expansion.

2. All devices shall be UL 864 and UUKL listed, where used for smoke control applications as described in this document and/or indicated on the drawings.

1.6 SUBMITTALS

A. See Section 230500 and General Conditions for additional requirements.

B. Product Data: Provide data for each system component and software module.

C. Shop Drawings.

1. Control damper and control valve schedules, including the size, pressure drop and location for intended use.

2. Terminal unit schedules shall be provided on a floor by floor basis and must include at a minimum but shall not be limited to room numbers, sizes, contract drawing tag id's, capacity values of minimum/maximum along with modes of operation (Occ/Unocc/Purge etc.), calibration values, etc.

3. Provide a Control Systems Network Riser diagram. This shall incorporate the following:

    a. The riser shall show on a floor by floor basis the BAS controllers and the communication Tier that the controllers reside on.
    b. The communication Tiers should be identified and qualified (Ethernet, RS-485, etc.) along with the cabling type.
    c. All Tier 1 devices along with 3rd party interfaces and gateways shall be shown including workstations, servers, controllers, printers, etc.
    d. Tier 2 and 3 devices can be grouped by type provided a total quantity of devices is indicated. An example of grouping for Tier 2 and 3 would be for terminal equipment showing VAV's with the quantity separate from Fan Coils with a quantity, etc.
    e. All routers, switches, bridge, modems, etc shall be shown.
    f. If a separate Network is required to achieve any smoke control or life safety functions to comply with UL-864 requirements the riser shall be segregated accordingly.

4. Provide Electrical load calculations for the entire BAS system as follows.

    a. Electrical Load calculation sheets shall be provided as part of this submittal package. Provide on a panel by panel basis grouping the loads by floor providing a total VA load for the floor.
    b. This shall also apply to VAV box loading when utilizing step down transformers for 24VAC distribution.
    c. The BAS contractor shall review the Electrical power plans for the dedicated BAS circuits and indicate in the initial submittal the panels/controllers that will be on each circuit with the panel and circuit number depicted.
    d. The KVA and Electrical Panel/Circuit number will also be shown on the BAS controller Network riser diagrams showing totals for panels and totals for floors.
    e. If additional circuits are required, the BAS contractor shall indicate this in the submittal and demonstrate by the load calculations the quantity of additional circuits that are required.
    f. The Electrical Load Calculations shall be updated and submitted with the final as-built documents.

5. Electrical panel enclosure layouts and wiring diagrams to numbered terminal blocks shall be provided as part of the submittal documentation for all BAS panels. The layouts shall depict all components and the wiring diagrams must be in ladder logic diagram format.

6. Unique individual control flow diagrams shall be provided for all systems. These shall show all input and output system components in their correct locations and orientations. Typical diagrams are allowed providing the systems are truly identical but the unit numbers for major systems are clearly listed. For terminal units the drawing number for the "typical" must be indicated on the terminal unit schedules. All control diagrams shall be provided with their associated points schedules.

7. List connected data points, including connected control unit and input device.

8. Indicate all system graphics for all controlled systems including all air handling systems, hydronic pumping systems, monitored systems, data (connected and calculated) point addresses and operator notations.

9. Show system configuration with peripheral devices, batteries, power supplies, diagrams, modems and interconnections.

10. The sequence of operation for each HVAC system and the associated control diagrams shall be provided. The sequence should include normal operation along with failure modes of operation detailing any software lockouts that require user intervention and any time delays or specialty interfaces. All equipment and control labels shall correspond to those shown on the contract documents.

11. Develop and provide emergency, fire, smoke management control and device response matrices in an MS Excel spreadsheet format.

12. Show electronic ranges for each valve, damper, inlet vanes actuators etc., (i.e. 4 – 20 ma or 0-10 vdc).

13. All control logic and controllable components shall be depicted and identified within each matrices developed.

14. Furnish PICS and BTL listing information for each BACnet compliant device.

15. All UUKL components shall be depicted and identified.

D. Manufacturer's Installation Instructions: Indicate manufacturer's installation instructions for all manufactured components.

E. Submit brochures that contain only that information which is relative to the particular equipment or materials to be furnished. Do not submit catalogs that describe several different items other than those items to be used unless irrelevant information is marked out and relevant material is clearly marked.

F. Specifications Compliance Statement

1. The manufacturer shall submit a point by point statement of compliance with the specifications.

2. The statement of compliance shall consist of a list of all paragraphs (line by line).

3. Where the proposed system complies fully, such shall be indicated by placing the word "comply: opposite the paragraph number.

4. Where the proposed system does not comply, or accomplishes the stated function in a manner different from that described, a full description of the deviation shall be provided.

5. Where a full description of a deviation is not provided, it shall be assumed that the proposed system does not comply with the paragraph in question.

6. Submissions which do not include a point by point statement of compliance as specified shall be disqualified.

G. Project Record Documents: Record actual locations of control components, including control units, thermostats and sensors, trunk cable routing, junction boxes, transformers, VAV terminal box power circuiting, box addresses.

1. Revise shop drawings to reflect actual installation and operating sequences.

2. Include submittal data in final “Record Documents” form.

3. All start-up/checkout documentation shall be initialed and signed by the on-site control technician with intimate knowledge of the project.

4. Provide start-up/checkout documentations for all DDC controllers connected to the BAS network. Documentation shall include all controller points used and unused (spare). Furthermore, all final settings, calibration, coefficient values, K factors, spanning, actual spring ranges, etc., shall be documented and indicated for all active points in use.

5. Revise all control sequences of operation to final turnover conditions. Sequences of operation that restate the Design Engineer’s sequences will not be acceptable. Complete details will be given within the sequences of operation provided by the Contractor. Details shall include, but not be limited to, the following items: Control strategy, timers, delays, logic sequencing, start/stop, end devices involved, sensors involved, set points, globally commanded values, shared data between panels and controllers.

6. Provide a separate drawing with detailed operation sequence for each UL category UUKL smoke control system. This means if there are four pressurized stairs each has its own drawing and sequence specific to that system. No system shall be a duplicate.

7. VAV controller startup/commissioning documentation shall include as a minimum but not limited to the following final as-built information:

   a. Min/max CFM settings.
   b. Controller volume tracking differential.
   c. Box size and area multiplier.
   d. Box K factor as determined by BAS and TAB.
   e. BACnet device instance numbers.
   f. BACnet device RS-485 MAC address.
   g. Auto-zero enabled/disabled.
   h. Auto-zero scheduled time.
   i. Communications priority (life safety, critical, normal).
   j. Tstat set point override range (+/- 5°F).
   k. Rom set point (base).
   l. Generic additional points added to controller.
   m. Controller box identifier shall match mechanical tag as called out on mechanical plans.
   n. When used for smoke control unit shall be UL category UUKL.

H. Operations and Maintenance Data:

1. Include interconnection wiring diagrams for completed field installed systems with identified and numbered system components and devices.

2. Include keyboard illustrations and step-by-step procedures indexed for each operator function.

3. Include inspection period, cleaning methods, cleaning materials recommended and calibration tolerances.

1.7 QUALITY ASSURANCE

A. Perform work in accordance with NFPA 70 and Divisions 26, 27 and 28 specifications.

B. Manufacturer Qualifications: The BAS manufacturer shall be a recognized national manufacturer, installer and service company specializing in manufacturing the Products specified in this section with minimum ten (10) years of documented experience.

C. Installer Qualifications: The Building Automation System (BAS) shall be engineered, programmed, and installed by controls mechanics and electricians regularly employed by the manufacturer of the BAS control equipment. Company specializing in performing the type of work specified in this section with minimum ten (10) years of documented experience and approved by manufacturer. Bids from independent or franchised dealers or others whose principal business is not the manufacture, installation and service of Building Automation Systems will not be acceptable.

D. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. and testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.8 WARRANTY

A. See Section 230500 and General Conditions for additional requirements.

B. The system specified herein and shown on the drawings shall be guaranteed to be free from original defects in both material and workmanship for a period of twelve (12) months of normal use and service, excepting damages from other causes. This guarantee shall become effective starting the date the Contract work is accepted as complete by the Owner and in accordance with the General Provisions/Conditions.

C. Provide five (5) year manufacturer’s warranty for field programmable micro-processor based units.

D. Submit manufacturer’s warranty and ensure forms have been filled out in Owner’s name and registered with manufacturer.

1.9 MAINTENANCE SERVICE

A. Provide service and maintenance of energy management and control systems for one (1) year from Date of Substantial Completion/Acceptance of System by Owner.

B. Provide two (2) complete inspections during the first year, one (1) in each season, to inspect, calibrate and adjust controls as required and submit written reports.

1.10 PROTECTION OF SOFTWARE RIGHTS

A. Prior to delivery of software, the Owner and the party providing the software shall enter into a software license agreement with provisions for the following:

1. Limiting use of software to equipment provided under these specifications.
2. Limiting copying.
3. Preserving confidentiality.
4. Prohibiting transfer to a third party.

1.11 GENERAL

A. Acceptable manufactures subject to compliance with the specifications

1. Siemens Building Technologies

2. Johnson Controls
3. Schneider Electric - StruxureWare

B. The entire system and all control components shall be powered with emergency power.

C. All electrical work shall comply with Divisions 26, 27 and 28 Specifications.

PART 2 - PRODUCTS

2.1 ELECTRIC LOW VOLTAGE WIRING

A. All wiring shall comply with the requirement of Division 26. This section shall add additional requirements for the installation of the Building Automation System.

B. Furnish all labor and material to install the necessary wiring to accomplish the successful and complete operation of the new Building Automation System.

C. All electric wiring, wiring connections and all interlocking required for the installation of the temperature control system, as herein specified, shall be provided by the Contractor, unless specifically shown on the Electrical drawings or called for in the Electrical specifications.

D. Furnish all labor and material to install necessary relays, general purpose enclosures and appurtenances to control designated devices relative to the DDC.

E. All wiring throughout shall be concealed where possible.

F. All conduit used shall be EMT, 3/4" minimum size or larger. Conduit sizes shall be large enough to permit the individual conductors to be readily installed or withdrawn without damage to the conductors or their insulation. Splicing of wires will be permitted only in junction boxes or pull boxes. Conduit shall be rigid up to 8’-0″ AFF in mechanical rooms.

G. Conduit shall never to be relied upon for a fault current and safety ground return conductor.

H. All UL category UUKL portions of the system shall be in conduit.

I. All UL category UUKL portions of the system shall be powered from emergency power.

J. 2-Hour Fire Rated Mineral Insulated (MI) Conductors

1. General

a. This section includes 2 hour fire rated type MI mineral-insulated metal-sheathed cable with multiple, twisted copper conductors within a seamless copper sheath, cable connectors and connections.

b. The following control circuits shall be 2 hour fire rated type MI mineral-insulated metal-sheathed cable where not installed within 2 hour fire rated rooms, closets, enclosures and/or shafts:

1) Fire alarm conductors traveling between fire zones
2) Control wiring to all stairwell pressurization systems and associated equipment.
3) Engine start circuit from each automatic transfer switch to the generator.

2. References

   a. NFPA 72 – National Fire Alarm and Signaling Code
   b. International Building Code (IBC) Section 909 - 2009
   c. ANSI/NFPA 70 - National Electrical Code
   d. FM 3D0Q9.AM 8/1997
   e. UL Category FHIT – Classified Electrical Circuit Integrity System with a 2 hour fire rating, 12/2012.

3. Qualifications

   a. Manufacturer shall be a company specializing in manufacturing products specified in this Section with minimum ten years documented experience.

   b. Cable shall not off gas or propagate smoke.

4. Regulatory Requirements

   a. Cable shall conform to requirements of ANSI/NFPA 70.

   b. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

5. Project Conditions

   a. Verify that field measurements and conditions are as shown on Drawings.

   b. Cable routing shown on Drawings is approximate. Route cable as required to meet project conditions.

   c. Where cable routing is not shown, and destination only is indicated, determine exact routing and lengths required.

6. Coordination

   a. Coordinate work specified in this section with work provided under other electrical work and the work of other trades.

   b. Determine required separation between cable and other work.

   c. Determine cable routing to avoid interference with other work.

7. Manufacturer

   a. Pentair Thermal Management/Pyrotenax System 1850 2-hour fire rated.

8. Mineral-Insulated Metal-Sheathed Cable

   a. Description: ANSI/NFPA 70, Type MI

   b. Conductor: Copper

   c. Insulation Voltage Rating: 300 volts.

   d. Insulation Material: Magnesium oxide refractory mineral.

e. Metal-sheath Material: Seamless soft-drawn copper.

f. Fire Rating: Cable assembly, including factory splices and supports shall have a 2 hour fire rating as listed and classified by Underwriters Laboratories, Inc.

g. Overjacket:

1) If installed interior to the building: none required
2) If installed direct buried, PVC or manufactured extruded jacket.

h. Cable sheath shall be marked with conductor size, voltage and UL fire resistant classification number.

i. Each components of the cable assembly shall contain less than 300 ppm of lead, and shall meet the requirements of LEED for Healthcare MR Credit 4.2.

9. Wiring Connectors And Terminations

a. Cable Termination:

1) Pentair Thermal Management/Pyrotenax Model PyroPack – Multi-conductor (Installation PTM document #545E) and fire alarm twisted pair cables (PTM document #578E).

b. Cable Splice:

1) All cable spices of MI cable required due to length of conductor shall be factory installed and have 2 hour fire rating equivalent to the conductor itself. Field spices shall not be allowed unless installed within 2 hour fire rated rooms. Field spices within 2 hour fire rated rooms shall be Tyco Thermal Controls/Pyrotenax Model Installation Sheet 550.

10. Examination

a. Verify that cable end factory temporary seals have remained intact, that the insulation has not been exposed to air, and that no moisture has entered cable insulation.

b. Verify that work of other trades likely to damage cable has been completed.

11. Storage

a. Cables shall be shipped from the manufacturer with ends temporarily sealed against moisture ingress.

b. When cables are cut in the field, the end shall be sealed using standard sealing compound and PVC tape.

c. Cable shall be stored in a clean dry location.

12. Handling

a. Cable shall be uncoiled by rolling or rotating supply reel. Do not pull from coil periphery or center.

b. Take precautions necessary to prevent damage to cable from contact with sharp objects, including pulling over foreign material or sheaves.

13. Wiring Methods

a. Fire Rated Locations: Use only fire rated cable.

b. Use wiring methods indicated on Drawings and as specified herein.

K. The ground system shall not be used as a current carrying conductor except for faults and noise suppression. The grounding system shall be used to control noise and transients which might affect the operation of the automation system. As such, the ground requirements shall be in excess of a grounding system used solely for physical protection minimum (Code requirement).

L. In all cases, the bond to ground shall be as short as possible. The bonds shall be installed per Division 26 and the manufacturer's requirements.

M. Set screw connectors shall be galvanized or plated steel. White metal cast type will not be permitted.

N. Flexible conduit shall be used at field devices, i.e., pressure switches, flow switches, temperature devices, etc. Convolutions shall be steel, interlocked continuously. Aluminum will not be permitted. "Liquidtight" shall be used in wet locations. Flexible connector shall be a minimum of 18" long.

O. Only core drilling is permitted to pierce the floors in the electrical closets and elsewhere. The use of water for drilling shall be controlled by a suitable vacuum system, using proper dams to prevent damage to floors below. The BAS Contractor shall be responsible for providing a suitable sleeve in all core drilled holes as specified herein.

P. All wiring shall be run in EMT as noted below:

1.	Sensor to Panel (Block Wall):	In Wall Conduit (EMT)
2.	Sensor to Panel (Stud Wall):	In New Conduit (EMT)
3.	Sensor to Panel (Mechanical Room):	In New Conduit (EMT)
4.	Panel to Front End Workstation:	In New Conduit (EMT)
5.	Front End:	In New Conduit (EMT)

Q. Wiring

1. Power wiring gauge shall be as noted in Division 26 and NEC.

2. Communication wiring shall be installed per manufacturer's recommendations.

3. Conduit is not considered as a shield.

4. All wiring associated with the control signals to the smoke damper control/sequence must be in approved conduit.

5. All signal wiring to all field devices shall be run with no splices, separately from any wiring having voltage greater than 30 volts.

R. The Contractor shall install all shielded cable and ground systems in accordance with Division 26. The installation of ground loops shall not affect any sensing or control circuits.

S. All devices and equipment shall be mounted in minimum NEMA 1 enclosures.

T. In addition to the requirements specified above, all communication wiring cables shall include a minimum of (1) individually 100% shielded pair ([2] conductors) as unused spare conductors. Where the number of conductors and specific cable specified above for each type of communication wiring will not meet this requirement for spare conductors, Contractor shall provide approved equivalent product of Belden or other manufacturer with the necessary number of conductors and which meets the requirements specified above.

U. Low Voltage Control Wiring (30 VAC or Less)

1. Low voltage control wiring shall be minimum 16 gauge, or heavier if required, twisted pair, 100% shielded with PVC cover Belden #9316 or approved equivalent product of other manufacturers run in conduit with no splices, separate from any wiring above 30 volts.

V. Coordination of Interfacing/Interlocking

1. The Contractor shall be responsible for coordinating all required interface/interlocking software, software logic, sequencing and wiring necessary to provide a fully automated and fully functional operable system to meet or exceed the intent of the Design Engineer's Sequence of Operation. Coordination may include but not limited to the following at no additional cost to the Owner. Variable frequency drive (VFD) interlocking and wiring logic including software, relays factory/field installed wiring and/or VFD drive modifications. This would include coordination of miscellaneous points as specified under the point list in this specification. Systems to include all points, analog, digital, sensors wiring, software, wiring, communications gateways, etc., to connect and communicate to any Fire, Plumbing, HVAC, Lighting, BAS, Security, World Wide Web (Internet) systems installed under this project.

2.2 BUILDING AUTOMATION SYSTEM ARCHITECTURE

A. General

1. The Building Automation System shall consist of a number of Nodes and associated equipment connected by industry standard network practices. All communication between Nodes shall be by digital means only. The BAS shall provide control, alarm detection, scheduling, reporting and information management for the entire facility, and Wide Area Network (WAN) if applicable, from a single ODBC-compliant database.

2. The system shall be designed with a top-level minimum 100 Mb Ethernet network, using the BACnet/IP protocol. A sub-network using the BACnet MS/TP protocol, with a minimum of 76.8kb speed, shall connect the local, stand-alone controllers with Ethernet-level controller/routers. The use of ARCNET, LONworks, RS-232 serial communications, or BACnet Ethernet for these controllers is prohibited.

3. The Building Automation System network shall at minimum comprise of the following:

a. Operator Workstations – fixed and portable.

b. Network processing, data storage and communication equipment including file server and web server hardware and software.

c. Routers, bridges, switches, hubs, modems and the like communications equipment.

d. Active processing Nodes including field panels.

e. Intelligent and addressable elements and end devices.

f. Third-party equipment interfaces.

g. Other components required for a complete and working Building Automation System.

4. The Building Automation System shall be accessible via Enterprise Intranet and high speed Internet browser with security protection for user access.

5. The PC Workstations, File servers and principal network equipment shall be standard products of recognized major manufacturers available through normal PC vendor channels. These devices shall exceed all of the BAS manufacturer's minimum performance specifications, including operating system software, server software, database management software, storage memory, processing memory, and processing speed and power. "Clones" are not acceptable.

6. Provide all of the PC and server operating system software, communications software, server software, database management software, and all BAS manufacturer's user interface, system configuration, setup, and programming software tools. Provide licenses for all software residing in the Building Automation System and transfer these licenses to the Owner prior to completion.

B. Network

1. The Building Automation System shall incorporate a primary Tier 1 and Tier 2 networks. At the Contractor's option, the Building Automation System may also incorporate integrated tertiary Tier 3 networks.

a. The Tier 1 portion of the Network shall comprise the Operator Workstations, Network File Servers, Network Application Nodes (NAN), Network Application Controllers (NAC), Web Servers and IP based Integration Controllers. This shall be the main backbone of the system which shall be an Ethernet LAN/WAN, using BACnet/IP as the communications protocol; minimum speed shall be 100Mb.

b. The Tier 2 portion of the Network shall comprise the various Unitary Application Controllers (UAC). These shall communicate via BACnet MS/TP field buses managed by the NAN/NAC's. Minimum speed shall be 76.8kbps. The Level 2 field bus consists of an RS485, token passing bus.

2. The Building Automation System Network shall utilize an open architecture capable of:

a. Utilizing standard Ethernet communications of 10/100 Mb/sec with a minimum speed of 100 Mb/sec. This shall be the Tier 1 level of the Network.

b. Connecting and communicating via BACnet/IP.

3. The Building Automation System network shall support both copper and optical fiber communication media. As a minimum provide CAT 6E cabling within the building for Tier 1 communication. For any connections between buildings, fiber optic cabling shall be utilized.

C. Third-Party Interfaces

1. Building Automation System Contractor shall integrate real-time data from systems supplied by other trades as required.

2. The Building Automation System shall include necessary Building Automation System hardware equipment and software to allow data communications between the Building Automation System and systems supplied by other trades.

3. The trade contractor supplying other systems will provide their necessary hardware and software and will cooperate fully with the Building Automation System Contractor in a timely manner and at their own cost to ensure reliable communications and the complete data integration as required in this document.

4. The Building Automation System Contractor shall provide all necessary coordination with vendors, contractors, owners, engineers, and other representatives at no additional cost to the Owner. Provide a completed fully functional, operational, integrated and seamless communicating infrastructure system.

D. Power Fail / Auto Restart

1. Provide for the automatic, orderly and predefined shutdown of parts or all of the Building Automation System following total loss of power to parts or all of the Building Automation System.

2. Provide for the automatic, orderly and predefined startup of parts or all of the Building Automation System following total loss of power to those parts or all of the Building Automation System. Archive and annunciate time and details of restoration.

3. Provide for the orderly and predefined scheduling of controlled return to normal, automatically time scheduled, operation of controlled equipment as a result of the auto restart processes.

4. Maintain the Building Automation System real-time clock operation during periods of power outage for a minimum of 72 hours.

E. Downloading and Uploading

1. Provide all BAS manufacturer software tools necessary to generate Building Automation System software-based sequences, database items and associated operational definition information and user-required revisions to same on designated Operator Workstations and the means to download same to the associated Application Nodes.

2. Provide the capability to upload Building Automation System operating software information, database items, sequences and alarms to the designated Operator Workstations with automatic archiving of same on the Operator Workstations. The functions of this Part shall be governed by the codes, approvals and regulations applying to each individual Building Automation System application.

3. The entire control system shall be approved and listed by UL 916 - Energy Management.

4. All DDC panels shall be powered through uninterruptible power sources (UPS) with sufficient capacity to ride through a (2) minute power interruption between transfers from normal to emergency power. UPS’s and wiring shall be provided by the BAS Contractor.

5. Uploading or downloading functions performed at any location shall not affect controllers, communications, inputs, outputs at any location or address within the Building

Automation Control Architecture nor shall any controller level functions be disrupted in any manner.

F. Network Automation Nodes (NAN)

1. (NAN) Network Automation Nodes shall be stand-alone, multi-tasking, multi-user, real-time digital controllers complete with all hardware, software, and communications interfaces, power supplies. The Building Automation System shall provide high speed browser access and connectivity over the customer Enterprise-Wide Network and I.T. infrastructure, and/or over the Internet. NANs shall communicate with each other and share their data over the Enterprise-Wide Network using BACnet IP to accomplish coordinated global control and energy management strategies as required. NAN's shall communicate with the BAS Server over the Enterprise-Wide Network using BACnet/IP or IT standard Web Services. The NAN's shall be designed, packaged, installed, programmed and commissioned in consideration of their specific service and prevailing operating conditions. The Network Automation Nodes shall be designed, manufactured, and supported by the same BAS manufacturer that manufactures and supplies the Network Automation Controllers, the Unitary Automation Controllers, the BAS server software, and the setup, configuration and programming software tools. The NAN's shall be proven standard products of their original manufacturer and not a custom product for this Project.

2. A failure at a Network Automation Node shall not cause failures or non-normal operation at any other system Network Automation Node other than the possible loss of active real-time information from the failed Network Automation Node.

3. Ancillary Network Automation Node equipment, including interfaces and power supplies, shall not be operated at more than 80% of their rated service capacity.

4. NANs shall provide both standalone and networked direct digital control of mechanical and electrical building system controllers as required by the Specifications. The primary NAN shall support a minimum of [5,000] field points together with all associated features, sequences, schedules, applications required for a fully functional distributed processing operation.

5. NANs shall monitor and report communication status to the Building Automation System server. The BAS shall provide and record a system advisory upon communication failure and restoration.

6. All NANs shall include all necessary internal server software to provide a complete graphical user interface via a Browser connection, either via the Enterprise-Wide Network or directly via a local port on the NAN. This user interface will provide the ability to view, monitor, and/or override any data point or object in the NAN's database, to view equipment and area schedules and override stop/start times, to view, acknowledge, or discard system alarms, and/or to view point trending data.

7. All NAN shall be provided with face mounted LED type annunciation to continually display its operational mode, power and communications.

8. The NAN's shall be tested and listed by the BACnet Testing Laboratory (BTL) as BACnet Building Controllers (B-BC).

9. Each NAN shall be provided with the necessary un-interruptible power facilities to ensure its continued normal operation during periods of line power outages of, at minimum, 1-minute duration. Normal functionality shall include all normal software processing,

communication with powered field devices and network communications with other powered Controls Systems NAN, Data Servers and OWS. Each NAN shall report its communication status to the BAS server Application. The BAS server Application shall provide and record a system advisory upon communication failure and restoration. Each NAN shall retain program, control algorithms, and setpoint information in non-volatile memory in the event of a power failure, and shall return to normal operation upon restoration of power.

10. Each NAN shall have sufficient memory to support its operating system, database, and program requirements, including the following:

    a. Data sharing.
    b. Device and network management.
    c. Alarm and event management.
    d. Scheduling.
    e. Point data trending.
    f. Energy Management.

11. Each NAN shall support firmware upgrades without the need to replace hardware. Each NAN shall have a minimum of 15 percent spare capacity of memory secondary system controllers, point capacity and programming functions as indicated in the NAN's built-in self-diagnostics tools.

12. Each NAN shall continuously perform self-diagnostics, communication diagnosis, and provide both local and remote annunciation of any detected component failures, low battery condition; and upon failure shall assume the predetermined failure mode.

13. Each NAN shall monitor the status of all overrides and inform the operator that automatic control has been inhibited, and allow the operator to manually override automatic or centrally executed commands. The NAN shall include an internal audit record of any and all operator command overrides.

14. The BAS shall provide all necessary BAS manufacturer's software tools to generate and modify and archive the Controls Systems Application software-based sequences, database elements, associated operational definition information and user-required revisions to same at any designated Workstation together with the means to download same to the associated NAN's NAC's and UAC's.

15. In the event of loss of normal power, there shall be orderly shutdown of the controllers to prevent the loss of database or software programming. When power is restored flash memory, battery backup or super capacitor will be automatically loaded into non-volatile flash memory and shall be incorporated for all programming data.

G. Network Application Controller (NAC)

1. The Network Application Controller (NAC) shall provide all of the same abilities described for the NAN, including communications over Ethernet and the Enterprise-Wide Network and the built-in web server and ability to serve a graphical user interface to a standard PC Browser application. The main differences will be in a lower controller count for the Tier 2 network and the NAC shall have direct hardwired input/output capabilities. The NAC's shall be tested and certified by the BACnet Testing Laboratory (BTL) as Building Controllers (B-BC).

    a. Each NAC shall have a minimum of 24 hardwired input/output points.

b. Each NAC shall have an integral Input/Output communication bus for point expansion. The input/output expansion modules shall be for point IO only and all control processing algorithms shall reside in the NAC.

c. The NAC's shall be utilized for large systems control and the contractor shall provide an NAC for each of the following systems:

1) Air Handling Unit

2) Chiller Plant (based on the size of the plant, more than a single controller may be required for redundant operation).

3) Boiler plant (based on the size of the plant, more than a single controller may be required for redundant operation).

4) Heat Exchanger Systems for Processed Chilled Water, Reheat/Radiation/Radiant Hot Water, etc.

H. Unitary Application Controller (UAC)

1. Unitary Application Controller (UAC) shall be a fully user-programmable for both standalone and networked direct digital control of HVAC systems. The UAC's shall be tested and certified by the BACnet Testing Laboratory (BTL) as BACnet Advanced Application Controllers (B-AAC) or as BACnet Application Specific Controllers (B-ASC), depending on the control application.

2. The B-AAC listed UAC versions shall be used for critical application where a real time clock is required and the ability to directly sample and record data status or value, manage real time equipment or system schedules, and execute and manage alarm sequences. The B-ASC listed UAC versions shall be used for simple terminal and unitary HVAC equipment. A dedicated UAC shall be configured and provided for each terminal HVAC system (VAV Box, Unit Heater, Fan Coil Unit, CV Box)

3. Each UAC shall be able to retain program, control algorithms, setpoints, logic and command information through the use of non-volatile memory (flash, EEPROM). For B-AAC listed UAC versions, other information such as trend data, historical data schedules will be maintained for at least 72 hours in the failure and shall return to normal operation upon restoration of power.

4. Each UAC shall report its communication status to the Building Automation System. The Building Automation System shall provide a system advisory upon communication failure and restoration.

5. Each UAC shall support firmware upgrades without the need to replace hardware and shall have a minimum of 15 percent spare capacity of I/O functions. The type of spares shall be in the same proportion as the implemented functions on the controller, but in no case there shall be less than one point of each implemented I/O type.

6. Provide a means to prevent unauthorized personnel form accessing setpoint adjustments and equipment control functions.

7. The UAC shall provide the ability to download and upload configuration data, both locally at the Node and via the FMS communications network.

8. Each UAC shall be a dedicated controller without the need to use expansion modules to accomplish the entire primary control sequences. Sharing controller, sensor, input/output data over any high level or low level network to accomplish the specified control sequences is unacceptable. Global sharing of general data such as OA-T, OA-RH OA-CO^2 levels between controllers over the BMS network is acceptable as long as speed of transmitting the data does not impact the UAC controller ability to perform in any mode of operation.

9. If it is determined that the UAC controller cannot perform specified sequence of operation because of dependency for shared information that Contractor shall provide a higher level controller at no additional cost. This change shall be identified by separate submittal to Design Engineers.

2.3 PORTABLE OPERATOR'S TERMINAL

A. Acceptable Manufacturers subject to compliance with the specification:

1. Dell
2. Toshiba
3. HP

B. Provide one (1) portable operator terminal with a minimum LCD display of 80 characters by 25 lines and a full featured keyboard. The portable operator’s terminal shall be hand-held and plug directly into individual distribution control panels as described below. Provide a user friendly, English language prompted interface for quick access to system information, not codes requiring look-up charts.

C. General

1. Furnish portable operator’s terminal for system. Portable operator’s terminal shall allow for local accessing of program information.

2. Laptop terminal portable operator’s terminal shall have the following features:

a. Intel Core i3 Dual Core 2. 3 GHz w/3 MB cache
b. Full active matrix color display with minimum 1366 x 768 resolution, 15".
c. AC adapter
d. Battery pack / battery charger
e. 500 GB fixed disk drive
f. 4.0 GB of 2133MHz DDR4 RAM
g. 8X DVD +/- RW drive
h. Audio built in
i. Latest version of Microsoft Windows
j. WLAN/BT/WiGig

k. Integrated pointing device

l. 3 USB ports

D. Functionality of the portable operator's terminal connected at any high or lower level controller:

1. Access all controllers on the network.

2. Backup and/or restore controller data bases for all system panels, not just the DDC controller.

3. Display all point, selected point and alarm point summaries.

4. Display trending, historical and totalization information.

5. Add, modify, and/or delete any existing or new system point.

6. Command, change setpoint, enable/disable any system point vertical or physical.

7. Program and load custom control sequences as well as standard energy management programs.

E. Connection of a POT on controller to a distributed control processor shall not interrupt nor interfere with normal network operation in any way, prevent alarms from being transmitted or preclude centrally-initiated commands and system modification.

F. Portable operator terminal access to controller shall be password-controlled and menu-driven.

2.4 OPERATOR INTERFACE

A. The Contractor shall provide all the necessary hardware and software to interface with the existing Central Facility Management System (CFMS). A Communication Protocol Interface (CPI) between each system provided under this section and the CFMS system shall be provided by the BAS Contractor. The CPI shall allow the following:

1. Monitoring and commanding of all points for each system is required. If it requires points to be un-bundled to accomplish this, the BAS Contractor shall provide this for seamless integration.

2. Trend reports shall be compiled by the CFMS; however, point information and format shall be provided to the CFMS from the native system as directed.

3. The CAD drawings for the native system shall be capable of being located into the CFMS for the purpose of making dynamic graphics.

B. Transmission of the native system to the CFMS shall be via Ethernet. All necessary labor and material to tie into the existing campus Ethernet shall be provided under this section.

C. Each native system shall have a CFMS CPI unless otherwise provided for in the specification. If the BAS does not have a native CPI as part of their system, the BAS Contractor shall utilize a Tridium JACE to perform the interface function.

D. If a custom CPI is required, the BAS Contractor shal be responsible for the cost to develop the custom application along with all startup and check out labor.

E. The cost to develop the gateway shall be provided under this section. The cost to check out, program, create graphics and verify each developed CPI shall be included under this section. The gateway operation must be verified in the presence of and signed-off by the Owner’s CFMS representative.

2.5 OPERATOR WORKSTATION

A. Basic Interface Description

1. Command Entry/Menu Selection Process: Operator Workstation interface software shall minimize operator training through the use of English language prompting, English

language point identification, and industry standard PC application software. The operator interface shall minimize the use of a typewriter style keyboard through the use of a mouse or similar pointing device, and "point and click" approach to menu selection. Users shall be able to start and stop equipment or change setpoints from graphical displays through the use of a mouse or similar pointing device.

2. Graphical and Text-Based Displays: At the option of the user, Operator Workstations shall provide consistent graphical or text-based displays of all system point and application data described in this specification. Point identification, engineering units, status indication, and application naming conventions shall be the same at all workstations.

B. Computer System Access Operation Control Stations (OCS) Description: This system access workstation is also referred to as the Building Automation System “Front end”.

C. Provided Workstation with:

1. Workstation shall be general purpose, commercially available, personal computer with sufficient memory and processor capacity to perform all functions described in this specification.

2. Sufficient hard drive memory storage shall be provided to accommodate all fully configured point data bases, all application databases, all graphics data bases, all user-defined reports, and all historical data archival as described in this specification.

3. Each shall include the following:

a. Intel Core i3-6100 3.7 Ghz, 6 MB cache with 4 GB 2133Mhz DDR4 Non-ECC memory.
b. 19" color LCD monitor 1280x1024
c. HDMI video output.
d. 750 GB fixed disk.
e. Mouse.
f. (1) Printer for alarms, minimum 240 characters/seconds.
g. (1) Printer for reports, minimum Laser printer similar.
h. 16X DVD +/- RW drive
i. Ethernet network interface card

4. The operator functions provided by the system access Operator Terminal shall include, but not be limited to, the following:

a. Start and Stop Points
b. Modify Setpoints
c. Modify PID Loop Setpoints
d. Override PID Control
e. Change Time/Date
f. Add/Modify Start/Stop Weekly Scheduling
g. Add/Modify Setpoint Weekly Scheduling
h. Enter Temporary Override Schedules
i. Define Holiday Schedules
j. View Analog Limits
k. Enter/Modify Analog Warning Limits
l. Enter/Modify Analog Alarm Limits
m. Enter/Modify Analog Differentials
n. View Point History Files

5. UPS system with one hour backup.

6. The workstation shall provide access to all real or calculated points in the controller to which it is connected, or any other controller in the network. This capability shall not be restricted to a subset of predefined "global points", but shall provide totally open exchange of data between the operator terminal and any DDC panel in the network.

7. Provide English language prompting to eliminate the need for the user to remember command formats or point names. Prompting shall be provided consistent with a user's password clearance and the types of points being displayed, to eliminate the possibility of operator error. Operator shall not require the use of special templates for navigation.

8. On-line, interactive user's "Help" manuals and tutorials shall be provided. Based upon operator request, the "help" function shall provide general system operating instructions, and specific descriptions of commands available in the currently displayed menus.

9. Identification for all real or calculated points shall be consistent for all network devices.

10. In addition to instantaneous summaries, the Operator's Terminal shall allow a user to view a Point History file for system points. Point History files shall provide a record of value of analog points over the last 24 hours, at 30 minute intervals, or a record of the last (10) status changes for binary type points.

D. Provide Server with:

1. PC Hardware – The Workstation/Server computer shall be configured as follows:

a. Memory – 32 GB Ram, Dual Channel, RDIMM at 1333 MHz minimum
b. CPU– Intel® 2x Xeon® E5-2430 dries or equal Server class machine
c. 2.20 GHz, 10M Cache,
c. Hard Drive – 1TB each for RAID level 1 array
d. Hard drive backup system –DVD +/- RW
e. USB ports
f. Keyboard – 101 Keyboard and 2 Button Mouse
g. CRT configuration

1) 19” LCD Flat Panel Monitor 1280 x 1024 resolution minimum

h. LAN communications – Dual NIC cards

i. Windows Server 2008 R2 64-bit

E. Database Configuration

1. Provide database configuration for each hardware and software point.

2. Specific point parameters, such as alarm limits, alarm message, point name and point description shall be as approved by the Owner.

F. Trends

1. Provide real time and historical trends for hardware and software points as directed by the Owner.

2. Archiving or transfer of trend and historical data information shall not interfere, reduce communication throughout stow network speed or reduce local controller operation by any measure, due to trend or historical data capture rates and storage routines.

G. Internet / Intranet Browser

1. A multi-user color graphics and textual interface shall be provided that allows customers to access their Building Automation System data via the Internet or Intranet. This interface shall use HTML-based pages to send and receive data from a Building Automation System to a web browser.

2. Browser shall:

a. Automatically reflect any changes made to the Building Automation System without additional programming.

b. When installed behind a corporate firewall, shall work in conjunction with other security measures that have been implemented.

c. Allow the user to navigate and command the Building Automation System using the same format as the Operator Workstation.

d. Be an industry-standard browser

e. Provide user password access control.

f. Provide the means by which the user can create, edit and view groups of FMS data points.

g. Provide navigation tools for moving between the views. In addition, it shall provide tools for gaining access to help and for logging out of the system.

H. Remote Notification

1. Provide as part of the project automatic remote notification for personnel of user defined Building Automation System events in the form of alphanumeric paging, email and text messaging. Communication protocols for support of this shall include but not be limited to the following:

a. SMTP (Simple Mail Transfer Protocol)

b. SMS (Short Message Services)

2. There shall be no limit to the number of points that can be configured for remote notification of alarm conditions and no limit on the number of remote devices which can receive messages from the system.

3. On a per point basis, system shall be configurable to send messages to an individual or group and shall be configurable to send different messages to different remote devices based on alarm message priority level.

4. Remote devices may be scheduled as to when they receive messages from the system to account for operators' work schedules.

5. System must be configurable to send messages to an escalation list so that if the first device does not respond, the message is sent on to the next device after a configurable time has elapsed.

6. Message detail shall be configurable on a per user basis.

7. During a "flood" of alarms, remote notification messages shall have the ability to optimize several alarms into an individual remote notification message.

8. Workstation shall have the ability to send manual messages allowing an operator to type in a message to be sent immediately.

9. Workstation shall have a feature to send a heartbeat message to periodically notify users that they have communication with the system.

I. Reports

1. Provide real time reports for hardware and software points as directed by the Owner.

2. The BAS Contractor shall program and test all alarming and alarm report routing to final devices such as printer, computers, pagers, monitors, cell phones, www, etc. Alarming requirements and routing shall be coordinated with the Owner by first compiling and all points listing for Owner's review prior to any programming.

2.6 DYNAMIC COLOR GRAPHIC DISPLAYS: COLOR GRAPHICS SHALL BE PROVIDED AS SPECIFIED IN THE EXECUTION PORTION OF THIS SPECIFICATION TO OPTIMIZE SYSTEM PERFORMANCE ANALYSIS AND SPEED ALARM RECOGNITION

A. System Selection/Penetration: The operator interface shall allow users to access the various system schematics and floor plans via a graphical penetration drill down scheme, menu selection, and text-based commands.

B. Dynamic Data Displays: Dynamic temperature values, humidity values, flow values, and status indication shall be shown in their actual respective locations, and shall automatically update to represent current conditions without operator intervention.

C. Windowing: The windowing environment of the workstation shall allow the user to simultaneously view several graphics at the same time to analyze total building operation, or to allow the display of a graphic associated with an alarm to be viewed without interrupting work in progress.

D. Graphics Definition Package: Graphic generation software shall be provided to allow the user to add, modify, or delete system graphic displays.

1. The Contractor shall provide libraries of pre-engineered screens and symbols depicting standard air handling unit components (e.g. fans, cooling coils, filters, dampers, etc.), complete mechanical systems (e.g. constant volume-terminal reheat, VAV, etc.) and electrical symbols.

2. The graphic development package shall use a mouse or similar pointing device in conjunction with a drawing program to allow the user to perform the following:

a. Define symbols
b. Position and size symbols
c. Define background screens

d. Define connecting lines and curves
e. Locate, orient and size descriptive text
f. Define and display colors for all elements
g. Establish correlation between symbols or text and associated system points or other displays.

3. Graphical displays can be created to represent any logical grouping of system points or calculated data based upon building function, mechanical system, building layout, or any other logical grouping of points which aids the operator in the analysis of the facility. To accomplish this, the user shall be able to build graphic displays that include point data from multiple DDC panels, including application specific controllers used for DDC unitary or VAV terminal unit control.

E. Graphic

1. Provide graphic screens each system for this project.

2. Provide the following as a minimum:

a. Each air handling unit and exhaust air handling unit.
b. Chilled water system.
c. Condenser water system.
d. Process chilled water system.
e. Steam system.
f. Hot water system.
g. Each heat exchanger.
h. Each chiller.
i. Each hot water system.
j. Each glycol system.
k. Each exhaust fan.
l. Each lab pressure control system.
m. Each animal holding, procedure and operating room in the Vivarium.
n. Process condenser water system.
o. Each piece of equipment.
p. Each controlled system.

3. Provide graphic representation of building’s form and site plans locating all equipment and panels.

4. Each hardware point shall be represented on graphic screen.

5. Selected software points shall be represented on respective process system graph as determined by the Owner. Examples of these software points are:

a. Control loop setpoint value.
b. Control loop auto/manual selection.
c. Lead/lag selection for pumps and other motors.
d. Campus chilled water global points.
e. Calculated points such as run time.
f. Other vertical software points as required.

F. The Contractor shall coordinate all required graphical modes, features, binding, logic, etc., for a complete fully functional graphical operating system. All graphical schemes shall be submitted and approved by Architect/Engineer and Owner prior to programming.

2.7 UNINTERRUPTIBLE POWER SUPPLY (UPS)

NOT USED.

A. Provide UPS backup for the following components of the BAS system:

1. All field controllers (NAN, NAC and UAC types).
2. All components of the BAS communication infrastructure.
3. Workstations and Servers

B. The BAS contractor shall be responsible for sizing the UPS system/system's that will be required. All additional cabinets required for protection, cooling fans and filters shall be part of this projects scope. Load calculations shall be submitted for review.

C. The UPS shall provide the following:

1. Sized for 125% of the connected load for the following durations:

a. Workstations and Servers: 1 hour.
b. Field Controllers and all network infrastructure components: 2 minutes.

2. Designed to operate on Emergency Generator power.

3. Utilizes double conversion online topology designed to protect equipment by supplying reliable, network-grade power providing extremely tight voltage and frequency regulation.

4. Internal bypass and input power factor correction.

5. The primary sections of the UPS are: input disconnect and filter stage, input PFC power stage, energy storage stage (DC bus capacitor bank), output power stage (inverter), bypass and a battery charger. The control of power module and fault detection logic is microcontroller-based providing the following:

a. Input filter stages.
b. Provide seamless transitions from battery to line and vice versa, as well as the low and high frequency power stages ripple.
c. The output power (inverter) stage operates directly from the DC bus and produces a 120VAC output.

6. Field-replaceable hot swappable battery modules allowing for replacement without the need to interrupt the connected load

7. Either an optional dry contact to provide a battery low alarm or an integrated network card. If a network card is required, the BAS contractor shall own as part of this project the scope required to install and monitor the UPS network and report the UPS alarms on the BAS network.

D. The BAS contractor shall include the UPS infrastructure on their Network Riser Diagram and submit for review. The UPS/UPS's shall be shown on the project coordination drawings.

E. Acceptable Manufacturer:

1. APC

2. Sola
3. Eaton

PART 3 - EXECUTION

3.1 PROJECT MANAGEMENT

A. The BAS Contractor shall designate a project manager who will be responsible for the following:

1. Construct and maintain project schedule.
2. On-site coordination with all applicable trades and subcontractors.
3. Authorized to accept and execute orders or instructions from Owner/Architect.
4. Attend project meetings as necessary to avoid conflicts and delays.
5. Make necessary field decisions relating to this scope of work.
6. Coordination/Single point of contact.

3.2 NUMBERING/NAMING CONVENTIONS

A. The Contractor shall collaborate with the Owner directly to determine the Owner's preference for naming conventions, etc. before entering the data in the system.

B. As a minimum the BAS Contractor shall submit to the Architect/Engineer and Owner the layout of the network, identifying all DDC controllers. Each controller will be identified by address and system being served. All physical and software generated objects, points and attributes shall be listed along with a description.

3.3 START-UP AND COMMISSIONING

A. When installation of the system is complete, calibrate equipment and verify transmission media operation before the system is placed on-line. All testing, calibrating, adjusting and final field tests shall be completed by the installer. Verify that all systems are operable from local controls in the specified failure mode upon panel failure or loss of power.

B. Provide any recommendation for system modification in writing to Owner. Do not make any system modification, including operating parameters and control settings, without prior approval of Owner.

C. The BAS Contractor will provide industry standard checkout and startup checklists for each DDC controller installed for the project. If not standard is available, the BAS Contractor shall develop a spreadsheet in MS Excel format and submit to the Engineer for approval prior to system checkout.

3.4 INSTRUCTION AND ADJUSTMENT

A. The Contractor shall provide factory-trained instructor to give full instructions to the owner designated personnel in the operation of the system installed. Instructors shall be thoroughly familiar with all aspects of the subject matter they are to teach. The Contractor shall provide all students with a student binder containing product specific training modules for the system installed. All training shall be held during normal working hours of 8:00 AM to 5:00 PM weekdays.

B. Upon completion of the project, the Contractor shall:

1. Fine-tune and "de-bug" all software control loops, routines, programs and sequences of control associated with the control system supplied.

2. Completely adjust and make ready for use, all transmitters, relays, damper operators, valves, etc., provided under this Section. This Contractor shall furnish copies of complete, detailed, calibrating checkout and commissionary documentation for reach controller. Documentation shall list each procedure and shall be signed by the control specialist performing the service.

3. Furnish a complete set of system operation manual, including standard manufacturers' operating manuals, complete as-built installation diagrams, and complete software hardcopy documentation, as well as a magnetic optical back-up.

   EDIT ITEM

4. Provide an on-site training program for the Owner's staff in the operation and use ofthe control system. Training shall include two (2) segments, as follows:

   a. Segment 1 shall include 16 hours of classroom and hands-on training. This segment shall instruct personnel in the system configuration, component characteristics, control strategy on each controlled system and all requirements for daily operation and use of the system. This segment shall give the Owner's representative a working proficiency in the day-to-day operational requirements (i.e., system monitoring, alarm acknowledgment, HVAC system troubleshooting techniques, setpoint and time schedule adjustments, manual override, etc.).

   b. Segment 2 shall include 6 hours of on-site training. This segment will be geared for the Owner's designated prime operator. An emphasis on overall software management and manipulation shall be made, to allow the prime operator(s) to make control strategy and overall facility and system management changes as required. Attendees shall have attended Segment 1.

   c. All training shall take place at the site and at times mutually agreed to between that BAS Contractor and the Owner. The BAS Contractor shall provide to the Owner's designated representative, at least three (3) weeks before each segment, a course syllabus outline and schedule. The BAS Contractor shall provide all training material, reference material and training aids, as required, all as part of his Contract cost.

3.5 MINERAL INSULATED (MI) METAL-SHEATHED CABLE

A. Install products in accordance with manufacturer's instructions.

B. Bending:

   1. Not less than five (5) times the cable diameter for cable not more than ¾ inch.

C. Pulling:

   1. For all cables up to and including ½" diameter, use ten inch (250mm) or larger sheaves.

D. Splicing:

   1. All fire rated splices shall be made in the factory.

2. In the event a field splice is necessary, it must be made within a 2 hour fire rated room, approved by the engineer and:

    a. Made in the field by manufacturer's field technician, or

    b. Made in the field by personnel trained by the cable manufacturer using manufacturer's components.

E. Terminations:

1. Field made terminations shall be made with cable manufacturer's termination kits only. Stripping tools, crimping and compression tools available from the manufacturer shall be used for proper cable termination.

2. Terminations must be completed immediately once started to avoid moisture ingress from surrounding air. Prior to completing each termination, test insulation resistance and follow manufacturer's drying procedures until insulation resistance reaches an acceptable level.

F. Exposed or Surface installations:

1. Cable may be secured directly to fire rated building structure using an approved method such as one, or any combination, of the following:

    a. Straps: ½ inch (13mm) wide x 3 1/2 inch (38mm) long by 0.030 (0.75mm) thick stainless steel or copper straps. Each strap shall contain two ¼ inch (6mm) holes for securing with 3/16 inch (5mm) by minimum 1 3/4 inch (44mm) long steel anchors.

    b. Steel struts and cable tray: Use only the steel strut framing system and support recommended by Pyrotenax. Aluminum or other materials are not acceptable.

2. Supports shall not exceed three (3) feet on center horizontally, or six (6) feet vertically.

3. Cables shall be installed perpendicular and parallel to building lines.

G. Embedded Installations:

1. Protect against damage during pulling, and during concrete pouring or backfill and tamping.

2. Where cables emerge from grade, provide PVC conduit, metal plate or angle iron. This protection shall minimally extend from 18 inches (460mm) below grade to 8 ft. (2.5m) above grade.

3. Provide overall extruded polymer jacket over exposed copper cable sheath when embedded in corrosive environments.

H. Wall or floor penetrations:

1. Provide sleeve to protect cable and penetration opening during pulling.

2. Provide approved fire stopping of all penetrations.

I. Neatly train and lace cable inside boxes, equipment, and panelboards.

J. Field Quality Control

1. Inspect cable for physical damage and proper connection.

2. Measure tightness of bolted connections and compare torque measurements with manufacturer's recommended values.

3. Verify continuity of each conductor.

4. Prior to energizing cables, measure insulation resistance of each cable. Tabulate and submit for approval.

K. Provide certification from cable manufacturer that installation is in accordance with their requirements.

END OF SECTION 251000

SECTION 260500 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. This Section includes general administrative and procedural requirements for Electrical installations. The administrative and procedural requirements specified herein are included in this Section to expand the requirements specified in Division 01.

1.2 RELATED DOCUMENTS

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

B. This section is a part of each Division 26 Section.

1.3 SUBMITTALS

A. General: Submit the following according to the Conditions of the Contract and as specified in Division 01 Section titled "SUBMITTALS."

B. Prior to purchasing any equipment or materials, a list of their manufacturers shall be submitted for review.

C. Prior to assembling or installing the work, the following shall be submitted for review:

1. Scale drawings indicating insert and sleeve locations.

2. Scale drawings showing all major conduit duct banks, individual conduit runs of 2-1/2 inch and larger with sizes, elevations and appropriate indication of coordination with other trades. This submission to us shall consist of an electronic file submittal and 2 paper prints.

3. Catalog information, factory assembly drawings and field installation drawings as required for a complete explanation and description of all items of equipment.

4. Coordination drawings for access panel and door locations.

D. Documents will not be accepted for review unless:

1. They include complete information pertaining to appurtenances and accessories.

2. They are submitted as a package where they pertain to related items.

3. They are properly marked with service or function, project name, where they consist of catalog sheets displaying other items which are not applicable.

4. List of all deviations and exceptions from the specified requirements for the product is provided on the first sheet of the submittal.

5. They indicate the project name and address along with the Contractor's name, address and phone number.

6. They are properly marked with external connection identification as related to the project where they consist of standard factory assembly or field installation drawings.

E. Shop Drawing Review

1. The purpose of the review of shop drawings is to maintain integrity of the design. Unless the contractor clearly points out changes, substitutions, deletions or any other differences between the submission and the Contract Documents in writing on the Contractor's letterhead, review by the Engineer or Architect does not constitute acceptance. It is not to be assumed that the engineer has read the text nor reviewed the technical data of a manufactured item and its components including where the Vendor has pointed out differences between his product and the specified model.

2. Upon receipt of the approved manufacturers and material suppliers list, the Contractor shall immediately obtain complete Shop Drawings, Product Data and Samples and equipment and material Specification Compliance Review documents from the manufacturers, suppliers, vendors and all Division 26 Contractors, for all materials and equipment as specified herein in various sections of the specifications and shall submit data and details of such materials and equipment for review by the Architect and Engineer. Prior to submission of the Shop Drawings, Product Data and Samples to the Architect and Engineer, the Contractor shall thoroughly review the Shop Drawings, Product Data and Samples and certify they are in compliance with the Contract Documents. The Contractor shall provide a compliance review ("Compliance Review") of the applicable Drawings, Specifications and Addenda for all equipment and materials. The Compliance Review will be a paragraph-by-paragraph review of the Specifications with the following information marked for each Specification section paragraph or in the margin of the original Specification and any subsequent Addenda.

   a. "C": Comply with no exceptions.
   b. "D": Comply with minor deviations. For each and every deviation, provide a numbered footnote with reasons for the proposed deviation and how the intent of the Specification can be satisfied.
   c. "E": Exception. Equipment, product or material does not comply. For each and every exception, provide a numbered footnote with reasons for each exception and suggest possible alternatives for the owner's consideration.
   d. "N/A": The specification paragraph does not apply to the proposed equipment, material or product.
   e. Unless a deviation or exception is specifically noted in the Compliance Review, it is assumed that the Contractor is in complete compliance with the Contract Documents. Deviations or exceptions taken in cover letters, subsidiary documents, by omission or by contradiction does not relieve the Contractor from being in complete compliance unless the exception or deviation has been specifically noted (explicitly, not by implication) in the Compliance Review.

3. It is the responsibility of the contractor to confirm all dimensions, quantities, and the coordination of materials and products supplied by him with other trades. Review of shop drawings containing errors does not relieve the contractor from making corrections at his expense.

4. Substitutions of equipment, systems, materials, temperature controls must be coordinated by the Contractor with his own or other trades which may be involved with the item, such as, but not limited to, equipment substitutions which change electrical requirements, or hanging or support weights or dimensions.

5. Any extra changes or credits which may be generated by other trades due to substitutions will not be accepted unless the Contractor has an agreement in writing with the Owner.

6. Proposed substitutions shall be in accordance with the requirements of the section governing substitutions. Substitutions of equipment, systems, etc. requiring approval of local authorities must comply with such regulations and be filed at the expense of the Contractor (should filing be necessary). Substitutions are subject to approval or disapproval by the Engineer. The contractor in offering substitutions shall hold the Owner and Engineer harmless if the substituted item is an infringement of patent held by the specified item.

F. Explanation of Shop Drawing Stamp

1. Reviewed - No Exception Taken: indicates that we have not found any reason why this item should not be acceptable within the intent of the contract documents.

2. Exception Taken As Noted: indicates that we have found questionable components which, if corrected or otherwise explained make the product acceptable.

3. Revised and Resubmit: indicates that this item should be resubmitted for review before further processing.

4. Resubmit Specified Item: indicates that the item will not meet the intent of the Contract.

5. Incomplete - Resubmit: Indicates that the submission is not complete and ready for review by the Architect or Engineer.

6. Verified for Electrical Services: Indicates that the electrical requirements have been confirmed with the electrical contract documents.

7. Architects Review Required: Indicates that the submission will require the Architects review.

8. Structural Review Required: Indicates that the submission will require the Structural Engineer’s review.

9. Acoustical Consultant Review Required: Indicates that the submission will require the acoustical consultant’s review.

10. No shop drawing stamp or note shall constitute an order to fabricate or ship. Such notification can only be performed by the Project Manager for Construction, the Contractor scheduling his own work, or the Owner.

11. The Contractor is responsible for having "Reviewed" copies of shop drawings bearing the “Reviewed - No Exception Taken” stamp of the Architect/Engineer or Owner's Consultant are kept on the job site and work is implemented in the field in accordance with these documents.

12. Where information from one Contractor is required by another contractor, it is the responsibility of the contractors to exchange information and coordinate their work.

1.4 QUALITY ASSURANCE

A. Qualify welding processes and operators for structural steel according to AWS D1.1 “Structural Welding Code Steel” (where required)

B. Products Criteria:

1. All equipment furnished as part of the work shall comply with the latest editions of all applicable state and municipal "energy codes." Provide certification from the equipment suppliers for all energy-consuming equipment that the equipment fully complies with these codes. Equipment submissions will not be accepted for review unless accompanied by such certification in writing.

2. All equipment and materials shall be new and without blemish or defect.

3. All products and equipment shall be tested and/or listed and labeled by approved agency, such as Underwriters Laboratories (UL), according to prescribed standard or by approved agency according to New York City Office of Technical Certification and Research (OTCR) approved criteria. It is the responsibility of this trade to demonstrate or obtain and pay for all costs and fees of such approval and, when applicable, to prepare and submit an alternative product application to OTCR for review and approval.

4. All equipment and materials shall be free of asbestos.

5. Electrical equipment and materials shall be products which will meet with the acceptance of the agency inspecting the electrical work. Where such acceptance is contingent upon having the products examined, tested and certified by Underwriters or other recognized testing laboratory, the product shall be examined, tested and certified. Where no specific indication as to the type or quality of materials or equipment is indicated, a first-class standard article shall be furnished.

6. It is the intent of these specifications that wherever a specific manufacturer of a product is specified or scheduled, and the specifications include other approved manufacturers or the terms "other approved" or "or approved equal" or "equal" are used, the submitted item must conform in all respects to the specified item. Consideration will not be given to claims that the submitted item meets the performance requirements with lesser construction. Performance as delineated in schedules and in the specifications shall be interpreted as minimum performance.

7. All equipment of one type shall be the products of one Manufacturer.

8. Substituted equipment or optional equipment where permitted and approved, must conform to space requirements. Any substituted equipment that cannot meet space requirements, whether approved or not, shall be replaced at the Contractor's expense. Any modifications of related systems as a result of substitutions shall be made at the Contractor's expense.

9. Note that the approval of shop drawings, or other information submitted in accordance with the requirements hereinbefore specified, does not assure that the Engineer, Architect, or any other Owner's Representative, attests to the dimensional accuracy or dimensional suitability of the material or equipment involved or the ability of the material or equipment involved or the mechanical performance of equipment. Approval of Shop Drawings does not invalidate the plans and specifications if in conflict, unless a letter requesting such change is submitted and approved on the Engineer's letterhead.

10. Substitutions of Electrical Equipment for that shown on the schedules or designated by model number in the specifications will not be considered if the item is not a regular cataloged item shown in the current catalog of the manufacturer.

C. Manufacturer's Recommendations: Where installation procedures of any part thereof are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations shall be furnished prior to installation. Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material.

1.5 COORDINATION

A. Arrange for conduit spaces, chases, slots, and openings in building structure during progress of construction, to allow for electrical installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for electrical items requiring access that are concealed behind finished surfaces.

D. Provide all designating signs for safety switches, overcurrent devices, controls, alarms, and the like, as required by the agencies having jurisdiction.

1.6 COORDINATION DRAWINGS

A. Prepare coordination drawings in accordance with Division 01 Section titled “PROJECT COORDINATION” to a scale of 3/8 inch =1'-0 inch (1:75) or larger; detailing major elements, components, and systems of electrical equipment and materials in relationship with other systems, installations, and building components in spaces such as electric switchgear room, and electric closets. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the Work, including (but not necessarily limited to) the following:

1. The coordination drawings shall be produced using AutoCad 2011 or later software. The design drawings will be made available on disks in AutoCad format for use as a basis for the "Coordination" drawings. These documents remain the property of Cosentini Associates and shall be used for no other purpose without expressed, written consent. The contractor shall assume all liabilities resulting from unauthorized use or modifications to the drawings.

2. Indicate the proposed locations of major raceway systems, equipment, and materials. Include the following:

a. Clearances for servicing equipment, including space for equipment disassembly required for periodic maintenance.

b. Exterior wall and foundation penetrations.

c. Fire-rated wall and floor penetrations.

d. Equipment connections and support details.

e. Sizes and location of required concrete pads and bases.

3. Indicate conduit banks, concrete encased conduit banks, cable trays, individual raceway (conduit) runs larger than 3 inches, etc. loads and support points and submit to the Structural Engineer for review and approval. Indicate the elevation, location, support points, and loads imposed on the structure at support, anchor points, and size of all lines. Indicate all beam penetrations and slab penetrations sized and coordinated. Indicate all work routed underground or embedded in concrete by dimension to column and building lines.

4. Identify all equipment and systems that are installed as part of the work of this Division that by Code require seismic restraint.

5. Indicate seismic support and restraint for all piping and equipment installed as part of the work of this Division and specified under another section of Division 21

6. Identify all equipment and systems installed as part of the work of this Division that by Code does not require seismic restraint whose failure in a seismic event will cause the failure of life safety, high hazard or essential facilities systems installed as part of the work of this Division or restrained equipment and systems installed as part of the work of other Divisions.

7. The equipment and systems identified that by Code do not require seismic restraint whose failure may result in failure of equipment and systems (installed as part of the work of this Division or the restrained equipment and systems installed as part of the work of other Divisions) requiring seismic restraint due to their proximity and relative position shall be seismically restrained.

8. Indicate seismic support and restraint for equipment and system identified in 6 & 7 above.

9. Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.

10. Prepare floor plans, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.

11. Prepare reflected ceiling plans to coordinate and integrate sprinkler installation, air outlets and inlets, light fixtures, communication systems components and other ceiling-mounted items.

B. Project Coordination Drawings

1. This Trade shall add to Coordination Drawings prepared by the HVAC Contractor showing all of the electrical work (equipment, conduit, etc.) to be installed as part of the work of this section of the specifications.

2. All seismic supports and restraints as part of the seismic design (as outlined under another section of this work) shall be shown on the coordination drawings.

3. The Coordination Drawings shall be prepared on electronic media (CADD) at not less than 3/8": 1'-0" scale

4. Requirements for vibration isolation shall be shown on the coordination drawings by each trade.

5. This Trade after showing all of the electrical work shall forward the completed reproducible Coordination Drawings to the General Contractor/Construction Manager.

6. The Electrical Contractor shall attend a series of meetings arranged by the General Contractor/Construction Manager to resolve any real or apparent interferences or conflicts with the work of the other Contractors.

7. The Electrical Contractor shall then make adjustments to his work on the Coordination Drawings to resolve any real or apparent interferences or conflicts.

8. After any real or apparent interferences and conflicts have been incorporated into the Coordination Drawings, the Electrical Contractor shall “sign-off” the final Coordination Drawings.

9. The Electrical Contractor shall not install any of this work prior to “sign-off” of final Coordination Drawings. If the electrical work proceeds prior to sign-off of Coordination Drawings, any change to the electrical work to correct the interferences and conflicts that result will be made by the Electrical Contractor at no additional cost to the project.

10. Coordination Drawings are for the Electrical Contractor’s and Owner’s use during construction and shall not be construed as replacing any shop, as-built, or Record Drawings required elsewhere in these Contract Documents.

11. Review of Coordination Drawings shall not relieve the HVAC Contractor from his overall responsibility for coordination of all work performed pursuant to the Contract or from any other requirements of the Contract.

1.7 RECORD DOCUMENTS

A. Prepare record documents in accordance with the requirements in Division 01. In addition to the requirements specified in Division 01, comply with the following:

1. A complete set of "as-built" or record electric drawings shall be made up and delivered to the Architect.

2. The drawings shall show:

a. All electric work installed exactly in accordance with the original design.

b. All electric work installed as a modification or addition to the original design.

c. The dimensional information necessary to delineate the exact location of all circuitry and wiring runs (other than lighting and appliance branch circuitry and small control, signal and communications runs) that are so buried or concealed as to be untraceable by inspection through the regular means of access established for inspection and maintenance.

d. The numbering information necessary to correlate all electrical energy consuming items (or outlets for same) to the panel or switchboard circuits from which they are supplied.

3. The documents shall be produced using BIM software in accordance with the requirements of Division 1.

4. The quantity of design drawings that are made available shall in no way be interpreted as setting a limit to the number of drawings necessary to show the required "as-built" information.

5. Progress prints of record drawings shall be submitted monthly during the construction period for Architect's approval.

6. As-built drawings for filing with the Building Department (where required) shall be prepared at the same scale, in the same plan format and use the same symbols and nomenclature as the plans filed by Engineer of Record with the Building Department for “Building Permit.”

1.8 MAINTENANCE MANUALS

A. Prepare maintenance manuals in accordance with Division 01. In addition to the requirements specified in Division 01, include the following information for major equipment items such as panelboards, lighting fixtures, and other items as specified elsewhere.

1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.

2. Manufacturer's printed operating procedures include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions.

3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.

4. Servicing instructions.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.

B. Unit shall be stored and handled in accordance with manufacturer's instructions.

C. Unit shall be shipped with all listed items and control wiring factory installed unless noted on the submittals and approved prior to shipment.

D. Unit shall be shipped complete as specified. Parts for field installation shall not be shipped and stored on site without prior approval.

E. Rigging: Units shall be fully assembled. Units requiring disassembly for rigging shall be factory assembled and tested. Disassembly, reassembly and testing shall be supervised by the manufacturer's representative.

F. Unit shall be shipped with firmly attached labels that indicate name of manufacturer, model number, serial number, and plan tagging.

G. The Vendor shall shrink wrap all electronic equipment and spare parts prior to shipping. Spare parts are to be delivered at time of owner acceptance.

H. Deliver, store and handle all materials to keep clean and protected from damage.

I. Store products in shipping containers and maintain in place until installation.

J. Protect equipment and other materials from damage after installed from construction debris and other damage.

1.10 CODES, PERMITS AND INSPECTIONS

A. All work shall meet or exceed the latest requirements of all national, state, county, municipal, and other authorities exercising jurisdiction over electrical construction work and the project.

B. All required permits and inspection certificates shall be obtained, paid for, and made available at the completion of the work.

C. Any portion of the work that is not subject to the requirements of an electric code published by a specific authority having jurisdiction shall be governed by the National Electrical Code and other applicable sections of the National Fire Code, as published by the National Fire Protection Association.

D. All products and equipment shall be tested and/or listed and labeled by approved agency, such as Underwriters Laboratories (UL), according to prescribed standards. It is the responsibility of this trade to demonstrate or obtain and pay for all costs and fees of such approval and, when applicable, to prepare and submit an alternative product application for review and approval.

E. Installation procedures, methods and conditions shall comply with the latest requirements of the Federal Occupational Safety and Health Administration (OSHA).

F. All equipment furnished as part of the electrical work shall comply with the latest editions of all applicable state and municipal “energy codes.”

1.11 GUARANTEES AND CERTIFICATIONS

A. All work shall be guaranteed to be free from defects. Any defective materials or workmanship as well as damage to the work of all trades resulting from same shall be replaced or repaired as directed for the duration of stipulated guaranteed periods.

B. The duration of guarantee periods following the date of beneficial use of the system shall be one year. Beneficial use is defined as operation of the system to obtain its intended use.

C. The date of acceptance shall be the date of the final payment for the work or the date of a formal notice of acceptance, whichever is earlier.

D. Certification shall be submitted attesting to the fact that specified performance criteria are met by all items of electrical equipment for which such certification is required.

1.12 SEPARATION OF WORK BETWEEN TRADES

A. The specifications for the overall construction delineate various items of work under separate trade headings. The list below sets forth this delineation to the extent that it affects the electric work.

B. In the absence of more detailed information, the list shall be taken as a specific instruction to the electrical trade to include the work assigned to it.

C. Indications that any trade is to perform an item of work means that it is to perform the work for its own accommodation only, except as specifically noted otherwise.

Oth = Divisions other than Electrical (Division 26); Mechanical (Divisions 21, 22 & 23)

Plb = Plumbing

FP = Fire Protection

Htg = Heating, Ventilating & Air Conditioning

Elec = Electrical.

f = Furnished.

i = Installed.

p = Provided (furnished and installed).

Item	Oth	Plb	FP	Htg	Elec	Note
Motors for mechanical equipment.		p	p	p		
Motor controllers for: Htg Plb FP		 f 	 f	 f 	 i i i	Specifications and drawings delineate exceptions. Includes motor control centers if applicable.
Motor control devices for: Htg Plb FP		 p 	 p	 p 		Specifications and drawings delineate exceptions. Control devices for mounting within controller are provided integral with controller.
Power wiring for motors: Htg Plb FP					 p p p	
Control wiring for motor controllers: Htg Plb FP				 p 	 p p	Specifications and drawings delineate exceptions.
Temporary light and power.	p					See General conditions specifications. To accommodate all trades.
Temporary water.	p					
Temporary heat.	p					

Item	Oth	Plb	FP	Htg	Elec	Note
Temporary toilets.	p					
Hoisting.					p	
Rigging.					p	
Bracing and dunnage for safe rigging.					p	
Cutting, chasing and patching.	p					Cost where due to late installation or improper coordination of work is the responsibility of electrical contractor.
Framed slots and openings in walls, decks and slabs.	p					Coordination drawings are required from the electrical contractor.
Sleeves through non-waterproof slabs, decks and walls.					p	Includes drilling of holes when required.
Sleeves through waterproof slabs, decks and walls.					p	Includes drilling of holes for other than field poured concrete.
Waterproof sealing of sleeves through waterproof slabs, decks and walls.					p	
Fireproof sealing (fire-stopping) excess opening spaces in slabs, decks and fire-rated walls.					p	
Fastenings.					p	
Supports.					p	
Flashing of electric conduits through roof (pitch pockets).	p					
Concrete foundations, pads and bases inside buildings.	p					Furnishing of anchors and vibration mounts included in the electric.

Item	Oth	Plb	FP	Htg	Elec	Note
Concrete foundations, pads and bases outside buildings.					p	Furnishing of anchors and vibration mounts included in the electric.
Field touch-up painting of damaged shop coats.					p	
Field rustproof painting of supporting steel members, frames and racks.					p	
Finish painting of exposed work.	p					Red coloring of exposed fire protection alarm systems circuitry included in electric. Red and white striping of exposed primary voltage runs included in electric.
Finished Wall and Ceiling Access Doors and Supporting Frames	i				f	Contractor shall locate the doors on approved shop drawings and shall be held responsible for the accessibility of all concealed outlet boxes, pull boxes, controls, equipment, etc.
Opening frames for ceiling recessed lighting fixtures and other electrical items.					p	
Electric heaters with integral fans, (unit heaters, cabinet heaters, fan coil units and the like.)				p		Line and control connections included in electric.
Electric heater cables for mechanical system pipe tracing.					p	
Electric power consuming items and controls for same not referred to above.	p	p	p	p		Line and control connections to equipment included in electric.

Item	Oth	Plb	FP	Htg	Elec	Note
Rubbish removal.					p	Removal of the shipping and packing materials of electrical items is included in the electric regardless by whom the items are furnished.
Special tools for maintenance of equipment furnished as part of electric work.					f	

D. Include in the electrical work all necessary supervision and the issuing of all coordination information to any other trades who are supplying work to accommodate the electrical installations.

E. For items of equipment that are to be installed but not purchased as part of the electrical work, the electrical work shall include:

1. The coordination of their delivery.

2. Their unloading from delivery trucks driven in to any point on the property line at grade level.

3. Their safe handling and field storage up to the time of permanent placement in the project.

4. The correction of any damage, defacement or corrosion to which they may have been subjected.

5. Their field make-up and internal wiring as may be necessary for their proper operation.

6. Their mounting in place including the purchase and installation of all dunnage, supporting members, and fastenings necessary to adapt them to architectural and structural conditions.

7. Their connection to building wiring including the purchase and installation of all "crown boxes" or other type of termination junction boxes necessary to adapt and connect them to this wiring. Included also shall be the purchase and installation of any substitute lugs or other wiring terminations as may be necessary to adapt their terminals to the building wiring as called for and to the connection methods set forth in these specifications.

F. Items of equipment that are installed but not purchased as part of the electrical work shall be carefully examined upon delivery to the project. Claims that any of these items have been received in such condition that their installation will require procedures beyond the reasonable scope of the electric work will be considered only if presented in writing within one week of the date of delivery to the project of the items in question. The electric work includes all procedures, regardless of how extensive, necessary to put into satisfactory operation, all items for which no claims have been submitted as outlined above.

1.13 DEFINITIONS AND INTERPRETATIONS

A. As used in the drawings and specifications for electrical work, certain non-technical words shall be understood to have specific meanings as follows regardless of indications to the contrary in the General Conditions or other documents governing the electric work.

1. "Furnish" – Purchase and deliver to the project site complete with every necessary appurtenance and support, all as part of the electrical work. Purchasing shall include payment of all sales taxes and other surcharges as may be required to assure that purchased items are free of all liens, claims or encumbrances. Payment of sales taxes is, however, specifically excluded.

2. "Install" – Unload at the delivery point at the site and perform every operation necessary to establish secure mounting and correct operation at the proper location in the project, all as part of the electrical work.

3. "Provide" – "Furnish" and "install."

4. "New" – Manufactured within the past two years and never before used.

5. Regardless of their usage in codes or other industry standards, certain words as used in the drawings or specifications for the electrical work, shall be understood to have the specific meanings ascribed to them in the following list:

a. "Circuitry" – Any electric work (not limited to light and power distribution) that consists of wires, cables, raceways, and/or specialty wiring method assemblies taken all together complete with associated junction boxes, pull boxes, outlet boxes, joints, couplings, splices and connections except where limited to a lesser meaning by specific description.

b. "Wiring" – Same as Circuitry.

c. "Circuit" – Any specific run of circuitry.

d. "Branch Circuit" – Any light and power distribution system circuit that, at its load end, is directly connected to one or more electrical energy consuming items with no overcurrent protection devices interposed, other than (where required) those protecting the energy consuming items from overloading or overheating.

e. "Appliance Panel" – Any panel, used in a light and power distribution system, containing single pole and/or multipole branches rated in various sizes.

f. "Lighting Panel" – Any panel used in a light and power distribution system, having all (or the majority) of its branches single pole and rated the same.

g. "Lighting and Appliance Branch Circuitry" – All or any portion of branch circuits outgoing from a lighting or appliance panel.

h. "Feeder" – Any item of light and power circuitry used in a distribution system that is not lighting and appliance branch circuitry.

i. "Main Feeder" – Any feeder that, at its supply end, is connected through its own overcurrent protection (and switching) device, and none other, directly to a main service or a main service overcurrent protection (and switching) device.

j. "Branch Feeder" – A feeder, other than a main feeder, that complies with the definition of a branch circuit.

k. "Submain Feeder" – Any feeder that is neither a main feeder nor a branch feeder.

l. "Distribution Panel" – Any panel, used in a light and power distribution system, containing only multi-pole branches and with all (or the majority) of its branches used for feeders supplying other panels.

m. "Power Panel" – Same as distribution panel, except with all (or the majority) of its branches used for feeders that do not supply other panels.

n. "Motor Power Circuit" – Any circuit that operates nominally at 100 volts or more, and that carries electrical input energy to a motor.

o. "Motor Control Circuit" (used in conjunction with a motor for which a magnetic starter is supplied) – Any circuit (other than a motor power circuit) that operates nominally at 100 volts or more, and that carries current intended for directing or indicating the performance of a motor starter.

p. "Motor Control Circuit" (used in conjunction with a motor for which a manual starter is supplied) – Any circuit containing an extension of power circuit wires, other than those constituting the direct connection between source of supply, starter and motor.

q. "Motor Control Actuating Device" – Any device that performs a switching function in a motor control circuit (pushbuttons, automatic contacting devices, etc.).

r. "Motor Control Actuated Device" – Any device that functions in response to voltage received from a motor control circuit (pilot lights, solenoids, etc.)

s. "Package Unit" – An item of equipment having one or more motors or other electric energy consuming elements integrally factory mounted on a single base, complete with all associated control devices and interconnecting wiring.

t. "Low Voltage" – Below 50 volts.

u. "Process Control System" – An overall control and/or logging system available as a "package" from specialty manufacturers (commonly referred to as a "Temperature Control System" or an "Automatic Control System" or a "Building Management System").

v. "Grade Slab" – A building floor slab that is in contact with or directly over grade (earth).

w. "Building Confines" – The extent of a building, as defined by the outside surfaces of its peripheral walls, the top surface of its roof, and the underside surface of its grade slab.

x. "Distribution Switch" – Any switch used in a light and power system other than a tumbler, toggle or specialty switch in the "wiring device" category.

y. "Normal Electric Work Conditions" – Locations within building confines that are neither damp, wet nor hazardous and that are not used for air handling.

z. "Underground" – Subsurface and exterior to building foundations.

aa. "At Underside of Grade Slab" – Under a grade slab and integrated into it.

bb. "Below Grade Slab" – Under a grade slab but not integrated into it.

cc. "Standard" (as applied to wiring devices) –- Not of a separately designated individual type.

dd. "Raceway" – Any pipe, duct, extended enclosure, or conduit (as specified for a particular system) that is used to contain wires, and that is of such nature as to require that the wires be installed by a "pulling in" procedure.

ee. "Concealed" (as applied to circuitry) – Covered completely by building materials, except for penetrations (by boxes and fittings) to a level flush with the surface as necessitated by functional or specified accessibility requirements.

ff. "Exposed" (as applied to circuitry) – Not covered in any way by building materials.

gg. "Subject to Mechanical Damage" – Exposed within seven feet of the floor in mechanical rooms, or other spaces where heavy items (over 100 pounds) are moved around or rigged as a common practice or as required for replacement purposes.

hh. "Secondary" (as applied to light and power distribution) – Under 600 volts.

ii. "Assembly" – A defined set of elements of electric work.

B. The following shall be treated as damp or wet location within building confines, regardless of whether or not a high ambient moisture level is found to exist:

1. Spaces where any designations indicating weatherproof (WP) or vapor-proof (VP) appear on the drawings.

2. Below waterproofing in slabs applied directly on grade.

3. Kitchens up to a height of 18" above finished floor.

4. Outside of waterproofing in foundation walls in contact with grade.

5. Above waterproofing in slabs having no building above.

6. Above waterproofing in fill on slabs having no building above.

C. Electric work in slabs, walls or suspended ceilings that bound on a space defined as a damp or wet location shall meet the damp or wet location requirements if it enters into or opens into the damp or wet location in any way.

D. Where the word "conduit" is used without specific reference to type, it shall be understood to mean "raceway".

E. Except where modified by a specific notation to the contrary, it shall be understood that the indication and/or description of any electrical item in the drawings and specifications for electrical work carries with it the instruction to furnish, install and connect the item as part of the electrical work regardless of whether or not this instruction is explicitly stated.

F. It shall be understood that the specifications and drawings are complementary and are to be taken together for a complete interpretation of the work. Where there are conflicts between the drawings and specifications or within the specifications or drawings themselves, the items of higher standard shall govern.

G. To the extent that they govern the basic work, the specifications also govern change order work if any.

H. No exclusion from or limitation in, the symbolism used on the drawings for electrical work or the language used in the specifications for electrical work shall be interpreted as a reason for omitting the appurtenances or accessories necessary to complete any required system or item of equipment.

I. The drawings for electrical work utilize symbols and schematic diagrams that have no dimensional significance. The work shall, therefore, be installed to fulfill the diagrammatic intent expressed on the electrical drawings, but in conformity with the dimensions indicated on the final working drawings, field layouts and shop drawings of all trades. In particular, information as to the exact size, location and electrical connection points for mechanical equipment shall be derived by reference to HVAC and Plumbing documents.

J. Certain details appear on the drawings for electrical work that are specific with regard to the dimensioning and positioning of the work. These are intended only for general information purposes. They do not obviate field coordination for individual items of the indicated work.

K. Information as to general construction and architectural general construction and architectural features and finishes shall be derived from structural and architectural drawings and specifications only.

L. The use of words in the singular shall not be considered as limiting where other indications denote that more than one item is referred to.

M. Ratings of devices, materials and equipment specified without reference to specific performance criteria shall be understood to be nominal or nameplate ratings established by means of industry standard procedures.

N. The restriction of conductors in wires to copper, as specified elsewhere, shall be understood to also apply to all conductors (wire, cable or bus as applicable), including those provided as part of factory assembled components such as transformers, switchboards, panelboards, overcurrent protection and switching devices. This restriction shall apply equally to all such equipment regardless of indications (or lack thereof) elsewhere to the contrary. Aluminum will not be acceptable.

1.14 PRE-CONSTRUCTION CONFERENCE PRIOR TO START OF WORK

A. Prior to commencing any Work, the CM, together with designated major Contractors, shall confer with the Architect and Engineer concerning the Work under the Construction Contract.

B. The pre-construction conference will be conducted under the leadership of the CM and will occur soon after the CM notifies the Subcontractors of contract award. The pre-construction conference will focus on items such as the expedited submittal review procedure, interface and coordination between Contractor work scope, the CM's project site rules and requirements, temporary utility requirements, CM's construction schedule, etc.

1.15 SEQUENCING AND SCHEDULING

A. Coordinate electrical equipment installation with other building components.

B. Arrange for chases, slots, and openings in building structure during progress of construction to allow for mechanical installations.

C. Coordinate the installation of required supporting devices and set sleeves in poured in place concrete and other structural components as they are constructed.

D. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning prior to closing in the building.

E. Coordinate connection of mechanical services.

F. Coordinate connection of electrical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.

G. Coordinate requirements for access panels and doors where electrical items requiring access are concealed behind finished surfaces. See paragraph titled “Separation of Work Between Trades” to determine whether access panels and doors the responsibility of the Contractor for Division 08 or the Contractor responsible for Division 26

H. Coordinate installation of identifying devices after completing covering and painting where devices are applied to surfaces. Install identifying devices prior to installing acoustical ceilings and similar concealment.

1.16 EXAMINATION OF SITE AND CONTRACT DOCUMENTS

A. Before submitting prices or beginning work, thoroughly examine the site and the Contract Documents.

B. No claim for extra compensation will be recognized if difficulties are encountered which examination of site conditions and Contract Documents prior to executing Contract would have revealed.

1.17 WORKMANSHIP

A. The entire work provide in this Specification shall be constructed and finished in every aspect in a workmanlike and substantial manner.

B. It is not intended that the Drawings shall show every raceway, conduit, fitting, equipment and appliance. Electrical Contractor shall furnish and install all such parts as may be necessary to complete the systems in accordance with the best trade practice.

C. Keep other trades fully informed as to shape, size and position of all openings required for apparatus and give full information to the General Contractor and other trades in a timely manner so that all opening may be built in advance. Furnish and install all sleeves, supports and the like as specified or as required.

D. In case of failure on the part of the Electrical Contractor to give proper and timely information as required above, he shall do his own cutting and patching or have same done by the General Contractor, but in any case, without extra expense to the Owner.

E. Obtain detailed information from the manufacturers of apparatus as to the proper method of installing and connecting same. Obtain all information from the General Contractor and other trades which may be necessary to facilitate work and completion of the whole project.

PART 2 - PRODUCTS

2.1 EQUIPMENT TOUCH UP PAINT

A. For Equipment: Equipment manufacturer's paint selected to match installed equipment finish.

B. Galvanized Surfaces: Zinc-rich paint recommended by item manufacturer.

2.2 ACCESS DOORS IN FINISHED CONSTRUCTION

A. Access doors as required for operation and maintenance of concealed equipment, boxes, controls, etc. will be provided as part of the work of Division 08.

B. This Contractor is responsible for access door location, size and its accessibility to the boxes, controls, equipment, etc. being served.

C. Coordinate and prepare a location, size, and function schedule of access doors required and deliver to a representative of the Contractor for Division 08.

D. Furnish and install distinctively colored buttons in finished ceiling.

E. Access doors shall be of ample size to perform proper maintenance on concealed equipment, boxes, controls, etc. but shall not be less than a minimum of 18-inches x 18-inches for installation in walls and a minimum of 22-inches x 22-inches for installation in ceilings.

F. Construct doors and frames to comply with the requirements of the NFPA and Underwriters Laboratories Inc. for fire rating. Install UL label on each door in a non-exposed location unless otherwise required by the local authority having jurisdiction.

PART 3 - EXECUTION

3.1 ROUGH-IN

A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

B. Refer to equipment specifications in Divisions 02 through 26 for rough-in requirements.

3.2 ELECTRICAL INSTALLATIONS

A. General: Sequence, coordinate, and integrate the various elements of electrical systems, materials, and equipment. Comply with the following requirements:

1. Coordinate electrical systems, equipment, and materials installation with other building components.

2. Verify all dimensions by field measurements.

3. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for electrical installations.

4. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.

5. Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building.

6. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.

7. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Architect.

8. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.

9. Install electrical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.

10. Coordinate location of access panels or doors where outlet boxes, junction boxes, or equipment are concealed behind finished surfaces.

11. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.

B. Locations of all devices, fixtures, and other visible components shall be as indicated on the architectural drawings. Mounting heights shall be as specified in Division 26 Section “Raceways and Boxes”.

C. Each piece of mechanical equipment located outside the building or on the roof shall be within 25 feet (7 m) of a duplex receptacle. Where necessary to meet these criteria, provide duplex receptacles in addition to those devices shown on the drawings. Each shall be complete with waterproof cover and integral GFI protection, and 20 ampere circuitry to the nearest 120 volt panel.

3.3 FIRE-STOPPING

A. Refer to Division 08 titled “Thermal and Moisture Protection” for fire-stopping requirements.

B. Contractor responsible for the work of Division 26 shall be responsible for fire-stopping of all work installed as part of the work of Division 26.

C. Fire-stopping system must be U.L. approved.

D. All spaces between raceways, conduit, etc. and their respective sleeves or fire-rated construction shall be packed full depth with an approved fire resistant material, compressed firmly in place. Fiberglass shall not be used. Sleeve clearances shall not exceed 2 inches between raceways, conduits, etc. and sleeves.

E. Fire-stopping material and installed configuration shall maintain the fire rating of the penetrated wall, floor or ceiling.

3.4 CUTTING AND PATCHING

A. General: Perform cutting and patching in accordance with Division 01 Section "Cutting and Patching." In addition to the requirements specified in Division 01, the following requirements apply:

1. Perform cutting, fitting, and patching of electrical equipment and materials required to:

a. Uncover Work to provide for installation of ill-timed Work.

b. Remove and replace defective Work.

c. Remove and replace Work not conforming to requirements of the Contract Documents.

d. Upon written instructions from the Architect, uncover and restore Work to provide for Architect observation of concealed Work.

e. Install equipment and materials in existing structures.

2. Cut, remove, and legally dispose of selected electrical equipment, components, and materials as indicated, including but not limited to removal of electrical items indicated to be removed and items made obsolete by the new Work.

3. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.

4. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.

5. Patch existing finished surfaces and building components using new materials matching existing materials and experienced Installers.

    a. Refer to Division 01 Section "Definitions and Standards" for definition of experienced "Installer."

6. Patch finished surfaces and building components using new materials specified for the original installation and experienced Installers.

7. Patch finished surfaces and building components using new materials specified for the original installation and experienced Installers. Installers' qualifications refer to the materials and methods required for the surface and building components being patched.

    a. Refer to Division 01 Section titled “References” for definition of "experienced Installer."

3.5 SITE VISITATION SURVEYS AND MEASUREMENTS

A. All existing conditions cannot be completely detailed on the drawings. These include, but are not limited to conduit, equipment, etc. This contractor shall survey the site and include all required costs in making up their bid proposal.

B. The contractor shall visit the premises to determine existing conditions and compare same with drawings and specifications and satisfy himself of all conditions prior to the submission of a bid proposal. No allowance will be made for failure to comply with these requirements and a bid proposal shall be construed as evidence he has done so.

C. Before submitting bid, visit the project site to satisfy yourself that all equipment shown or specified in the project contract documents can be installed generally as shown. Advise Owner prior to bid date, of any space or other installation problems.

D. Before submitting bid, become thoroughly familiar with all conditions under which work will be installed, as you will be held responsible for any assumptions, any omissions or errors made as a result of failure to become familiar with the site and Contract Documents.

E. Investigate each space through which equipment must be moved. Where necessary, equipment shall be shipped from manufacturer in sections of size suitable for moving through restrictive spaces available. Ascertain from building Owner at what time of day equipment may be moved through certain restrictive areas.

F. Install work so as to be readily accessible for operation, maintenance and repair. Minor deviations from drawings may be made to accomplish this, but changes which involve extra cost shall not be made without approval.

G. Removal and relocation of certain existing work will be necessary for the performance of the general work. All existing conditions cannot be completely detailed on the drawings. The Contractor shall survey the site and include all required changes in making up their bid proposal.

H. Submission of a bid shall be construed as evidence, that a careful examination of the portions of the existing building, equipment, etc., which affect this work and the access to such spaces has been made and that the Contractor is familiar with existing conditions and difficulties that will affect the execution of the work. Claims will not be allowed for labor, equipment or materials required because of difficulties encountered, which could have been foreseen during such an examination.

3.6 ELECTRICAL DEMOLITION

A. Comply with requirements of Division 02 titled “Existing Conditions”

B. This contractor shall provide all required labor, materials, equipment and perform all operations for complete demolition, removal and relocation of the existing work as indicated on the drawings and/or as specified or described and/or as required for the performance of the general work under this contract.

C. The project contains existing electrical installations. Integrate the existing installations into the overall project as described below.

D. Except for items specifically indicated as being reused, completely abandon existing electrical work by:

1. De-energizing it and/or cutting it loose from every live source.

2. Cutting away all exposed portions and any concealed portions that create interferences with the new installations of the various trades working at the project.

3. Removing all existing wires and cables from existing raceways that remain.

E. No portion of existing electrical installations shall be used to make up any of the required electrical work except as follows:

1. Equipment and devices, as specifically indicated.

2. Raceways with associated junction boxes and pull boxes) only for feeders as specifically indicated.

3. Raceways (with associated junction boxes and pull boxes) and cables for feeders as specifically indicated.

4. Concealed raceways (with associated outlet boxes) only for lighting and appliance branch circuitry to the maximum extent possible.

F. Unless otherwise specifically specified, include all cutting and patching of existing floors, walls, partitions and other materials in the existing building. The Contractor shall restore these areas to original conditions.

G. Specifications pertaining to equipment and devices, hereinafter included, apply to new work. Where it is required that items be made up with components that are both new and existing, it shall be interpreted that the specifications govern only as they are applicable to new components.

H. Outages of existing electrical systems necessitated by the new construction work of all trades shall be in accordance with a schedule issued in the field by the architect. Include all electric work, overtime labor and supervision necessary to adhere to this schedule.

I. Any existing electrical work that is pulled out or cut away in compliance with the above requirements shall be removed from the site as if it were rubbish. Proper credit shall be given for all salvageable items.

J. During demolition procedures, provide all necessary protection for existing electric work required for reuse.

K. Remove all low voltage (audio, data, Class 2, Class 3, PTLC, fire alarm, optical fiber, communications, coaxial, and network) cables that are abandoned.

3.7 CONNECTIONS TO EXISTING WORK

A. Plan installation of new work and connections to existing work to ensure minimum interference with regular operation of existing facilities. Submit to the Owner for approval, date schedule of necessary temporary shut-downs of existing services. All shutdowns shall be made at such times as will not interfere with regular operation of existing facilities and only after written approval of Owner. To ensure continuous operation, make necessary temporary connections between new and existing work. All costs resulting from temporary shut-downs shall be borne by this Contractor.

B. All shutdowns shall be done on overtime, unless approved during normal hours by Owner.

C. The drawings of necessity utilize symbols and schematic diagrams to indicate connections to existing work. Neither of these have any dimensional significance nor do they delineate every item required for the intended installations.

D. The contractor shall coordinate all connections to existing work with the facility engineer. Contractor shall field verify exact location of all existing services.

E. Connect new work to existing work in neat and approved manner. Restore existing work disturbed to original condition.

3.8 REFINISHING AND TOUCH UP PAINTING

A. Clean damaged and disturbed areas and apply primer, intermediate, and finish coats to suit the degree of damage at each location.

B. Follow paint manufacturer's written instructions for surface preparation and for timing and application of successive coats.

C. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

D. Repair damage to PVC or paint finishes with matching touch up coating recommended by manufacturer.

3.9 FIELD QUALITY CONTROL

A. Inspect installed components for damage and faulty work, including the following:

1. Cutting and patching for electrical construction.

2. Touch up painting.

3.10 CLEANING AND PROTECTION

A. On completion of installation, including outlets, fittings, and devices, inspect exposed finish. Remove burrs, dirt, paint spots, and construction debris.

B. Protect equipment and installations and maintain conditions to ensure that coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

END OF SECTION 260500

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Building wires and cables rated 600 V and less.

2. Connectors, splices, and terminations rated 600 V and less.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Field quality-control test reports.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70 as amended by state and local codes.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. American Insulated Wire Corp.; a Leviton Company.

2. General Cable Corporation.

3. Senator Wire & Cable Company.

4. Southwire Company.

B. Copper Conductors: Comply with NEMA WC 70.

C. Conductor Insulation: Comply with NEMA WC 70.

D. Multiconductor Cable: Comply with NEMA WC 70.

E. Type AC cable shall have 90 degree C insulation and shall be UL listed as type "ACTHH".

F. Type AC cables shall comply with the following:

1. Where used as the wiring method for branch circuit runs that have been specified elsewhere (or called for on the drawings) as requiring a ground wire, e.g., for electronic equipment and/or for landscape furniture systems, each cable shall incorporate a separate green insulated ground conductor sized equal to the phase conductors.

2. Where used as the wiring method for branch circuit runs, each cable shall incorporate a separate green insulated ground conductor sized equal to the phase conductors.

3. For runs with increased neutrals, type "MC" cable with type "THHN" insulated copper conductors, may be utilized in lieu of the "ACTHH" cable, and specified hereinbefore. Each run shall incorporate a full size green insulated grounding conductor. Type "MC" cable, where used in runs for which a separate grounding conductor has been specified, must include an insulated "isolated ground" wire in addition to the code mandated green insulated grounding conductor.

4. In lieu of providing increased size common neutrals, cables having multiple neutrals (one per branch circuit) may be provided.

5. Where armored cables are used as the wiring method for branch circuit runs that must incorporate redundant grounding conductors (such as in patient care areas of hospitals and other health care or medical occupancies), in addition to the primary grounding path, each cable shall incorporate a separate green insulated copper grounding conductor, sized equal to the circuit conductors, within the overall assembly. The use of armored cable for emergency circuitry in health care facilities is prohibited.

G. In general, cable ampacities are based on a 60 degree C rating for cables #1 AWG and smaller and on a 75 degree C rating for larger cables. In conjunction with this, note the following:

1. 75 degree C ratings may be utilized for cables #1 AWG and smaller where overcurrent protection and switching devices (OCD's), wiring devices and solidly connected equipment connected to such cables are listed and identified for use with 75 degree C rated conductors. (Note that these specifications require all OCD's - regardless of ampere rating to be suitable for use with 75 degree C rated conductors).

2. Increase indicated cable (and raceway) sizing as required for circuitry where conductors #1 AWG and smaller will connect directly to solidly connected utilization equipment whose load current will exceed the 60 degree C rating of the cable, and for which manufacturer's approval for cable terminations is less than 75 degrees C, or to receptacles whose ampere rating exceeds the 60 degree C rating of the connected cables unless such receptacles are listed for use with 75 degree C rated conductors. Note that accessible intermediate tap boxes may be utilized adjacent to 60 degree C rated terminations to allow conductor "upsizing" locally so as to comply with such termination requirements.

3. Increase indicated cable (and raceway) sizing as required for circuitry where conductors are run in conduits exposed to direct sunlight on or above rooftops in accordance with the temperature adjustment factors described in the electrical code. Conductors shall be Type XHHW-2.

H. For low voltage systems where circuits are power limited in accordance with Class 2 or Class 3 requirements (as defined in Article 725 of the National Electrical Code) utilize cables having characteristics as follows:

1. Cables shall be of a fluoropolymer type having adequate fire-resistant and low-smoke producing characteristics and shall be U.L. listed for plenum use (Type CL2P for Class 2 circuits, type CL3P or CMP for Class 3 circuits), except that where run in conduit, they may be U.L. type CL3, or where run in cable trays they may be U.L. type CMP.

I. For low voltage systems whose circuits are not power limited Class 2 or Class 3 (in accordance with the requirements of Article 725 of the National Electrical Code), and that are not telecommunications circuitry (in accordance with Article 800 thereof), utilize copper conductors having TFN insulation for sizes #16 AWG and smaller, and type THHN or THWN for sizes #14 AWG and larger. Wires shall be run in electric metallic tubing.

J. For low voltage circuits intended for the distribution of voice or data utilize communications cables (complying with requirements of Article 800 of the National Electrical Code) having characteristics as follows:

1. Cables shall be of a fluoropolymer type having adequate fire-resistant and low-smoke producing characteristics and shall be U.L. listed for plenum use (Type CMP), except that where run in conduit, they may be U.L. type CM.

2.2 CONNECTORS AND SPLICES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. AFC Cable Systems, Inc.

2. Hubbell Power Systems, Inc.

3. O-Z/Gedney; EGS Electrical Group LLC.

4. 3M; Electrical Products Division.

5. Tyco Electronics Corp.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper for feeders smaller than No. 2 AWG; copper for feeders No. 2 AWG and larger. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Exposed Feeders: Type THHN-THWN, single conductors in raceway.

B. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN-THWN, single conductors in raceway.

C. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.

D. Exposed Branch Circuits: Type THHN-THWN, single conductors in raceway.

E. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway or Hospital-Grade Metal-clad cable, Type MC.

F. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.

G. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

H. Class 1 Control Circuits: Type THHN-THWN, in raceway.

I. Class 2 Control Circuits: Type THHN-THWN, in raceway or Power-limited cable, concealed in building finishes.

J. Branch circuits in health care or medical facilities in any occupancy group shall contain redundant equipment grounding conductor.

K. Where required by code, or where indicated on the drawings, feeders and circuitry shall be a fire rated cable system. Mineral-insulated, metal-sheathed cable, Type MI or 2 hour rated MC power cable.

L. Provide THHW-2, THWN-2 or XHHW-2 insulation for conductors 1/0 and larger in "wet" locations. Conductors utilized in underground installations shall be UL Listed for use in wet locations. Type THHW-2 shall not be utilized where excluded by conduit sizing. Type THWN shall not be utilized for connection to 100 percent rated overcurrent devices.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members and follow surface contours where possible.

E. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

F. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."

G. Install MI and 2 hour rated MC power cables in accordance with the manufacturer’s recommendations, the UL product listing requirements, and the following:

1. For feeders and circuitry that are specified to include a ground conductor, or where the cable sheath ampacity is insufficient to comply with electrical code requirements, provide a separate ground conductor sized as required by the electrical code. For MI cable this shall be a separate MI conductor. For 2 hour rated MC cable this shall be a separate conductor within the cable.

2. Where MI cables terminate or pass through a ferrous enclosure, remove a portion of the enclosure and provide a non-ferrous brass plate.

3. Splices of MC 2 hour rated cable shall be made within a 2 hour rated enclosure.

4. Cables shall comply with termination temperature ratings as specified hereinafter.

5. Where required in order to comply with code restrictions on allowable voltage drop, increase the conductor size and/or add parallel sets of conductors, as required to limit the voltage drop to the point of final distribution to the code mandated maximum voltage drop. Add parallel conductors if the maximum available conductor size will not sufficiently limit the voltage drop.

6. Where installed in accordance with the above, and with the manufacturer's requirements and electrical code requirements for free air installation, the free air rating of the cable may be used. Provide calculations to demonstrate compliance with the requirements above.

7. The following shall be protected by construction having a minimum two-hour fire-resistance rating or shall be circuit integrity cable having a minimum two-hour fire-resistance rating:

   a. Feeders for Emergency Systems except where run within space directly protected by sprinklers.

   b. Normal and emergency feeders and branch circuits for smoke control fans.

   c. Control circuits for smoke control systems.

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

C. Maintain all splices and joints in removable cover boxes or cabinets where they may be easily inspected.

D. Locate each completed conductor splice or joint in the outlet box, junction box, or pull box containing it, so that it is accessible from the removable cover side of the box.

E. Join solid conductors #8 AWG and smaller by securely twisting them together and soldering, or by using insulated coiled steel spring "wire nut" type connectors. Exclude "wire nuts" employing non-expandable springs. Exclude push-on type connectors. Terminate conductors #8 AWG and smaller by means of a neat and fast holding application of the conductors directly to the binding screws or terminals of the equipment or devices to be connected. Terminals and connectors shall be U.L. approved specifically for the application.

F. Join, tap and terminate stranded conductors #6 AWG and larger by means of solder sleeves, taps and lugs with applied solder or by means of pressure indent type connectors, or mechanical connectors utilizing ball tipped set screws. Apply pressure indent type connectors, utilizing tools manufactured specifically for the purpose and having features preventing their release until the full pressure has been exerted on the lug or connector. Factory installed equipment or device terminals shall be of types UL approved specifically for the application.

G. Except where wire nuts are used, build up insulation over conductor joints to a value equal both in thickness and dielectric strength to that of the factory applied conductor insulation. Insulation of conductor taps and joints shall be by means of half-lapped layers of rubber tape, with an outer layer of friction tape; by means of half-lapped layers of approved plastic electric insulating tape; or by means of split insulating casings manufactured specifically to insulate the particular connector and conductor, and fastened with stainless steel or non-metallic snaps or clips.

H. Exclude splicing procedures for neutral conductors in lighting and appliance branch circuitry which utilize device terminals as the splicing points.

I. Exclude joints or terminations utilizing solder in any conductors used for grounding or bonding purposes.

J. Exclude all but solder or pressure indent type joints in conductors used for signaling or communications purposes.

K. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches (300 mm) of slack.

3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.6 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078413 "Penetration Firestopping."

3.7 FIREPROOFING WIRES AND CABLES:

A. Fireproofing of wires and cables shall be by means of a half-lapped layer of Scotch 77 fire and arc-proofing tape. The wrapped tape shall be secured by a band consisting of two layers of glass cloth electrical tape. Fireproofing shall be extended up into raceways. Fireproofing shall be applied in an overall manner to raceway groupings of conductors.

3.8 INSTALLATION OF CIRCUITRY FOR MISCELLANEOUS LOW VOLTAGE SYSTEMS:

A. Comply with requirements described in applicable subsections of this Section. In particular, note the following circuitry requirements for low voltage systems:

1. Wiring for miscellaneous low voltage systems may be run without conduit - subject to the approval of the local authorities - except where prohibited by other sections of these specifications or by indications on the drawings.

2. Where conduit is required, it shall be steel electric metallic tubing (EMT), except that it shall be galvanized intermediate steel conduit where located within 8 feet (2.4 m) of the floor in mechanical spaces (or is otherwise exposed to mechanical damage), or is intended for embedment in concrete.

3. Wires and cables shall have characteristics - in compliance with Articles 725 and/or 800 (as applicable) of the National Electrical Code - as described elsewhere in the specifications or drawings for this project, and shall be U.L. listed in accordance therewith.

4. Where wires and cables are permitted to be run without conduit, they shall be independently supported from the building structure or ceiling suspension systems at intervals not exceeding four feet on center, utilizing cable supports specifically approved for the purpose. Wires and cables shall not rest on or depend on support from suspended ceiling media (tiles, lath, plaster, as well as splines, runners or bars in the plane of the ceiling), nor shall they be supported from pipes, ducts or conduits. Where cables are bundled together, separate bundles shall be provided separately for each type of cabling and separately for each independent system. Bundling and/or supporting ties shall be of a type suitable for use in a ceiling air handling plenum regardless of whether or not installed in a plenum.

5. Cables shall be tagged or labeled at each termination point and in each intermediate junction box, pull box or cabinet through that they pass.

6. Comply with applicable requirements for locating and routing circuitry, for installing circuitry, and for fire-stopping as described in other sub-section of this Section.

3.9 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.

B. Perform tests and inspections and prepare test reports.

C. Tests and Inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test for compliance with requirements.

2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters. Include for all existing cables which are being made part of the new work.

3. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in cables and conductors No. 2 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner.

a. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each splice 11 months after date of Substantial Completion.

b. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

c. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

4. Where tests are specified to be performed by an independent testing agency, prepare systems, equipment, and components for tests and inspections, and perform preliminary tests to ensure that systems, equipment, and components are ready for independent agency testing. Include the following minimum preparations as appropriate.

    a. Perform insulation-resistance tests.

    b. Perform continuity tests.

    c. Perform rotation test (for motors to be tested).

    d. Provide a stable source of single-phase, 208/120-V electrical power for test instrumentation at each test location.

D. Test Reports: Prepare a written report to record the following:

1. Test procedures used.

2. Test results that comply with requirements.

3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

E. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 260519

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

1. Section includes grounding systems and equipment.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.4 INFORMATIONAL SUBMITTALS

A. Informational Submittals: Plans showing dimensioned as-built locations of grounding features specified in "Field Quality Control" Article.

B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.
1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with UL 467 for grounding and bonding materials and equipment.

D. Comply with NFPA 70, as amended by state and local codes.

PART 2 - PRODUCTS

2.1 CONDUCTORS

A. For insulated conductors, comply with Division 26 section Low-Voltage Electrical Power Conductors and Cables".

B. Material: Copper.

C. Equipment Grounding Conductors: Insulated with green-colored insulation.

D. Insulated Conductors: Copper or tinned-copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

E. Grounding Electrode Conductors: Stranded cable.

F. Bare Copper Conductors:
1. Solid Conductors: ASTM B 3.
2. Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.
4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch (6 mm) in diameter.
5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

G. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches (6.3 by 100 mm) in cross section, with 9/32-inch (7.14-mm) holes spaced 1-1/8 inches (28 mm) apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.

2.2 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, pressure type with at least two bolts.
1. Pipe Connectors: Clamp type, sized for pipe.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

D. Bus-bar Connectors: Mechanical type, cast silicon bronze, solderless exothermic-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

2.3 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel; 3/4 by 10 feet (19 by 3000 mm) in diameter.

B. Plate Electrodes: Copper plates, minimum 0.10 inch (3 mm) thick, 24 inch (600 mm) square.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.

B. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.

C. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
   1. Install bus on insulated spacers 2 inches (50 mm) minimum from wall, 6 inches (150 mm) above finished floor unless otherwise indicated.
   2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down to specified height above floor; connect to horizontal bus.

D. Conductor Terminations and Connections:
   1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
   2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
   3. Connections to Ground Rods at Test Wells: Bolted connectors.
   4. Connections to Structural Steel: Welded connectors.

3.2 EQUIPMENT GROUNDING

A. Equipment Grounding Conductor Application: Comply with NFPA 70, as amended by state and local codes, for sizes and quantities of equipment grounding conductors except where specific types, larger sizes, or more conductors are indicated.

B. Install insulated equipment grounding conductors with all feeders and branch circuits.

C. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
   1. Feeders and branch circuits.
   2. Lighting circuits.
   3. Receptacle circuits.

4. Single-phase motor and appliance branch circuits.
5. Three-phase motor and appliance branch circuits.
6. Flexible raceway runs.
7. Armored and metal-clad cable runs.

D. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

E. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

F. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated

G. Bonding jumpers shall be applied where wiring devices (receptacles and switches) are not equipped with approved self-grounding features. Include any necessary field modifications for termination of the bonding jumpers so as to ensure grounding continuity.

H. Bonding jumpers shall be applied to ensure that grounding continuity does not depend solely on the supporting screws fastening metallic enclosures together.

I. Include any necessary field modifications for termination of the bonding jumpers so as to ensure grounding continuity

J. Provide supplementary ground bonding of exposed metallic surfaces of fixed and portable electric utilization equipment subject to personal contact in all locations throughout floors intended for patient care at any time, on either an in-patient or out-patient basis. This requirement shall be interpreted as applying to all receptacles, and all solidly connected equipment (including lighting fixtures) located within eight feet of the floor, supplied from lighting and appliance panelboards throughout the project that are located on patient bedroom floors, and panels on any floor supplying circuitry to areas that may be occupied by in-patients or out-patients for diagnostic or therapeutic treatment. The grounding requirement shall also apply to radiology and radiotherapy equipment and other designated similar equipment intended for the treatment or testing of patients, regardless of the type of panel from which supplied. This supplementary ground bonding shall be accomplished by:
1. Providing a #2 AWG green insulated grounding conductor run in conduit between pairs of panels (normal and emergency) supplying branch circuitry to the same individual patient care area (bedroom, exam or treatment room, etc.).
2. Providing a grounding conductor in each run of light and power circuitry serving equipment as described above. Note that the quantities of conductors indicated on the drawings in runs of lighting and appliance branch circuitry - unless otherwise noted - do not include the required grounding conductors. Grounding conductors in circuitry runs shall be connected to the ground bus in the panel from which they originate.
3. Connecting the aforementioned grounding conductors to each outlet box or equipment cabinet or housing in which they terminate.

4. Providing a bonding jumper between each receptacle outlet box and the grounding pole of the receptacle. If the receptacle is of an approved self-bonding type, ground the receptacle in lieu of the outlet box and omit the bonding jumper.
5. Including in the final connection to each piece of solidly connected, i.e., not cord and plug connected, electrical utilization equipment located within 8 feet (2.4 m) of the floor, a grounding conductor connected to the housing of the utilization equipment.
6. Conforming to special grounding and bonding requirements as noted on the drawings for special patient care areas such as anesthetizing locations, ICU's and the like and rooms containing radiology equipment.

3.3 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Rods: Drive rods until tops are 2 inches (50 mm) below finished floor or final grade unless otherwise indicated.
1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.

C. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Section 260543 "Underground Ducts and Raceways for Electrical Systems," and shall be at least 12 inches (300 mm) deep, with cover.
1. Test Wells: Install at least one test well for each service unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.

D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

E. Grounding and Bonding for Piping:
1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.

F. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.

3.4 LABELING

A. Comply with requirements in Section 260553 "Identification for Electrical Systems" for instruction signs. The label or its text shall be green.

B. Install labels at the telecommunications bonding conductor and grounding equalizer and at the grounding electrode conductor where exposed.
   1. Label Text: "If this connector or cable is loose or if it must be removed for any reason, notify the facility manager."

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Tests and Inspections:
   1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
   2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
   3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal and at ground test wells. Make tests at ground rods before any conductors are connected.
      a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
      b. Perform tests by fall-of-potential method according to IEEE 81.
   4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

C. Grounding system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

E. Report measured ground resistances that exceed the following values:
   1. Power and Lighting Equipment or System: 5 ohms.

F. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Hangers and supports for electrical equipment and systems.

2. Construction requirements for concrete bases.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. IMC: Intermediate metal conduit.

C. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.5 ACTION SUBMITTALS

A. Product Data: For the following:

1. Steel slotted support systems.

2. Nonmetallic slotted support systems.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:

1. Trapeze hangers. Include Product Data for components.

2. Steel slotted channel systems. Include Product Data for components.

3. Nonmetallic slotted channel systems. Include Product Data for components.

4. Equipment supports.

1.6 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.7 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Comply with NFPA 70 as amended by State and Local Codes.

1.8 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified together with concrete Specifications.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Section 077200 "Roof Accessories."

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Allied Tube & Conduit.

b. Cooper B-Line, Inc.; a division of Cooper Industries.

c. ERICO International Corporation.

d. GS Metals Corp.

e. Thomas & Betts Corporation.

f. Unistrut; Tyco International, Ltd.

g. Wesanco, Inc.

2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.

3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.

4. Channel Dimensions: Selected for applicable load criteria.

B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

F. U-Channel Systems: 16-gauge steel channels, with 9/16-inch (14 mm) diameter holes, at a minimum of 8 inches (20 cm) on center, in top surface. Provide fittings and accessories that mate and match with U-channel and are of the same manufacture.

G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.

a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) Cooper B-Line, Inc.; a division of Cooper Industries.

2) Empire Tool and Manufacturing Co., Inc.

3) Hilti Inc.

4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.

5) MKT Fastening, LLC.

2. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.

3. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.

4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.

5. Toggle Bolts: All-steel springhead type.

6. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Section 055000 "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with two-bolt conduit clamps] single-bolt conduit clamps.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).

C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.

2. To New Concrete: Bolt to concrete inserts.

3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.

4. To Existing Concrete: Expansion anchor fasteners.

5. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts or beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.

6. To Light Steel: Sheet metal screws.

7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.

D. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

E. Raceway Supports: Comply with the following requirements:

1. Conform to manufacturer's recommendations for selection and installation of supports.

2. Strength of each support shall be adequate to carry present and future load multiplied by a safety factor of at least four. Where this determination results in a safety allowance of less than 200 lbs (90 kg), provide additional strength until there is a minimum of 200 lbs (90 kg) safety allowance in the strength of each support.

3. Install individual and multiple (trapeze) raceway hangers and riser clamps as necessary to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assembly and for securing hanger rods and conduits.

4. Support parallel runs of horizontal raceways together on trapeze-type hangers.

5. Support individual horizontal raceways by separate pipe hangers. Spring steel fasteners may be used in lieu of hangers only for 1-1/2-inch (DN 41) and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings only. For hanger rods with spring steel fasteners, use 1/4 inch (6 mm) diameter or larger threaded steel. Use spring steel fasteners that are specifically designed for supporting single conduits or tubing.

6. Support exposed and concealed raceway within 1 foot (30 cm) of an unsupported box and access fittings. In horizontal runs, support at the box and access fittings may be omitted where box or access fittings are independently supported and raceway terminals are not made with chase nipples or threadless box connectors.

7. In vertical runs, arrange support so the load produced by the weight of the raceway and the enclosed conductors is carried entirely by the conduit supports with no weight load on conductor terminals.

F. Vertical Conductor Supports: Install simultaneously with installation of conductors.

G. Miscellaneous Supports: Support miscellaneous electrical components as required to produce the same structural safety factors as specified for raceway supports. Install metal channel racks for mounting cabinets, panelboards, disconnects, control enclosures, pull boxes, junction boxes, transformers, and other devices.

H. In open overhead spaces, cast boxes threaded to raceways need not be supported separately except where used for fixture support; support sheet metal boxes directly from the building structure or by bar hangers. Where bar hangers are used, attach the bar to raceways on opposite sides of the box and support the raceway with an approved type of fastener not more than 24 inches (60 cm) from the box.

I. Fastening: Unless otherwise indicated, fasten electrical items and their supporting hardware securely to the building structure, including but not limited to conduits, raceways, cables, cable trays, busways, cabinets, panelboards, transformers, boxes, disconnect switches, and control components in accordance with the following:

1. Fasten by means of wood screws or screw-type nails on wood, toggle bolts on hollow masonry units, concrete inserts or expansion bolts on concrete or solid masonry, and machine screws, welded threaded studs, or spring-tension clamps on steel. Threaded studs driven by a powder charge and provided with lock washers and nuts may be used instead of expansion bolts and machine or wood screws. Do not weld conduit, pipe straps, or items other than threaded studs to steel structures. In partitions of light steel construction, use sheet metal screws.

2. Holes cut to depth of more than 1-1/2 inches (4 cm) in reinforced concrete beams or to depth of more than 3/4 inch (2 cm) in concrete shall not cut the main reinforcing bars. Fill holes that are not used.

3. Ensure that the load applied to any fastener does not exceed 25 percent of the proof test load. Use vibration- and shock- resistant fasteners for attachments to concrete slabs.

J. In general, walls and partitions are not suitable for supporting the weight of panelboards, dry type transformers, and the like. Include supporting frames or racks extending from floor slab to ceiling slab for all such items unless specifically instructed otherwise by the Architect.

K. Include supporting frames or racks for equipment, intended for vertical surface mounting, which is required in a free standing position.

L. Supporting frames or racks shall be of standard angle, standard channel or specialty support system steel members. They shall be rigidly bolted or welded together and adequately braced to form a substantial structure. Racks shall be of ample size to assure a workmanlike arrangement of all equipment mounted on them.

M. No work intended for exposed installation in damp locations is mounted directly on any building surface. In such locations, flat bar members or spacers shall be used to create a minimum of 1/4 inch (6 mm) air space between the building surfaces and the work.

N. Nothing (including outlet, pull and junction boxes and fittings) shall depend on electric conduits, raceways or cables for support except that threaded hub type fittings having a gross volume not in excess of 100 cubic inches (1600 cc) may be supported from heavy wall conduit, where the conduit in turn is securely supported from the structure within 5 inches (12 cm) of the fitting on two opposite sides.

O. Nothing shall rest on, or depend for support on, suspended ceiling media (tiles, lath, plaster, as well as splines, runners, bars and the like in the plane of the ceiling). Vertical members that suspend the ceiling (together with their horizontal bracing that occurs above the ceiling), however, may be used for support, subject to the following criteria:

1. Supporting procedures shall be in accordance with the ceiling system manufacturer's instructions.

2. Supporting members for circuitry shall be rigid. Wires may not be used for such supports.

3. The ceiling is not fire rated.

P. In conjunction with lighting fixtures or other items weighing less than 40 pounds (18 kg), the above restriction against supporting from suspended ceiling splines, runners or bars in the plane of the ceiling may be waived for ceilings that have been specifically approved for the weight and arrangement of fixtures being applied. Any support members, mechanical fastening means (i.e., bolts, screws or rivets), or other appurtenances, however, required to tie in or adapt to the fixtures and their ceiling opening frames (if any) to the ceiling in the approved manner shall be included as part of the electric work.

Q. As a minimum procedure, support surface or pendant mounted lighting fixture:

1. From its outlet box by means of an interposed metal strap, where weight is less than 5 pounds (2 kg).

2. From its outlet box by means of a hickey or other direct threaded connection, where weight is from 5 pounds (2 kg) to 50 pounds (20 kg).

3. Directly from structural slab, deck or framing member, where weight exceeds 50 pounds (20 kg).

R. As a minimum procedure, support recessed lighting fixtures as follows:

1. From ceiling suspension members, as described above, where weight is 80 pounds (35 kg) or less. Fluorescent fixtures shall be provided with clips to secure the fixtures to the ceiling members at two opposite ends of each fixture.

2. Directly from structural slabs, decks or framing members where weight is more than 80 pounds (35 kg).

S. Include in the electric work channel sills or skids for leveling and support of all floor mounted electrical equipment.

T. Where permitted loading is exceeded by direct application of electrical equipment to a slab or deck, include in the electric work proper dunnage as required to distribute the weight in a safe manner.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Section 055000 "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 GROUT

A. Install nonmetallic nonshrink grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors. Mix grout according to manufacturer's printed instructions.

B. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.

2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

3. Packaging: Premixed and factory packaged.

C. Clean surfaces that will come into contact with grout.

D. Provide forms for placement of grout, as required.

E. Avoid air entrapment when placing grout.

F. Place grout to completely fill equipment bases.

G. Place grout on concrete bases to provide a smooth bearing surface for equipment.

H. Place grout around anchors.

I. Cure placed grout according to manufacturer's printed instructions.

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529

SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Metal conduits, tubing, and fittings.

2. Metal wireways and auxiliary gutters.

3. Surface raceways.

4. Boxes, enclosures, and cabinets.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. GRC: Galvanized rigid steel conduit.

C. IMC: Intermediate metal conduit.

1.4 ACTION SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

C. Samples: For wireways and surface raceways and for each color and texture specified, 12 inches (300 mm) long.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:

1. Structural members in paths of conduit groups with common supports.

2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.

B. Seismic Qualification Certificates: For enclosures, cabinets, and conduit racks and their mounting provisions, including those for internal components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

4. Detailed description of conduit support devices and interconnections on which the certification is based and their installation requirements.

C. Source quality-control reports.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. AFC Cable Systems, Inc.
2. Allied Tube & Conduit; a Tyco International Ltd. Co.
3. Anamet Electrical, Inc. (Flexible metallic conduits only)
4. Electri-Flex Company. (Flexible metallic conduits only)
5. O-Z/Gedney; a brand of EGS Electrical Group.
6. Picoma Industries, a subsidiary of Zekelman Industries.
7. Republic Conduit.
8. Robroy Industries.
9. Southwire Company.
10. Thomas & Betts Corporation.
11. Western Tube and Conduit Corporation.
12. Wheatland Tube Company; a division of John Maneely Company.

B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. GRC: Comply with ANSI C80.1 and UL 6.

D. IMC: Comply with ANSI C80.6 and UL 1242.

E. EMT: Comply with ANSI C80.3 and UL 797.

F. FMC: Comply with UL 1; zinc-coated steel.

G. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

H. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.

2. Fittings for EMT:

a. Material: die cast.
b. Type: compression.

3. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.

4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.

I. Joint Compound for IMC, GRC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. AFC Cable Systems, Inc.
2. Arnco Corporation.
3. CANTEX Inc.
4. CertainTeed Corp.
5. Condux International, Inc.
6. Kraloy.
7. Lamson & Sessions; Carlon Electrical Products.
8. Niedax-Kleinhuis USA, Inc.
9. RACO; a Hubbell company.
10. Thomas & Betts Corporation.

B. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. ENT: Comply with NEMA TC 13 and UL 1653.

D. RTRC: Comply with UL 1684A and NEMA TC14.

E. LFNC: Comply with UL 1660.

F. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

G. Fittings for LFNC: Comply with UL 514B.

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cooper B-Line, Inc.
2. Hoffman; a Pentair company.
3. Mono-Systems, Inc.
4. Square D; a brand of Schneider Electric.

B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1, Type 3R, or Type 4 as applicable, unless otherwise indicated, and sized according to NFPA 70.

1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Wireway Covers: Screw-cover type unless otherwise indicated.

E. Finish: Manufacturer's standard enamel finish.

2.4 SURFACE RACEWAYS

A. Listing and Labeling: Surface raceways and tele-power poles shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finish in color selected by Architect.

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. Mono-Systems, Inc.
b. Panduit Corp.
c. Wiremold / Legrand.

C. Surface Nonmetallic Raceways: Two- or three-piece construction, complying with UL 5A, and manufactured of rigid PVC with texture and color selected by Architect from manufacturer's standard colors. Product shall comply with UL 94 V-0 requirements for self-extinguishing characteristics.

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. Hubbell Incorporated; Wiring Device-Kellems Division.
b. Mono-Systems, Inc.
c. Panduit Corp.
d. Wiremold / Legrand.

2.5 BOXES, ENCLOSURES, AND CABINETS

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. Adalet.
2. Cooper Technologies Company; Cooper Crouse-Hinds.
3. EGS/Appleton Electric.
4. Erickson Electrical Equipment Company.
5. FSR Inc.

6. Hoffman; a Pentair company.
7. Hubbell Incorporated; Killark Division.
8. Kraloy.
9. Milbank Manufacturing Co.
10. Mono-Systems, Inc.
11. O-Z/Gedney; a brand of EGS Electrical Group.
12. RACO; a Hubbell Company.
13. Robroy Industries.
14. Spring City Electrical Manufacturing Company.
15. Stahlin Non-Metallic Enclosures; a division of Robroy Industries.
16. Thomas & Betts Corporation.
17. Wiremold / Legrand.

B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy except us aluminum with ARC, Type FD, with gasketed cover.

E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

F. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, galvanized, cast iron [except use cast aluminum with ARC,]with gasketed cover.

G. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

H. Device Box Dimensions: 4 inches square by 2-1/8 inches deep (100 mm square by 60 mm deep) or 4 inches by 2-1/8 inches by 2-1/8 inches deep (100 mm by 60 mm by 60 mm deep) or deeper as required to accommodate wiring devices.

I. Gangable boxes are prohibited.

J. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1, Type 3R, or Type 4 as applicable with continuous-hinge cover with flush latch unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.

2. Nonmetallic Enclosures: [Plastic] [Fiberglass].

3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

K. Cabinets:

1. NEMA 250, Type 1 or Type 3R as applicable galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.

2. Hinged door in front cover with flush latch and concealed hinge.

3. Key latch to match panelboards.

4. Metal barriers to separate wiring of different systems and voltage.

5. Accessory feet where required for freestanding equipment.

6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.6 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. General Requirements for Handholes and Boxes:

1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.

2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.7 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with ANSI/SCTE 77. Strength tests shall be for specified tier ratings of products supplied.

1. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.

2. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012 and traceable to NIST standards.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed Conduit: GRC or IMC.

2. Concealed Conduit, Aboveground: GRC or IMC.

3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.

4. Boxes and Enclosures, Aboveground: NEMA 250, Type 4.

B. Indoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed in dry location and not Subject to Physical Damage: EMT.

2. Exposed and Subject to Severe Physical Damage: GRC or IMC. Raceway locations include the following up to 8’-0” above finished floor:
   a. Mechanical rooms.

3. Concealed in Ceilings and Interior Walls and Partitions: EMT.

4. Embedded in concrete slab: RTRC.

5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.

6. Damp or Wet Locations: GRC.

7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.

C. Minimum Raceway Size: 3/4-inch (21-mm)] trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.

2. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

E. Install surface raceways only where indicated on Drawings.

3.2 INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

B. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

D. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.

E. Install temporary closures to prevent foreign matter from entering raceway.

F. Protect stub-ups from damage where conduits rise through floor slabs. Arrange stub-ups so curved portions of bends are not visible above finished slab.

G. Install no more than the equivalent of four 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches (300 mm) of changes in direction.

H. Install exposed raceways parallel to or at right angles to nearby surfaces or structural members, and follow the surface contours as much possible.

1. Run parallel or banked raceways together on common supports.

2. Make parallel bends in parallel or banked runs. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for parallel raceways.

I. Join raceways with fittings designed and approved for the purpose and make joints tight.

1. Use insulating bushings to protect conductors.

J. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

K. Support conduit within 12 inches (300 mm)of enclosures to which attached.

L. Raceways Embedded in Slabs:

1. Embedment of circuitry in field poured concrete slabs and fill will be permitted subject to the approval of the structural engineer, compliance with the "pour schedule" established for the project, and to the following criteria:

2. They shall be routed in such a manner as to coordinate with the structural requirements of the building. Submit proposed routing to structural engineer for approval. Raceways proposed to be embedded in concrete which are not approved by the structural engineer shall be installed in another manner (in accordance with these specifications).

3. Note that embedment of conduit in field poured concrete slabs and/or fill will not be permitted in [tenant] office areas, [Insert Option Here] and other spaces where the location of all electrical lighting, power and signal outlets are not shown on the electrical drawings.

4. Maximum outside diameter of raceways shall not exceed one third of concrete thickness.. Raceways shall be run in a "single layer" with their outside surface no closer than 1 inch (25mm) to any surface of the concrete.

5. Install in middle 1/3 of slab thickness.

6. Provide support for raceways independent of reinforcing rods.

7. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.

8. Space raceways laterally to prevent voids in the concrete.

9. Run raceway larger than 1 inch (DN 27) trade size parallel to or at right angles to main reinforcement. When at right angles to reinforcement, place raceway close to slab support.

10. They shall not be spaced closer than 3 diameters on center, with a minimum of 3 inches (75mm) between the outside surfaces of the raceways, except at tees, crosses or other single level wide angle junction points**.**

11. Where crossovers or close groupings are unavoidable, circuitry shall either be dog-legged out of the concrete or be carefully field coordinated so as not to cause structural weakness. Where in metal deck or subfloor type of construction, crossovers shall occur only in valleys**.**

12. Where turned up or down into a wall or partition they shall, before entering same, be routed parallel for a long enough distance to assure that no relocation of the wall or partition will be necessary to conceal the required bend**.**

13. They shall be routed in accordance with field instructions issued by the Architect where such instructions differ from specifications set forth herein.

M. To the extent that circuitry cannot be embedded in concrete slabs and fill, floor and wall mounted outlets shall be supplied in conformance with so-called "poke through system" criteria as described below.

N. Criteria for the "poke through" system of circuitry are as follows:-

1. Circuitry shall be run in the hung ceiling space of the story which it serves or in the hung ceiling space of the story immediately below, utilizing openings cut through the floor slab when necessary.

2. The running of circuitry, at the story below the one served, shall be held to an absolute minimum, and shall be used only for tying floor outlets to their nearest adjacent outlets or for other such unavoidable purposes.

3. Circuitry serving a given story shall emanate from local supply or central facilities on the same story and none other.

4. Openings through floor slabs shall be cut, patched and "firestopped" as part of the electrical work. "Firestopping" shall include the filling in of excess opening spaces as well as the utilization of approved, fire-rated through-floor fittings for all floor outlets. These fire-rated fittings shall each be of the "dual service" type, complete with integral floor stanchion which can accommodate 120 volt and telephone and/or signal) circuitry and devices. All "firestopping" shall be performed as directed in the field. General instructions establishing cutting, patching and "firestopping" separate from the electric work are not applicable to the poke through system of circuitry.

5. Openings through floor slabs shall not be spaced closer together than 2 feet (61 cm), and no more than one fire-rated fitting per 65 square feet (6 square meters) of floor area in each span shall be utilized.

6. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot (3-m)intervals.

7. Arrange raceways to cross building expansion joints at right angles with expansion fittings.

8. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.

O. Stub-ups to Above Recessed Ceilings:

1. Use EMT, IMC, or GRC for raceways.

2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

P. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

Q. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

R. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch (35mm) trade size and insulated throat metal bushings on 1-1/2-inch (41-mm) trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

S. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install the locknuts with dished part against the box. Install locknuts hand tight plus 1/4 turn more.

T. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

U. Cut conduit perpendicular to the length. For conduits 2-inch (53-mm) trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

V. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

W. Telephone and Signal System Raceways 2-Inch Trade Size (DN 53) and Smaller: In addition to the above requirements, install in maximum lengths of 100 feet (30 m) and with a maximum of two 90-degree bends or equivalent. Install pull or junction boxes where necessary to comply with these requirements. Pull or junction boxes shall be sized in accordance with ANSI/EIA/TIA-569A guidelines. Pull boxes shall be placed in a straight section of conduit, for raceways over 2 inch size, bending radius shall be not less than 10 times the internal raceway diameter. For fiber optic cable, raceway bending radius shall be not less than 10 times the internal conduit diameter.

X. Surface Raceways:

1. Install surface raceway with a minimum 2-inch (50-mm)radius control at bend points.

2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches (1200 mm) and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

Y. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.

Z. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.

2. Where an underground service raceway enters a building or structure.

3. Where otherwise required by NFPA 70.

AA. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

BB. Expansion-Joint Fittings:

1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F (17 deg C) and that has straight-run length that exceeds 25 feet (7.6 m). Install in each run of aboveground RMC[and EMT] conduit that is located where environmental temperature change may exceed 100 deg F (55 deg C) and that has straight-run length that exceeds 100 feet (30 m).

2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:

a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F (70 deg C) temperature change.
b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F (86 deg C) temperature change.
c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F (70 deg C) temperature change.
d. Attics: 135 deg F (75 deg C) temperature change.

3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C) of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F (0.0115 mm per meter of length of straight run per deg C) of temperature change for metal conduits.

4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.

5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

CC. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches (1830 mm) of flexible conduit for [recessed and semirecessed luminaires,]equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations.

2. Install separate ground conductor across flexible connections.

3.3 INSTALLING JUNCTION, PULL AND OUTLET BOXES:

A. Apply junction and pull boxes in accordance with the following:-

1. Include pull boxes in long straight runs of raceway to assure that cables are not damaged when they are pulled in.

2. Include junction and pull boxes to assure a neat and workmanlike installation of raceways.

3. Include junction and pull boxes to fulfill requirements pertaining to the limitations to the number of bends permitted in raceway between cable access points, the accessibility of cable joints and splices, and the application of cable supports.

4. Where the wires and cables following the same routing are indicated as running through separate pull boxes, it shall be understood that a segregation of the wires and cables is required. Separately indicated pull boxes may be incorporated into single boxes on condition that segregation is maintained by barriers of the type hereinafter specified.

5. Include all required junction and pull boxes regardless of indications on the drawings (which, due to symbolic methods of notation, may omit to show some of them).

B. Apply outlet boxes in accordance with the following:-

1. Unless noted below or otherwise specifically indicated, include a separate outlet box for each individual wiring device, lighting fixture and signal or communication system outlet component. Outlet boxes supplied attached to lighting fixtures shall not be used as replacements for the boxes specified herein unless they are specifically rated to accept "through circuit" building wires.

2. A continuous row of fixtures of the end-to-end channel type, designed for "through wiring," and wired in accordance with the specifications hereinafter pertaining to circuitry through a series of lighting fixtures, may be supplied through a single outlet box.

3. A series of separate fixtures, designed for "through wiring," spaced not more than 2 feet (600mm) apart, and interconnected with conduit or raceway and circuitry which is in accordance with the specifications hereinafter pertaining to circuitry through a series of lighting fixtures, may be supplied through a single outlet box.

4. Connection to recessed ceiling fixtures supplied with pigtails may be arranged so that more than one, but not more than four, such fixtures are connected into a single outlet box. When adopting this procedure:-

   a. Utilize an outlet box no smaller than 4-11/16 inches (119mm) square by 2-1/8 inches (54 mm) deep.
   b. Allow no fixture to be supplied from an outlet box in another room.

5. Multiple local switches indicated at a single location shall be gang mounted in a single outlet box.

6. Include all required outlet boxes regardless of indications on the drawings (which due to symbolic methods of notation, may omit to show some of them).

7. Regardless of any indications on the drawings, flush wall mounted outlet boxes shall not be set back-to-back in fire rated walls or partitions, even if they are displaced vertically. Such outlets shall be offset horizontally by 24 inches (610mm) or as otherwise required to maintain the fire rating.

8. [Exclude "through-the-wall" collar type outlet boxes for flush devices indicated back-to-back in non-fire rated partitions or walls. Where necessary to accommodate box depths, outlets shown back-to-back shall be horizontally offset.]

C. Install junction boxes, pull boxes and outlet boxes in accordance with the following:-

1. Exclude surface mounted outlet boxes in conjunction with concealed circuitry.

2. Exclude unused circuitry openings in junction and pull boxes. In larger boxes each such opening shall be closed with a galvanized sheet steel plate fastened with a continuous weld all around. In small outlet type boxes, utilize plugs as specified for such boxes.

3. Close up all unused circuitry openings in outlet boxes. Unused openings in cast boxes shall be closed with approved cast metal threaded plugs. Unused openings in sheet metal boxes shall be closed with sheet metal knock-out plugs.

4. Pack "through the wall" collar type outlet boxes with a sound deadening, non-hardening, non-hygroscopic, non- combustible, high dielectric stuffing material manufactured specifically for the purpose.

5. Outlet boxes for switches shall be located at the strike side of doors. Indicated door swings are subject to field change. Outlet boxes shall be located on the basis of final door swing arrangements.

6. Boxes and plaster covers for duplex receptacles shall be arranged for vertical mounting of the receptacle.

7. Equip outlet boxes used for devices which are connected to wires of systems supplied by more than one set of voltage characteristics with barriers to separate the different systems.

D. Barriers in junction and pull boxes of outlet size shall be of the same metal as the box.

E. Barriers in junction and pull boxes which are larger than outlet size shall be of polyester resin fiberglass of adequate thickness for mechanical strength but in no case less than 1/4 inch (6.5mm). Each barrier shall be mounted, without fastenings, between angle iron guides so that they may be readily removed.

3.4 MOUNTING HEIGHTS:

A. Heights of all wall mounted outlets and equipment shall be in accordance with the following list. (Dimensions are above finished floor unless noted.)

1. Receptacle or telephone outlet in field constructed wall, partition or column unless otherwise specified below -- 18 inches (45 cm) to centerline.

2. Receptacle or telephone outlet in mechanical spaces, electric switchboard rooms, electric closets -- 60 inches (150 cm) to centerline.

3. Toggle switch outlet in field constructed wall partition or column -- 46 inches (117 cm) to centerline.

4. Bracket lighting outlets, except for "over door" -- 90 inches (228 cm) to centerline.

5. Bracket lighting outlet over door -- as required to center outlet between top surface of door lintel and underside of ceiling.

6. Wall exit sign except for over door -- 90 inches (228 cm) to centerline.

7. Exit sign over door -- As required to center sign between top surface of door lintel and underside of ceiling.

8. Outlet for any signal system device other than fire alarm station requiring manual operation -- 48 inches (122 cm) to centerline.

9. Manual fire alarm station -- 48 inches (122 cm) to centerline.

10. Outlet for any signal system visual or sounding device other than fire alarm visual device or visual/sounding device -- As required for device to clear underside of ceiling by 1 inch (25 mm).

11. Outlet for fire alarm visual device -- Visual device 80 inches (203 cm) AFF to device bottom, except as otherwise noted.

12. Clock outlet -- As required for clock to clear underside of ceiling by 1 inch (25 mm).

B. Architectural drawings and field instructions issued by the Architect take precedence over the above list and shall be adhered to.

C. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

D. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

E. Locate boxes so that cover or plate will not span different building finishes.

F. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

G. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

H. Set metal floor boxes level and flush with finished floor surface.

I. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.6 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.7 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533

SECTION 260544 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.
5. Silicone sealants.

B. Related Requirements:
1. Section 078413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Wall Sleeves:
1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.

B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

C. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

D. Sleeves for Rectangular Openings:

1. Material: Galvanized sheet steel.
2. Minimum Metal Thickness:
   a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and with no side larger than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
   b. For sleeve cross-section rectangle perimeter 50 inches (1270 mm) or more and one or more sides larger than 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.2 SLEEVE-SEAL SYSTEMS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. Advance Products & Systems, Inc.
      b. CALPICO, Inc.
      c. Metraflex Company (The).
      d. Pipeline Seal and Insulator, Inc.
      e. Proco Products, Inc.
   2. Sealing Elements: EPDM or Nitrile (Buna N) rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
   3. Pressure Plates: Stainless steel.
   4. Connecting Bolts and Nuts: Stainless Steel of length required to secure pressure plates to sealing elements.

2.3 SLEEVE-SEAL FITTINGS

A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.
   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. Presealed Systems.

2.4 GROUT

A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.

B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.5 SILICONE SEALANTS

A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.
   1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.

B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Comply with NECA 1.

B. Comply with NEMA VE 2 for cable tray and cable penetrations.

C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
   1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
      a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
      b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
   2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
   3. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed or unless seismic criteria require different clearance.
   4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
   5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level. Install sleeves during erection of floors.

D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:
   1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
   2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.

E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.

B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.3 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION 260544

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Identification for raceways.
2. Identification of power and control cables.
3. Identification for conductors.
4. Warning labels and signs.
5. Instruction signs.
6. Equipment identification labels.
7. Miscellaneous identification products.

1.3 ACTION SUBMITTALS

A. Product Data: For each electrical identification product indicated.

B. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.

C. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

1.4 QUALITY ASSURANCE

A. Comply with ANSI A13.1.

B. Comply with NFPA 70 as amended by State and Local Codes.

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.5 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 POWER AND CONTROL RACEWAY IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.

B. Colors for Raceways Carrying Circuits at 600 V or Less:
1. Black letters on an orange field.
2. Legend: Indicate voltage and system or service type.

C. Self-Adhesive Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.

D. Snap-Around Labels for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

E. Snap-Around, Color-Coding Bands for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches (50 mm) long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

F. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch (50 by 50 by 1.3 mm), with stamped legend, punched for use with self-locking cable tie fastener.

2.2 METAL-CLAD CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each cable size.

B. Colors for Cables Carrying Circuits at 600 V and Less:
1. Black letters on an orange field.
2. Legend: Indicate voltage and system or service type.

C. Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.

D. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tube with machine-printed identification label. Sized to suit diameter of and shrinks to fit firmly around cable it identifies. Full shrink recovery at a maximum of 200 deg F (93 deg C). Comply with UL 224.

2.3 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each cable size.

B. Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.

C. Self-Adhesive, Self-Laminating Polyester Labels: Preprinted, 3-mil- (0.08-mm-) thick flexible label with acrylic pressure-sensitive adhesive that provides a clear, weather- and chemical-resistant, self-laminating, protective shield over the legend. Labels sized to fit the cable diameter such that the clear shield overlaps the entire printed legend.

D. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tube with machine-printed identification label. Sized to suit diameter of and shrinks to fit firmly around cable it identifies. Full shrink recovery at a maximum of 200 deg F (93 deg C). Comply with UL 224.

E. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch (50 by 50 by 1.3 mm), with stamped legend, punched for use with self-locking cable tie fastener.

F. Write-On Tags: Polyester tag, 0.015 inch (0.38 mm) thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
   1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.

G. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of cable it identifies and to stay in place by gripping action.

H. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches (50 mm) long, with diameter sized to suit diameter of cable it identifies and to stay in place by gripping action.

2.4 CONDUCTOR IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide.

B. Self-Adhesive, Self-Laminating Polyester Labels: Preprinted, 3-mil- (0.08-mm-) thick flexible label with acrylic pressure-sensitive adhesive that provides a clear, weather- and chemical-resistant, self-laminating, protective shield over the legend. Labels sized to fit the conductor diameter such that the clear shield overlaps the entire printed legend.

C. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of conductor it identifies and to stay in place by gripping action.

D. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve with diameter sized to suit diameter of conductor it identifies and to stay in place by gripping action.

E. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tube with machine-printed identification label. Sized to suit diameter of and shrinks to fit firmly around conductor it identifies. Full shrink recovery at a maximum of 200 deg F (93 deg C). Comply with UL 224.

F. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

G. Write-On Tags: Polyester tag, 0.015 inch (0.38 mm) thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
   1. Labels for Tags: Self-adhesive label, machine-printed with permanent, waterproof, black ink recommended by printer manufacturer, sized for attachment to tag.

2.5 FLOOR MARKING TAPE

A. 2-inch- (50-mm-) wide, 5-mil (0.125-mm) pressure-sensitive vinyl tape, with yellow and black stripes and clear vinyl overlay.

2.6 UNDERGROUND-LINE WARNING TAPE

A. Tape:
   1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical [and communications] utility lines.
   2. Printing on tape shall be permanent and shall not be damaged by burial operations.
   3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.

B. Color and Printing:
   1. Comply with ANSI Z535.1 through ANSI Z535.5.
   2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE.
   3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE.

C. Detectable three-layer laminate, consisting of a printed pigmented polyolefin film, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core, bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
   1. Overall Thickness: 5 mils (0.125 mm).
   2. Foil Core Thickness: 0.35 mil (0.00889 mm).
   3. Weight: 28 lb/1000 sq. ft. (13.7 kg/100 sq. m).
   4. 3-Inch (75-mm) Tensile According to ASTM D 882: 70 lbf (311.3 N), and 4600 psi (31.7 MPa).

2.7 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.

C. Baked-Enamel Warning Signs:
1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
2. 1/4-inch (6.4-mm) grommets in corners for mounting.
3. Nominal size, 7 by 10 inches (180 by 250 mm).

D. Metal-Backed, Butyrate Warning Signs:
1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch (1-mm) galvanized-steel backing; and with colors, legend, and size required for application.
2. 1/4-inch (6.4-mm) grommets in corners for mounting.
3. Nominal size, 10 by 14 inches (250 by 360 mm).

E. Warning label and sign shall include, but are not limited to, the following legends:
1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 48 INCHES (1200 MM)." Adjust clearance dimensions as required for system voltage and equipment configuration.
3. Arc Flash Warning: “POTENTIAL ARC FLASH HAZARD - APPROPRIATE PERSONAL PROTECTIVE EQUIPMENT AND TOOLS REQUIRED WHEN WORKING ON THIS EQUIPMENT.”

2.8 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch (1.6 mm) thick for signs up to 20 sq. inches (129 sq. cm) and 1/8 inch (3.2 mm) thick for larger sizes.
1. Engraved legend with black letters on white face.
2. Punched or drilled for mechanical fasteners.
3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.9 CABLE TIES

A. General-Purpose Cable Ties: Fungus inert, self extinguishing, one piece, self locking, Type 6/6 nylon.
1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 12,000 psi (82.7 MPa).
3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
4. Color: Black except where used for color-coding.

B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self extinguishing, one piece, self locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 12,000 psi (82.7 MPa).
3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
4. Color: Black.

C. Plenum-Rated Cable Ties: Self extinguishing, UV stabilized, one piece, self locking.
1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 7000 psi (48.2 MPa).
3. UL 94 Flame Rating: 94V-0.
4. Temperature Range: Minus 50 to plus 284 deg F (Minus 46 to plus 140 deg C).
5. Color: Black.

2.10 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

F. Attach plastic raceway and cable labels that are not self-adhesive type with clear vinyl tape with adhesive appropriate to the location and substrate.

G. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.

H. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.

I. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:
1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

J. Painted Identification: Comply with requirements in painting Sections for surface preparation and paint application.

3.2 IDENTIFICATION SCHEDULE

A. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A, and 120 V to ground: Identify with self-adhesive vinyl label. Install labels at 10-foot (3-m) maximum intervals.

B. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:
1. Emergency Power.
2. Power.

C. Power-Circuit Conductor Identification, 600 V or Less:
1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded conductors.
   a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.
   b. Colors for 208/120-V Circuits:
      1) Phase A: Black.
      2) Phase B: Red.
      3) Phase C: Blue.
2. For conductors in pull and junction boxes, and handholes, use color-coding conductor tape to identify the phase.
3. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

D. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.

E. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use write-on tags or self-adhesive, self-laminating polyester labels with the conductor or cable designation, origin, and destination.

F. Control-Circuit Conductor Termination Identification: For identification at terminations provide heat-shrink preprinted tubes or self-adhesive, self-laminating polyester labels with the conductor designation.

G. Ground fault interrupter outlets: Identify receptacles supplied by ground fault interrupter circuit breakers or by upstream ground fault interrupter receptacles. Use engraved letters on device plate.

H. Automatically controlled outlets: Identify receptacles controlled by automatic controls (time switch, occupancy sensor, etc.) with the "controlled receptacle marking symbol" engraved into the device plate.

I. Conductors to Be Extended in the Future: Attach write-on tags or marker tape to conductors and list source and circuit number.

J. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
   1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
   2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
   3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.

K. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

L. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Baked-enamel warning signs.
   1. Comply with 29 CFR 1910.145.
   2. Identify system voltage with black letters on an orange background.
   3. Apply to exterior of door, cover, or other access.
   4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:
      a. Power transfer switches.
      b. Controls with external control power connections.
   5. Service equipment shall be labeled with the maximum available fault current. Label shall indicate date fault current calculation was performed.
   6. Switchboards, Panelboards, Equipment Control Panels, Meter Socket Enclosures, and Motor Control Centers: Labeled to warn of potential electric arc flash hazards. The label shall be located so as to be clearly visible before examination, adjustment, servicing, or maintenance of the equipment.
   7. Generators, Transfer Switches, Panels, Boxes, and Enclosures for Emergency Systems: Identify with "EMERGENCY" in black letters on a yellow background, or with yellow coloring.

M. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.

N. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- (10-mm-) high letters for emergency instructions at equipment used for power transfer [or load shedding].

O. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
   1. Labeling Instructions:
      a. Indoor Equipment: Engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high.
      b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
      c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
      d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.
   2. Equipment to Be Labeled:
      a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be engraved laminated acrylic or melamine label.
      b. Enclosures and electrical cabinets.
      c. Access doors and panels for concealed electrical items.
      d. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
      e. Emergency system boxes and enclosures.
      f. Enclosed switches.
      g. Enclosed circuit breakers.
      h. Enclosed controllers.
      i. Variable-speed controllers.
      j. Push-button stations.
      k. Contactors.
      l. Remote-controlled switches, dimmer modules, and control devices.
      m. Monitoring and control equipment.

END OF SECTION 260553

SECTION 262001 - FEEDERS AND BRANCH CIRCUITRY

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 basic requirements for the installation of light and power feeders and circuitry run at less than 600 volts.

B. Related Requirements:

1. Division 26, Section "Raceways and Boxes."

2. Division 26, Section "Conductors and Cables."

3. Division 26, Section "Panelboards."

1.3 ACTION SUBMITTALS

A. Shop Drawings:

1. Circuited up "as-built" drawings and panel directories as called for in the Division 26 related sections.

1.4 QUALITY ASSURANCE

A. Comply with NFPA 70, as amended by state and local codes.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Products shall be as specified in the Division 26 related sections.

PART 3 - EXECUTION

3.1 INSTALLATION OF FEEDERS

A. Feeder connections shall be in the phase rotation that establishes proper operation for all equipment supplied.

B. Feeders consisting of multiple cables and raceways shall be arranged such that each raceway of the feeder contains one cable for each phase leg (and one neutral cable if any).

C. Each individual tap off a feeder that consists of multiple cables per phase (and neutral if any) shall be arranged so that all of the cables of a phase leg (and neutral if any) of the feeder are connected to the corresponding phase leg (and neutral if any) of the individual tap.

D. Indications of conductor sizing for three phase and three phase/four wire feeders shall, unless otherwise noted on the drawings, be understood as follows:

1. Three (3) equally sized conductors represents a three phase feeder.

2. Four (4) equally sized conductors represents a three phase/4 wire feeder with 100 percent neutral.

3. Three (3) equally sized conductors plus one (1) smaller conductor represents a three phase/three wire feeder plus ground wire.

4. Four (4) equally sized conductors plus one (1) smaller conductor represents a three phase/four wire feeder plus ground wire).

5. Three (3) equally sized conductors plus one (1) larger conductor or two (2) equally sized conductors represents a three phase/4 wire feeder with neutral oversized to accommodate "harmonic-rich loads".

6. Three (3) equally sized conductors plus one (1) larger conductor or two (2) equally sized conductors and one smaller conductor represents a three phase/four wire feeder with neutral oversized to accommodate "harmonic-rich" loads plus a ground wire.

3.2 INSTALLATION OF LIGHTING AND APPLIANCE BRANCH CIRCUITRY

A. Circuitry indicated without sizing shall be understood to be lighting and appliance branch circuitry protected at 20 amps or less.

B. Conform all lighting and appliance branch circuitry (regardless of whether protected above or below 20 amps) to the following:

1. Except as noted below, circuitry shall be multi-wire utilizing common neutrals arranged so that no neutral conductor acts as a common wire for more than one circuit conductor connected to the same phase leg of the supply system.

a. Common neutrals shall not be utilized for circuitry runs containing more than three (3) 120 volt receptacle circuits within a single raceway conduit.

b. Common neutrals shall not be utilized for circuitry runs emanating from panels used for emergency power distribution regardless of any indication to the contrary on the floor plans.

2. Two and three pole branches in panels shall be used respectively for individual single phase load items connected line to line and individual three phase load items.

3. Multi-wire branch circuits shall be supplied by multi-pole circuit breakers.

4. Where circuitry indications require the use of 2-pole and/or 3-pole branch breakers that have not been scheduled, provide in the panelboards the required multi-pole breakers in lieu of the equivalent number of single pole branch breakers. Required quantities of single, two, and three pole branch breakers shall be confirmed prior to ordering panels.

5. Branch circuitry supplying relay controlled lighting fixtures shall be understood to include all necessary interconnections between the control panels containing the relays and the associated lighting or appliance panels.

6. Under no condition shall any local switch break a neutral conductor.

7. At any location where lighting and appliance branch circuitry is extended from a flush mounted panelboard to a suspended ceiling immediately above, at least four 1-inch empty conduits shall be included (in addition to those required for active circuitry) to permit future wiring escape from the panelboard. The empty conduits shall extend up from the panel and shall terminate in a threaded conduit cap immediately after turning out into the hung ceiling space.

8. Raceway sizes shall conform to standard maximum permissible occupancy requirements except where these are exceeded by other requirements specified elsewhere.

C. Conform lighting and appliance branch circuitry, indicated as being protected at 20 amps or less, to the following:

1. 120 volt circuitry shall be supplied from 20 amp panel branches except as indicated, and as noted below:

2. Except as specified below, minimum conductor size shall be #12 AWG.

3. Common neutrals shall not be utilized for circuitry runs containing more than three (3) 120 volt receptacle circuits within a single raceway conduit.

4. Conductors for 120 volt circuitry extending in excess of 75 feet, from the point of supply, to the first outlet shall be #10 AWG (minimum) copper to the first outlet. Increase beyond #10 AWG if required for compliance with code-mandated voltage drop restrictions.

5. Conductors used in runs consisting of more than six wires (exclusive of grounding conductors) in a single raceway shall be #10 AWG copper minimum. Increase beyond #10 AWG as required to comply with code-mandated derating factors, and as specified hereinbefore.

6. Circuits supplying receptacles that are not of the ground fault circuit interrupting type, and are located as noted below, shall be connected to panel branches that are equipped with ground fault interrupting features.

   a. Receptacles located in bathrooms. Bathrooms shall be defined as spaces containing a basin plus a toilet, tub or shower.

   b. Receptacles located in locker rooms with associated shower facilities.

c. Receptacles located within 6 feet of any sink including those mounted within the cabinets below the sink and including those serving fixed equipment or appliances

d. Receptacles in wet locations.

7. Circuits supplying HWAT cable shall be connected to panel branches equipped with 30 ma interrupting features for equipment protection. (11-12-2021)

D. Where circuitry has not been delineated for lighting fixtures, receptacles, switches and miscellaneous items intended for protection at 20 amps, such items shall be provided with circuitry conforming to the requirements listed below. Prior to installation of circuitry, submit for review floor plans showing circuit numbers, home runs, and interconnecting circuitry for all such items.

1. When circuiting up recessed ceiling lighting fixtures, connect fixtures on the basis of more than one fixture to a single outlet box, in an approved manner, as required to ensure that circuits will not be unnecessarily lightly loaded due to mandated, restrictions on the maximum number of outlets per circuit. Except with special permission, unnecessarily light loading shall be understood to mean, less than 1000 volt amps (VA) on a 120 volt circuit. (11-12-2021)

2. The total load on a circuit shall be computed by ascribing volt-amps to individual items on the basis of the following:

ITEM	VOLT-AMPS (VA)
Any lighting fixture.	Input volt-amps as per lighting fixture schedule.
Any outlet with no specific wattage or circuiting instruction indicated.	180 volt amperes
Any outlet (other than for resistance heating) with wattage indicated.	1.15 x Indicated wattage
Any resistance heating outlet with wattage indicated.	1.0 x Indicated wattage
Any fractional HP motor with HP indicated.	2500 x Indicated HP
Any outlet with amps indicated.	120 x Indicated amps

3. Not more than 1300 total VA shall be applied to any 15 amp, 120 volt panel branch circuit nor more than 1450 VA to any 20 amp, 120 volt branch circuit.

4. A separate 20 amp panel branch circuit supplying no other outlets shall be used for each outlet indicated as an "individual appliance circuit" outlet. (11-12-2021)Lighting fixture shall be connected to 20 amp panel branch circuits. Solidly connected equipment less than 1300 VA shall be connected to 15 amp panel branch circuits except as indicated or noted herein.

5. Any installed lighting and appliance branch circuitry, found (as a result of unnecessarily light loading of conductors) to make excessive use of panel branches, shall be rearranged.

6. Circuits shall be balanced on phases at their supply point as evenly as possible.

7. The final arrangement of lighting and appliance branch circuitry shall be fully delineated on the record, or "as-built" drawings called for elsewhere.

END OF SECTION 262001

SECTION 262010 – LOW VOLTAGE DISTRIBUTION

GENERAL

1.1 RELATED DOCUMENTS

A. All of the Contract Documents, as listed on the Table of Contents and including General and Supplementary Conditions and Division 01, General Requirement s, shall be included in, and made part of, this Section.

1.2 SUMMARY

A. The Electrical Subcontractor shall furnish and install the low voltage distribution equipment as specified herein and as shown on the contract drawings.

B. The following low voltage distribution equipment shall be provided for the renovated areas of the existing building, as a minimum, but not necessarily limited to the following:

1. Normal distribution system.
2. Hoisting, rigging, setting of all equipment.
3. Testing, cleaning and adjusting.
4. Fees, permits, royalties, guarantees.
5. Shop drawings.
6. Power system studies and trip settings.
7. Phasing of construction and power interruptions.
8. Contactors
9. Enclosed circuit breakers.
10. Fuses
11. Motor controllers - magnetic starters.
12. Panelboards - branch circuit and distribution. (100A-1200A)
13. Safety switches, motor disconnect devices

1.3 RELATED WORK

A. For work to be included as part of this Section, to be furnished and installed by the Electrical Subcontractor, refer to the Related Work section of Specification Section 26 0510.

B. Carefully examine all of the Contract Documents, criteria sheets and all other Sections of the specifications for requirements which affect work under this Section, whether or not such work is specifically mentioned in this Section.

1.4 REFERENCES

A. The equipment specified herein shall be designed, assembled, and tested and installed in accordance with latest applicable standards of NEMA, IEEE, ANSI and UL as follows:

1. Transformers

a. NEMA
b. ANSI

2. Low Voltage Metal Enclosed Switchgear

   a. ANSI C37.20 (Switchgear assemblies)
   b. ANSI C37.13 (Low-voltage power circuit breakers)
   c. ANSI C37.17 (Trip devices)
   d. ANSI C37.90 (Relays)
   e. ANSI C39.1 (Meters)
   f. NEMA SG-5 (Switchgear assemblies)
   g. NEMA SG-3 (Low-voltage power circuit breakers)
   h. UL 1558

3. Molded Case Circuit Breakers

   a. UL 489 - Molded Case Circuit Breakers
   b. NEMA AB1 - Molded Case Circuit Breakers
   c. NEMA 250 - Enclosures for Electrical Equipment
   d. Fed. Spec. W-C-375a

4. Panelboards

   a. UL 67 – Panelboards
   b. UL 50 – Cabinets and boxes
   c. NEMA PB-1
   d. Fed. Spec. W-P115C
   e. Fed. Spec. W-C-375a
   f. Circuit Breaker – Type I, class I
   g. Fusible Switch – Type II, class I

1.5 QUALITY ASSURANCE

A. The manufacturers listed within this specification have been preselected for use on this project. No submittal will be accepted from a manufacturer other than specified.

B. To ensure system compatibility, all low voltage distribution equipment shall be the products of one manufacturer.

1.6 WARRANTY

A. Attention is directed to provisions of the General Requirements, Supplementary General Requirements and Section 26 0510 regarding guarantees and warranties for the work under this Contract.

1.7 QUALIFICATIONS

A. The manufacturer of the low voltage distribution equipment shall be the manufacturer of the major components within the equipment.

B. For the equipment specified herein, the manufacturer shall be ISO 9000, 9001 or 9002 certified.

C. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

1.8 SEISMIC REQUIREMENTS

A. The equipment and major components specified herein shall be suitable for, and certified by actual seismic testing to meet, all applicable seismic requirements of the 2006 International Building Code (IBC).

1. The test response spectrum shall be based upon a 5% damping factor, and a peak (SDS) value applied at the base of the equipment in the horizontal direction.

2. The forces in the vertical direction shall be at least 66% of those in the horizontal direction.

3. The tests shall cover a frequency range from 1 to 100Hz.

B. Guidelines for the installation consistent with these requirements shall be provided by the equipment manufacturer and based upon testing of representative equipment. Equipment certification acceptance criteria shall be based upon the ability for the equipment to be returned to service immediately after a seismic event within the above requirements without the need for repairs.

C. The following minimum mounting and installation guidelines shall be met, unless specifically modified by the above referenced standards.

1. The Contractor shall provide equipment anchorage details, coordinated with the equipment mounting provision, prepared and stamped by a licensed Civil Engineer in the project state. Mounting recommendations shall be provided by the manufacturer based upon the above criteria to verify the seismic design of the equipment.

2. The equipment manufacturer shall certify that the equipment can withstand, that is, function; following the seismic event, including both vertical and lateral required response spectra as specified in above codes.

3. The equipment manufacturer shall document the requirements necessary for proper seismic mounting of the equipment. Seismic qualification shall be considered achieved when the capability of the equipment, meets or exceeds the specified responsespectra.

1.9 DELIVERY, STORAGE AND HANDLING

A. Manufacturer's directions shall be followed completely in the delivery, storage, protection and installation. Promptly notify the Architect in writing of any conflict between any requirements of the Contract Documents and the manufacturer's directions. Obtain the Architect's written instructions before proceeding with the work. Should Electrical Subcontractor perform any work that does not comply with the manufacturer's directions or written instructions from the Architect, he shall bear all costs arising in correcting any deficiencies that should arise.

B. Equipment and materials shall be delivered to the site and stored in original sealed containers, suitably sheltered from the elements, but readily accessible for inspection by the Architect until installed. All items subject to moisture damage such as controls shall be stored in dry, heated spaces. Equipment such as switchgear with heater elements installed shall have the heater elements energized after the equipment is received by the Electrical

Subcontractor.

C. The Electrical Subcontractor shall be responsible to fully inspect all shipments for damage and report damage to the manufacturer and the Architect.

D. Equipment shall be tightly covered and protected against dirt, water, and chemical or mechanical injury and theft. At the completion of the work, equipment and materials shall be cleaned and polished thoroughly and turned over to the Owner in a condition satisfactory to the Architect. Damage or defects that develop before acceptance of the work shall be made good at the Electrical Subcontractor's expense.

E. The Electrical Subcontractor shall make necessary field measurements to ascertain space requirements, for equipment and connections to be provided under his respective Trade and shall furnish and install such sizes and shapes of equipment to allow for the final installation to conform to the drawings and specifications.

F. The low voltage distribution equipment shall be split into shipping groups for handling as directed by the Electrical Subcontractor or as the manufacturer’s limitations dictate. Shipping groups shall be designed to be shipped by truck, rail or ship. Shipping groups shall be bolted to skids. Accessories shall be packaged and shipped separately. Each switchgear shipping group shall be equipped with lifting eyes for handling solely by crane.

G. The low voltage distribution equipment being stored prior to installation shall be stored so as to maintain the equipment in a clean and dry condition. If stored outdoors, indoor gear shall be covered and heated, and outdoor gear shall be heated.

1.10 ACCEPTABLE MANUFACTURERS

A. Eaton

B. Siemens

C. Square D

D. General Electric

1.11 WITHSTAND AND INTERRUPTING RATINGS OF ELECTRICAL COMPONENTS

A. Calculated available 3 phase and single phase to ground short circuit currents indicated on the drawings are provided for information only, to assist in the selection of withstand and interrupting ratings and coordination of devices and equipment.

B. Prior to submission of shop drawings, the manufacturer shall perform short circuit calculations to determine actual available 3 phase and single line to ground short circuit current at each component in the system based on actual equipment, feeder lengths, impedances, etc. of the equipment proposed for this project. Failure to perform the study prior to submission of shop drawings shall not relieve the manufacturer from providing devices that meet the requirements of the final study report.

C. Each component shall be UL listed and labeled and shall be fully rated to withstand and interrupt calculated available 3 phase and single phase to ground short circuit current levels.

1.12 SUBMITTALS

A. Prepare and submit shop drawings in accordance with the requirements hereinbefore specified, and with Section 01 3300 – Submittal Procedures in the manner described therein, modified as indicated in Section 26 0510 and as noted hereinafter.

B. All shop drawings shall have clearly marked the appropriate specification numberor drawing designation, for identification of the submittal.

C. Disposition of shop drawings shall not relieve the Electrical Subcontractor from the responsibility for deviations from drawing or specifications, unless he has submitted in writing a letter itemizing or calling attention to such deviations at time of submission and secured written approval from the Engineer, nor shall such disposition of shop drawings relieve the Electrical Subcontractor from responsibility for errors in shop drawings or schedules.

D. Shop drawings shall include, but shall not be limited to, the following:

1. Enclosed circuit breakers.
2. Fuses
3. Motor controllers - magnetic starters.
4. Safety switches, motor disconnect devices
5. Equipment identification

1.13 CLOSEOUT SUBMITTALS AND O & M MANUALS

A. The following information shall be submitted for record purposes, in a binder, prior to final payment:

1. Final as-built drawings and information for items listed above.
2. Operation and maintenance manuals with the following information:

a. Instruction books and/or instruction leaflets
b. Recommended renewal parts

3. Wiring diagrams.
4. Certified production test reports.
5. Installation information.
6. Seismic certification and equipment anchorage details.

PART 2 – PRODUCTS

2.1 ENCLOSED CIRCUIT BREAKERS

A. Molded Case Circuit Breakers

1. Circuit breakers shall be molded case and shall provide circuit overcurrent protection with inverse time and instantaneous tripping characteristics.

2. Circuit breakers shall be bolt-on operated by a toggle-type handle and shall have a quick-make, quick-break over-center switching mechanism that is mechanically trip-free. Automatic tripping of the breaker shall be clearly indicated by the handle position. Contacts shall be nonwelding silver alloy, and arc extinction shall be accomplished by means of arc chutes. A push-to-trip button on the front of the circuit breaker shall provide a

local manual means to exercise the trip mechanism.

3. Circuit breakers shall have a minimum symmetrical interrupting capacity as indicated on the drawings.

4. Circuit breakers smaller than 250 ampere frame may be of the thermal-magnetic type with inverse time-current characteristics, unless adjustable trip settings are required to achieve selective coordination with upstream device(s). .

   Circuit breakers 250 ampere frame and above, and circuit breakers smaller than 250 ampere frame, that require adjustable trip settings to achieve selective coordination with upstream device(s), shall be microprocessor-based with true RMS sensing trip units

   a. Each molded case circuit breaker microprocessor-based tripping system shall consist of three current sensors, a microprocessor, and a flux-transfer shunt trip. True RMS sensing circuit protection shall be achieved by analyzing the secondary current signals received from the circuit breaker current sensors and initiating trip signals to the circuit breaker trip actuators when predetermined trip levels and time delay settings are reached.

   b. Interchangeable rating plugs shall establish the continuous trip ratings of each circuit breaker. Rating plugs shall be interlocked so they are not interchangeable between frames, and interlocked such that a breaker cannot be closed and latched with the rating plug removed.

   c. The microprocessor-based trip system shall have thermal memory capabilities to prevent the breaker from being reset following an overload condition until after a preset time delay.

   d. Molded Case Circuit Breaker Trip Units

      1) System coordination shall be provided by the following microprocessor-based time-current curve shaping adjustments:

         a) Adjustable long time pick-up and delay

         b) Adjustable short time pick-up and delay, with selective curve shaping

         c) Adjustable instantaneous pick-up

      2) Adjustable settings for molded case circuit breaker trip units shall have restricted access to the adjustments by one of the following means:

         a) Removable and sealable covers over the adjusting means.
         b) Bolted equipment enclosure doors.
         c) Locked doors accessible only to qualified personnel.

5. Provide circuit breakers UL listed for application at 100% of their continuous ampere rating in their intended enclosure.
6. Provide shunt trips, bell alarms, and auxiliary switches as shown on the contract drawings.

B. Enclosures

1. All enclosed circuit breakers shall have NEMA 1 general purpose enclosures unless

otherwise noted. Provide enclosures suitable for locations as indicated on the drawings and as described below.

a. NEMA 1 surface or flush-mounted general purpose enclosures primarily intended for indoor use.

b. NEMA 12 dust-tight enclosures intended for indoor use primarily to provide protection against circulating dust, falling dirt, and dripping non-corrosive liquids.

c. NEMA 3R raintight enclosures intended for outdoor use primarily to provide protection against rain, sleet, and damage from external ice formation.

d. NEMA 4 watertight stainless steel intended for indoor or outdoor use primarily to provide protection against windblown dust and rain, splashing rain, hose-directed water, and damage from external ice formation.

e. NEMA 7, Class I, Group D hazardous location cast aluminum intended for indoor use in locations classified as Class I, Group D as defined in the National Electrical Code.

f. NEMA 9, Class II, Groups E, F, G hazardous location cast aluminum intended for indoor use in locations classified as Class II, Groups E, F, and G as defined in the National Electrical Code.

2. All enclosed circuit breakers shall have metal nameplates, front cover mounted, that contain a permanent record of catalog number and maximum rating. Provide handle mechanisms that are padlockable in the "OFF" position.

C. Finish

1. Prior to assembly, all internal and external steel and aluminum enclosure part shall be thoroughly cleaned and phosphatized. A polyester powder coating shall be applied electrostatically, and then fused on by baking in an oven. The coating shall have a thickness of not less than 1.5 mils for interior equipment and 3.0 mils for exterior equipment. The finish shall have the following properties:

a.	Impact resistance (ASTM D-2794):	60 Direct/60 Indirect
b.	Pencil Hardness (ASTM D-3363):	H
c.	Flexibility (ASTM D-522):	Pass 1/8 inch mandrel
d.	5% Salt Spray(ASTM B117-85 [20]):	600 hours
e.	Color:	ANSI 49 or 61 Gray

2.2 FUSES

A. All fuses shall be rated for proper voltage in which they are applied. Interrupting ratings shall be greater than the short circuit current available at the terminals of the switch.

B. Fuse Types

1. Fuses for motor branch circuits shall be time delay Class J.

2. Fuses for equipment other than motor loads shall be general fast acting RK-5 or Class J.

3. Medium voltage fuses for primary protection for transformers shall be as specified in switchgear specifications.

4. Control power transformers for motor controller circuits shall be as recommended by motor starter and motor control center manufacturer.

5. Fuses for motors shall be sized at 250% of the motor FLA

6. Fuses for non-motor loads shall be sized at 125% of rated FLA of equipment served.

C. Spare Fuses

1. Provide spare fuses in the amount of 20% (not less than three (3) nor more than nine (9) of all sizes and types).

2. Spare fuses shall include general purpose fuses, motor fuses, and control fuses used in motor control centers, starters, etc.

3. A complete list and quantity of spare fuses shall be submitted with record drawings for review.

D. Spare Fuse Cabinet

1. Furnish and install a heavy duty steel cabinet 2'-0" wide by 3'-0" high by 1'-0" deep with shelves.

2. Cabinet shall be provided with hinged lockage cabinet door.

E. Manufacturers

1. Gould Shawmut
2. Bussman
3. CEFCO

2.3 MOTOR CONTROLLERS – MAGNETIC STARTERS

A. Motor Controllers

1. Combination starter units through NEMA size 3 shall be full voltage, non-reversing, unless shown otherwise. Combination starters NEMA size 4 and above shall be auto-transformer type reduced voltage, closed transition starters with starting taps at 65%, 80% and 90% of full voltage. All accessories for reduced voltage starters shall be the same as full voltage starters.

2. All 480 volt starters sizes shall be as follows:

a. 1/2 to 10 HP: NEMA Size 1
b. 15 to 25 HP: NEMA Size 2
c. 30 to 50 HP: NEMA Size 3
d. 60 to 100 HP: NEMA Size 4 - Reduced Voltage
e. 125 to 200 HP: NEMA Size 5 - Reduced Voltage

3. All 208 volt starters sizes shall be as follows:

a. 1/2 to 7½ HP: NEMA Size 1
b. 10 HP: NEMA Size 2
c. 15 to 25 HP: NEMA Size 3
d. 30 to 40 HP: NEMA Size 4 - Reduced Voltage
e. 50 to 75 HP: NEMA Size 5 - Reduced Voltage

4. All starters shall utilize magnetic only breakers/motor circuit protectors and shall be sized by the equipment manufacturer based on the motor horsepower size indicated on the accepted mechanical equipment shop drawings (also refer to nameplate rating of motors). The manufacturer shall replace, at no cost to the Owner any breaker that is not coordinating with the motor starter.

5. Thermal magnetic devices with solid state overload devices may be provided to obtain specified short circuit rating. If the overloads require power, redundant power supplies shall be provided.

6. The magnetic only breaker shall provide adjustable magnetic protection up to, but not over 1,700% motor nameplate full load current to comply with NEC requirements. All magnetic only breaker/combination starter units shall have a "tripped" position on the unit disconnect and a push-to-test button on the magnetic only breaker.

7. For all normal power, 480 volt motors, provide ground fault protection, with pick-up of approximately 20% of device rating for all starters.

8. Line starters shall be electrically operated, electrically held, three pole assemblies with arc extinguishing characteristics and shall have silver-to-silver renewable contacts. They shall have a minimum of four normally open and four normally closed auxiliary contacts wired to a terminal block.

9. Each motor controller shall include an overload relay assembly with the following features:

   a. Ambient insensitive or ambient compensated.

   b. Overload relays shall be resettable from the outside of the enclosure, by means of an insulated button.

   c. Overload protection shall be based on the actual nameplate full load ampere rating and service factor of the motor. The Electrical Subcontractor shall obtain this information from the final accepted shop drawings for each motor to be served and shall provide this information to the motor controller manufacturer.

   d. Ground fault protection (for normal power motors only)

   e. A built-in push-to-test button

   f. Electrically isolated normally open - normally closed contacts.

   g. Phase loss protection

   h. The assembly shall allow automatic restart upon restoration of power following a shutdown/power interruption

10. Each starter shall be equipped with the following:

a. A primary and secondary fused control power transformer sized 50 VA above the minimum rating.

b. Two LED indicating lights, red for run; green for stop.

c. A mechanical H-O-A selector switch. Electronic or touch pad type H-O-A switches will not be acceptable.

d. Device panel with space to accommodate five (5) oil-tight, pilot-control devices or indicating ammeters, voltmeters, or elapsed time meters.

11. Two-speed, two-winding starters shall be provided for two-speed, two-winding motors. Starters shall be provided with overcurrent protection, sized for each speed. Two (2) motor circuit protectors per starter shall be provided. In addition, three (3) pilot lights ("High", "Low", "Off") and a 4 position selector switch (High/Low/Off/Automatic) shall be provided. Refer to HVAC schedule for quantities. Single short circuit protective device for both speeds will not be acceptable.

12. Two-speed, two-winding, reversing starters shall be provided for two-speed, two-winding motors. Starter shall be provided with overload protection in each speed. Two (2) motor circuit protectors per starter, one sized for each speed shall be provided. In addition, five (5) pilot light (Forward, Reverse, High, Low, Off) and three (3) selector switches ([1] 3 position [Local, Off, Auto]) ([1] 2 position [Forward, Reverse]), and ([1] 2 position [High, Low]) shall be provided. Two-speed and reversing contactors shall be mechanically and electrically interlocked. Each contactor (Forward, Reverse, High, Low) shall be provided with two (2) spare normally open contacts and two (2) spare normally closed contacts.

13. For all motors 3.0 HP and above, provide a current transformer with an amp transducer with a 4-20 milliampere analog output mounted on Phase B of output of starter. Wire current transformer /transducer to shorting time terminal board for remote use by HVAC Subcontractor. Provide power supply for transducer as required.

14. No IEC control devices shall be used.

15. All pilot lights shall be LED type for long life.

16. Time delay relays shall be provided as follows:

a. All motors 15 HP and above to delay starting of motor upon energization of motor control center.

b. All two-speed motors for delay between "high" and "low" speeds to allow coast-down of motor.

c. All reversing starters between forward and reverse and between reverse and forward to allow motor to stop.

d. All timers shall be adjustable between 1 and 60 seconds continuous. Final adjustment shall be made by the Electrical Subcontractor to coordinate with system conditions. List of settings shall be provided to the Owner and Electrical Engineer for review.

B. Wiring/Terminations

1. Wiring shall be NEMA Class I, Type B.

2. All control wiring internal to the assembly shall be done at the factory by the manufacturer. Field control wiring shall terminate at pull-apart terminal blocks in the wiring gutter.

3. The manufacturer shall submit wiring diagram(s) for each type of starter assembly. Prior to submission for approval by the Engineer, the Electrical Subcontractor shall submit these drawings to the HVAC/Automatic Temperature Control (ATC) Subcontractors to determine suitability in their system(s). Following this review, the Electrical Subcontractor may submit the drawings to the Engineer for review. The submittal shall clearly indicate that the HVAC/ATC Subcontractors have reviewed the wiring diagrams and have accepted them for use with their systems.

C. Enclosures

1. The equipment in these specifications shall have NEMA 1 general purpose, indoor enclosures, with devices arranged as shown on contract drawings, unless noted otherwise.

D. Finish

1. Prior to assembly, all internal and external steel and aluminum enclosure part shall be thoroughly cleaned and phosphatized. A polyester powder coating shall be applied electrostatically, and then fused on by baking in an oven. The coating shall have a thickness of not less than 1.5 mils for interior equipment and 3.0 mils for exterior equipment. The finish shall have the following properties:

a.	Impact resistance (ASTM D-2794):	60 Direct/60 Indirect
b.	Pencil Hardness (ASTM D-3363):	H
c.	Flexibility (ASTM D-522):	Pass 1/8 inch mandrel
d.	5% Salt Spray(ASTM B117-85 [20]):	600 hours
e.	Color:	ANSI 49 or 61 Gray

E. Manual Starters

1. Manual starters shall be provided with thermal overload protection in each phase, quick-break operating mechanism, silver contacts, pressure type terminal contacts, bimetallic type overload device, H/O/A selector switch, etc.

2.4 SAFETY SWITCHES AND MOTOR DISCONNECT DEVICES

A. Ratings

1. All safety switches / motor disconnect devices shall be heavy duty type

2. Safety Switches 60 amperes and below (motors 10 HP, 480 volt; 5 HP, 208 volt, and smaller)

a. 30 to 60 Amperes.
b. 250 Volts AC, DC; 600 Volts AC.

c. 2, 3 or 6 Poles.
d. Fusible or Non-Fusible
e. Copper-Aluminum Terminals.

3. Safety Switches over 60 amperes (motors 15 HP, 480 volt; 7½ HP, 208 volt and above)

a. 60 to 1,200 Amperes.
b. 600 Volts AC.
c. 3 or 6 Poles.
d. Fusible or Non-Fusible
e. Copper-Aluminum Terminals.

B. Construction

1. All safety switches / motor disconnect devices shall include the following:

a. Metal nameplates mounted on the front cover with:

1) A permanent record of switch type
2) Catalog number
3) HP ratings (with both standard and time delay fuses)

b. Handle whose position is easily recognizable and is padlockable in the "OFF" position

c. Visible blades when the door is in the open position

d. Reinforced fuse clips

e. Non-teasible, positive, quick-make quick-break mechanisms

f. Switch assembly and operating handle shall be an integral part of the enclosure base.

g. All switches shall be Underwriters Laboratories, Inc. listed, HP rated, meet Federal Specification WS-865c, and NEMA Specifications KSI-1975.

h. Switches shall have defeatable door interlocks that prevent the door from opening when the operating handle is in the "ON" position.

2. Heavy-duty switches shall have line terminal shields.

3. All fused switches shall have Class J time delay fuses.

C. Special Configurations

1. Where motor disconnect devices are installed between variable speed drives and their associated motor, an interlock switch shall be provided on the motor disconnect devices and 2#14-1/2"C. shall run from the interlock switch to the associated variable speed drive to turn off the drive while the motor disconnect switch is in the off position.

2. All two speed motors shall be provided with 6 pole motor disconnect devices.

3. All motors/pumps/air handling units shall be provided with proper size/rating motor disconnect device whether indicated on drawings or not to comply with NEC. Install and

connect motor disconnect devices furnished by other Trades.

4. For all motors under 1/2 HP, furnish and install a manual starting thermal type switch with pilot light as a disconnecting means, unless otherwise indicated on the drawings. These thermal switches shall be toggle operated and shall be rated 1 HP, motor overload protection shall be provided by means of a bimetallic type thermal relay in combination with interchangeable heaters. Heaters shall be installed without removing the starter from the housing or disturbing the wiring. Toggle shall be trip free. Thermal switches shall be furnished in a NEMA, Type 1 enclosure in mechanical and utility areas and flush in walls with stainless steel plates in architecturally finished areas. All heaters shall be sized per the horsepower of the motor code letter. Coordinate with HVAC and Plumbing Trades.

D. Wiring/Terminations

1. All power wiring shall be furnished and installed between disconnect switches, control cabinets, contactors and motor terminals required by equipment furnished by other Trades.

E. Enclosures

1. The equipment in these specifications shall have NEMA 1 general purpose, indoor enclosures, with devices arranged as shown on contract drawings, unless noted otherwise.

2. NEMA Type 3R enclosures shall be used where the disconnect switch is exposed to the weather or in wet areas.

3. Where pin terminal fittings are provided on aluminum conductor for connection to set screw type terminations, oversized enclosures shall be provided.

F. Finish

1. Prior to assembly, all internal and external steel and aluminum enclosure part shall be thoroughly cleaned and phosphatized. A polyester powder coating shall be applied electrostatically, and then fused on by baking in an oven. The coating shall have a thickness of not less than 1.5 mils for interior equipment and 3.0 mils for exterior equipment. The finish shall have the following properties:

a. Impact resistance (ASTM D-2794): 60 Direct/60 Indirect
b. Pencil Hardness (ASTM D-3363): H
c. Flexibility (ASTM D-522): Pass 1/8 inch mandrel
d. 5% Salt Spray(ASTM B117-85 [20]): 600 hours
e. Color: ANSI 49 or 61 Gray

2.5 EQUIPMENT IDENTIFICATION

A. Manufacturers Standard Nameplate

1. A master nameplate, giving equipment designation, voltage rating, ampere rating, short circuit rating, impedance, manufacturer's name, general order number, item number, etc. shall be provided for all electrical distribution equipment specified herein.

2. Control components mounted within the assembly, such as fuse blocks, relays,

pushbuttons, switches, etc., shall be suitably marked for identification corresponding to appropriate designations on manufacturer's drawings and/or wiring diagrams.

B. Unique Equipment Identification Nameplate

1. Furnish and install uniquely engraved nameplates, mounted on the face of each assembly, shall be furnished for all electrical distribution equipment specified herein.

2. Nameplates shall be laminated plastic and secured with screws.

3. Nameplates shall be a minimum of 2 inch high x 2 1/2 inch wide, laminated with black letters on white background.

4. Characters shall be 3/16 inch high, minimum.

5. Engraved nameplate shall include equipment designation, ampere rating of upstream device (if applicable), voltage, phase, number of wires (i.e. 3 wire or 4 wire), and upstream panel feeder.

6. Equipment that serves other electrical distribution equipment, such as substation serving distribution panels, motor control centers serving motors and equipment, distribution panels serving lighting and appliance panels and other equipment, engraved nameplates shall also be provided for all feeder breakers, mounted on the face of the assembly, with panel/equipment designations as indicated on the drawings.

PART 3 - EXECUTION

3.1 COOPERATION AND WORK PROGRESS

A. The Electrical work shall be carried on under the usual construction conditions, in conjunction with all other work at the site. The Electrical Subcontractor shall cooperate with the Architect, General Contractor, all other Subcontractors and equipment suppliers working at the site. The Electrical Subcontractor shall coordinate the work and proceed in a manner so as not to delay the progress of the project.

B. The Electrical Subcontractor shall coordinate his work with the progress of the building and other Trades so that he will complete his work as soon as conditions permit and such that interruptions of the building functions will be at a minimum. Any overtime hours worked or additional costs incurred due to lack of or improper coordination with other Trades or the Owner by the Electrical Subcontractor, shall be assumed by him without any additional cost to the Owner.

C. The Electrical Subcontractor shall furnish information on all equipment that is furnished under this Section but installed under another Section to the installing Subcontractor as specified herein.

D. The Electrical Subcontractor shall provide all materials, equipment and workmanship to provide for adequate protection of all electrical equipment during the course of construction of the project. This shall also include protection from moisture and all foreign matter. The Electrical Subcontractor shall also be responsible for damage which he causes to the work of other Trades, and he shall remedy such injury at his own expense.

E. Waste materials shall be removed promptly from the premises. All material and equipment

stored on the premises shall be kept in a neat and orderly fashion. Material or equipment shall not be stored where exposed to the weather. The Electrical Subcontractor shall be responsible for the security, safekeeping and damages, including acts of vandalism, of all material and equipment stored at the job site.

F. The Electrical Subcontractor shall be responsible for unloading all electrical equipment and materials delivered to the site. This shall also include all large and heavy items or equipment which require hoisting. Consult with the General Contractor for hoisting/crane requirements. During construction of the building, the Electrical Subcontractor shall provide additional protection against moisture, dust accumulation and physical damage of the main service and distribution equipment. This shall include furnishing and installing temporary heaters within these units, as approved, to evaporate excessive moisture and ventilate it from the room, as may be required.

G. It shall be the responsibility of the Electrical Subcontractor to coordinate the delivery of the electrical equipment to the project prior to the time installation of equipment will be required; but he shall also make sure such equipment is not delivered too far in advance of such required installation, to ensure that possible damage and deterioration of such equipment will not occur. Such equipment stored for an excessively long period of time (as determined in the opinion of the Architect) on the project site prior to installation may be subject to rejection by the Architect.

H. The Electrical Subcontractor shall erect and maintain, at all times, necessary safeguards for the protection of life and property of the Owner, Workmen, Staff and the Public.

I. Prior to installation, the Electrical Subcontractor has the responsibility to coordinate the exact mounting arrangement and location of electrical equipment to allow proper space requirements as indicated in the NEC. Particular attention shall be given in the field to group installations. If it is questionable that sufficient space, conflict with the work of other Subcontractors, architectural or structural obstructions will result in an arrangement which will prevent proper access, operation or maintenance of the indicated equipment, the Electrical Subcontractor shall immediately notify the Contractor and not proceed with this part of the Contract work until definite instructions have been given to him by the Architect.

J. The Electrical Subcontractor shall not allow any equipment or piping foreign to the electrical installation to be installed or pass through any room in which electrical systems or equipment are located, such as electric rooms, electric closets, telephone or data closets. The Electrical Subcontractor shall notify the Contractor of such violations and request immediate removal.

3.2 INSTALLATION

A. General

1. Unless specifically noted or indicated otherwise, all equipment and material specified in Part 2 of this specification or indicated on the drawings shall be installed under this Contract whether or not specifically itemized herein. This Section covers particular installation methods and requirements peculiar to certain items and classes or material and equipment.

2. The Electrical Subcontractor shall obtain detailed information from manufacturers of equipment provided under Part 2 of this specification as to proper methods of installation.

3. The Electrical Subcontractor shall obtain final roughing dimensions and other information as needed for complete installation of items furnished under other Sections

or furnished by the Owner.

4. The Electrical Subcontractor shall keep fully informed of size, shape and position of openings required for material and equipment provided under this and other Sections. Ensure that openings required for work of this Section are coordinated with work of other Sections. Provide cutting and patching as necessary.

5. All miscellaneous hardware and support accessories, including support rods, nuts, bolts, screws and other such items, shall be of a galvanized or cadmium plated finish or of another approved rust-inhibiting coating.

6. Throughout this Section where reference is made to steel channel supports, it shall be understood to mean that the minimum size shall be 1 5/8" mild strip steel with minimum wall thickness of 0.105", similar to Unistrut P1000 or equal products manufactured by Kindorf or Husky Products Co.

B. Concrete Housekeeping Pads

1. Concrete pads shall be installed for all freestanding electrical distribution equipment.

2. The General Contractor shall provide the concrete work. Electrical Subcontractor shall supervise and coordinate concrete work to ensure that proper size and location, and grounding cable, rods, conduit, etc., are located as detailed and as required. The Electrical Subcontractor shall also ensure that the concrete is level to within manufacturers published tolerances.

3. All concrete housekeeping pads shall extend beyond the equipment supported as follows:

   a. Equipment with front and rear access, or equipment mounted freestanding with access in front and rear:

      1) 1” in front of the equipment
      2) 6" on each side of the equipment
      3) 6” in back of the equipment

   b. Equipment with front access only, mounted against a wall:

      1) 1” in front of the equipment
      2) 6" on each side of the equipment
      3) 0” in back of the equipment

4. Mounting height of the highest overcurrent/disconnect device in the above equipment shall not exceed 6'-6" above finished floor. If overcurrent devices exceed 6’-6” above finished floor as a result of the housekeeping pad, the pad shall extend in front of the gear a minimum of 4’-0”, and include ramps on each end.

C. Electrical Distribution Equipment

1. The Electrical Subcontractor shall install the electrical distribution equipment specified herein per the manufacturer’s recommendations and the Contract Drawings.

2. The installation of all equipment, including working space requirements, shall conform to all NEC and local codes.

3. All necessary hardware to secure the assembly in place shall be provided by the Electrical Subcontractor.

4. The Electrical Subcontractor shall ensure that no piping, ductwork or other equipment foreign to the electrical trade passes through the area extending from the floor to the structural ceiling with the width and depth equal to that of the electrical distribution equipment, plus 6" on either side of the equipment.

5. Floor mounted assemblies shall be installed on concrete housekeeping pads and shall be provided with adequate lifting means. Floor mounted assemblies shall be capable of being moved into installation position and bolted directly to the floor without the use of floor sills. The Electrical Subcontractor shall ensure the floor is level to 1/8 inch per 3-foot distance in any direction.

6. All electrical equipment shall be installed such that the handle of the highest circuit breaker does not exceed 6’-6” above finished floor.

7. The location of all electrical distribution equipment installed in mechanical or plumbing equipment rooms shall be coordinated with the respective Subcontractor.

8. The equipment shall be installed and checked in accordance with the manufacturer’s recommendations prior to first energization. This shall include but not limited to:

   a. Checking to ensure that the pad location is level to within .125 inches.
   b. Checking to ensure that all bus bars are torqued to the manufacturer's recommendations.
   c. Assemble all shipping sections, remove all shipping braces and connect all shipping split mechanical and electrical connections.
   d. Secure assemblies to foundation or floor channels.
   e. Measure and record megger readings phase-to-phase, phase-to-ground, and neutral-to-ground (four-wire systems only).
   f. Inspect and install all circuit breakers, components, etc. in their proper compartments.

9. Identification shall be provided for all electrical distribution equipment. The electrical system identification shall clearly describe the equipment connected. For additional information, refer to specification section 26 0520.

10. Points of access for all rooms and spaces containing equipment and wiring operating at 600 volts and above shall be kept locked and shall include conspicuously posted warning signs. The warning sign shall be legible and permanent and shall contain the following verbiage: DANGER – HIGH VOLTAGE – KEEP OUT.

11. Control wiring shall be provided as required. Interface all local and remote control wiring and operational systems for each load.

D. Wall Mounted Equipment

1. Recessed and surface mounted equipment shall be mounted on walls with studs and cross-bracing, as required to assure sufficient strength so as to restrict any movement of the equipment.

E. Busway

1. Coordinate busway penetrations through floor slabs and provide a 4" high, minimum concrete curb around all busways at each floor penetration. Provide floor flanges for all busway penetrations through floor. Flanges shall be designed for a minimum 2 hour fire rating. Only UL listed firestops shall be used.

2. Busway shall be permitted to run directlyto the substation feeder circuit breaker provided that the load side lugs for all feeder breakers, spare breakers and provisions for future breakers in the same switchgear cubicle are accessible and unobstructed for conductor terminations.

3. All sections of busway within 40'-0" of a connected substation or transformer shall be vibration isolated at each support.

4. Use non-metallic vibration isolators made of material suited for the service, and selected for at least 0.1" deflection.

3.3 REQUIREMENTS FOR EMERGENCY SYSTEMS WIRING

A. All feeder and branch circuit wiring for the emergency system shall be kept entirely independent of all other wiring, devices and equipment, and shall not enter the same raceways, boxes or cabinets with other wiring or each other, except as specifically allowed by the Code.

3.4 MATERIALS AND WORKMANSHIP

A. All materials and equipment shall be new and unused and shall meet requirements of the latest Standards of NEMA, UL, IPCEA, ANSI and IEEE. Equipment shall have components required or recommended by OSHA, applicable NFPA documents and shall be UL listed and labeled.

B. Despite references in the specifications or on the drawings to materials or pieces of equipment by name, make or catalog number, such references shall be interpreted as establishing standards of quality for materials and performance.

C. Finish of materials, components and equipment shall not be less than Industry good practice. When material or equipment is visible or subject to corrosive or atmospheric conditions, the finish shall be as approved by the Architect.

D. Provide proper access to material or equipment that requires inspection, replacement, repair or service. If proper access cannot be provided, confer with the Architect as to the best method of approach to minimize effects of reduced access.

E. All work shall be installed in a neat and workmanlike manner and shall be done in

accordance with all Local and State Codes.

F. The Owner will not be responsible for material, equipment or the installation of same before testing and acceptance.

3.5 FACTORY TESTING

A. Standard factory tests shall be performed on the electrical distribution equipment provided under this section. All tests shall be in accordance with the latest version of ANSI and NEMA standards.

B. Dry type Transformers

1. Ratio tests at the rated voltage connection and at all tap connections.

2. Polarity and phase relation tests on the rated voltage connection.

3. Applied potential tests.

4. Induced potential test.

5. No-load and excitation current at rated voltage on the rated voltage connection.

6. Resistance measurements on all windings at the rated voltage connection of each unit and at the tap extremes of the first unit made of a new design.

C. Factory tests as outlined above shall be witnessed by the Owner's representative.

1. The manufacturer shall notify the Owner two (2) weeks prior to the date the tests are to be performed.

2. The manufacturer shall include the cost of transportation and lodging for up to three (3) Owner's representatives. The cost of meals and incidental expenses shall be the Owner's responsibility.

D. The manufacturer shall provide three (3) certified copies of factory test reports.

3.6 FIELD SETTINGS

A. The Electrical Subcontractor shall perform field adjustments of the circuit breakers as required to place the equipment in final operating condition.

B. Where electrical distribution equipment is provided with adjustable settings, each setting on each piece of equipment shall be set in the field by a qualified representative of the manufacturer prior to initial energization. The qualified representative of the manufacturer shall be retained by the Electrical Subcontractor. Settings shall be as determined by the final coordination study of the distribution system. See Section 26 0570.

C. Transformers

1. Adjust taps to deliver appropriate voltage and measure primary and secondary voltage to confirm proper setting.

D. Field Adjustments for Motor Control Centers/Starters

1. Follow the manufacturer's instructions and the contract documents concerning any short circuit device settings, heater selection, timing relays, or startup of components.

2. Heater installation and overload relay adjustment shall be the responsibility of the Electrical Subcontractor after field installation of the motor control center and verification of all motor full load amperes.

3.7 FIELD QUALITY CONTROL

A. Provide the services of a qualified factory-trained manufacturer's representative to assist the Electrical Subcontractor in installation and start-up of the equipment specified under this section. The manufacturer's representative shall provide technical direction and assistance to the Electrical Subcontractor in general assembly of the equipment, connections and adjustments, and testing of the assembly and components contained therein.

B. The Electrical Subcontractor shall provide three (3) copies of the manufacturer's field start-up report.

3.8 MANUFACTURER'S CERTIFICATION

A. A qualified factory-trained manufacturer's representative shall certify in writing that the equipment has been installed, adjusted, and tested in accordance with the manufacturer's recommendations.

B. The Electrical Subcontractor shall provide three (3) copies of the manufacturer's representative's certification before final payment is made.

C. A certified test report of all standard production tests shall be available to the Engineer upon request.

3.9 TRAINING

A. The Electrical Subcontractor shall provide a training session for up to 6 Owner's representatives at a jobsite location determined by the Owner.

B. The training session shall be conducted by a manufacturer's qualified representative. The training program shall consist of the instruction on the operation of the assembly, circuit breakers, and major components within the assembly.

C. The training program shall include the following:

1. Review of the project one-line drawings and schedules.

2. Review of the factory record shop drawings.

3. Review of all equipment in the electrical distribution system.

4. Discuss the maintenance timetable and procedures to be followed in an ongoing maintenance program.

5. Provide three ring binders to participants complete with copies of drawings and other course material covered.

END OF SECTION

SECTION 262813 – FUSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Cartridge fuses rated 600-V ac and less for use in control circuits, enclosed switches, panelboards, switchboards, and enclosed controllers.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material, dimensions, descriptions of individual components, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:

1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.

a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.

b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.

2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.

3. Current-limitation curves for fuses with current-limiting characteristics.

4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse.

5. Coordination charts and tables and related data.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

1. Ambient temperature adjustment information.

2. Current-limitation curves for fuses with current-limiting characteristics.

3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse.

4. Coordination charts and tables and related data.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NEMA FU 1 for cartridge fuses.

D. Comply with NFPA 70; including the amendments of local jurisdiction.

1.7 PROJECT CONDITIONS

A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F (5 deg C) or more than 100 deg F (38 deg C), apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.8 COORDINATION

A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

1. Bussmann, an Eaton business
2. Edison, a brand of Bussman by Eaton
3. Mersen, USA.
4. Littelfuse, Inc.

2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

2.3 SPARE-FUSE CABINET

A. Characteristics: Wall-mounted steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.

1. Size: Adequate for storage of spare fuses specified with 15 percent spare capacity minimum.

2. Finish: Gray, baked enamel.

3. Identification: "SPARE FUSES" in 1-1/2-inch- (38-mm-) high letters on exterior of door.

4. Fuse Pullers: For each size of fuse, where applicable and available, from fuse manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.

B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.

C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

B. Install spare-fuse cabinet(s).

3.3 IDENTIFICATION

A. Install labels complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems" and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 262813