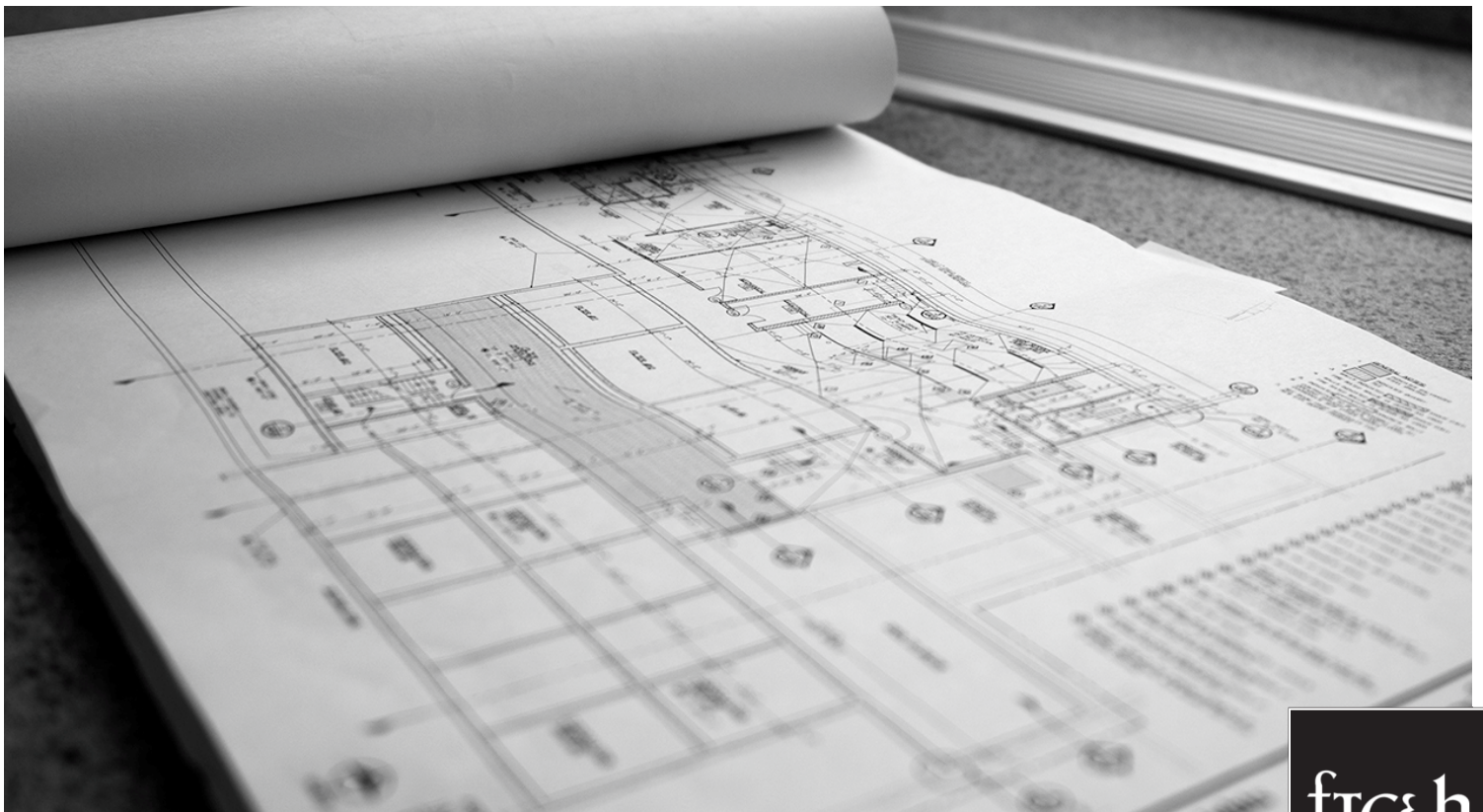


Wayne State University
Cohn Building Student Commons
General Contractor

5557 Cass Avenue, Detroit, Michigan 48202
WSU Project Number 048-291367

BIDS AND PERMITS

Project Manual
Fishbeck Project Number 190812



Fishbeck, Thompson, Carr & Huber, Inc.
engineers | scientists | architects | constructors

ftc&h

PROJECT MANUAL
FOR
WAYNE STATE UNIVERSITY (WSU)

COHN BUILDING
STUDENT COMMONS
WSU PROJECT NUMBER 048-291367

GENERAL CONTRACTOR

October 31, 2019
Fishbeck Project Number 190812

ARCHITECT/ENGINEER

FISHBECK
39500 MacKenzie Drive, Suite 100
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248.324.2090

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SECTION 01 11 00 – SUMMARY OF WORK

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 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work covered by the Contract Documents comprises construction, coordination, and installation of furniture provided by the Owner under a separate contract.
- B. The Work includes the following major items:
 - 1. Demolition of existing space.
 - 2. New partitions, doors, windows, and finishes.
 - 3. Upgrades to the mechanical system.
 - 4. Upgrades to the electrical destruction and lighting.
 - 5. Information Technology and Audio-Visual upgrades.

1.3 TYPE OF CONTRACT

- A. Construct the Work of this Contract under a single lump sum Contract.

1.4 GENERAL

- A. Imperative Language: These Specifications (Divisions 01 through 28) are written in the imperative and abbreviated form. This imperative language of the technical specifications is directed at the Contractor unless specifically noted otherwise. Incomplete sentences shall be completed by inserting "shall", "shall be" and similar mandatory phrases by inference in the same manner as they are applied to notes on the Drawings. The words "shall", "shall be" and similar mandatory phrases shall be supplied by inference where a colon (:) is used within sentences or phrases. Except as worded to the contrary, fulfill (perform) all indicated requirements whether stated in the imperative or otherwise.
- B. Related Sections: Some Sections of these Specifications (Divisions 01 through 28) may include a paragraph titled "Related Sections". This paragraph is an aid to the Project Manual user and is not intended to include all Sections which may be related. It is the Contractor's obligation to coordinate all Sections whether indicated under "Related Sections" or not.
- C. Reference to the General Conditions: In Divisions 01 through 28, a reference to the General Conditions includes by inference all amendments or supplements in the Supplementary Conditions.
- D. Furnish, Install, Perform, Provide:
 - 1. The word "furnish," when used in connection with services, materials, or equipment, shall mean to supply and deliver said services, materials, or equipment to the site (or some other specified location) ready for use or installation and in usable or operable condition.
 - 2. The word "install," when used in connection with services, materials, or equipment, shall mean to put into use or place in final position said services, materials, or equipment complete and ready for intended use.
 - 3. The words "perform" or "provide," when used in connection with services, materials, or equipment, shall mean to furnish and install said services, materials, or equipment complete and ready for intended use.
 - 4. When "furnish," "install," "perform," or "provide" is not used in connection with services, materials, or equipment in a context clearly requiring an obligation of the Contractor, "provide" is implied.

1.5 WORK UNDER OTHER CONTRACTS

- A. The owner will award a contract for the furnishing an installation of the following work:
 - 1. Furniture Package.
- B. Furniture Vendor's Responsibilities:
 - 1. Arrange for and deliver Shop Drawings, Product Data and Samples to the Contractor.
 - 2. Arrange and pay for Product delivery to the site.
 - 3. On delivery, inspect Products jointly with the Contractor.
 - 4. Submit claims for transportation damage.
 - 5. Arrange for replacement of damaged, defective or missing items.
 - 6. Arrange for Manufacturer's warranties, inspections and service.
- C. General Contractor's Responsibilities:
 - 1. Coordinate delivery schedule of material to the site with the Owner and Supplier.
 - 2. Review Shop Drawings, Product Data and Samples.
 - 3. Repair or replace items damaged by the Work of this Contract.
 - 4. Provide power, data, low voltage and final connections.
- D. Information on Owner furnished material:
 - 1. Is included in the following Sections:
 - a. Division 12 Section "Furnishings."

1.6 CONTRACTOR USE OF PREMISES

- A. Limit use of premises to allow for work by other contractors.
- B. Limit construction traffic access to site; Contractor may access the Site through Stair 1, Elevator 1, and third floor Corridor C2.
- C. Coordinate use of premises under direction of the Owner.
- D. Where the Contract Documents identify certain site elements within the construction limits, such as items outside the work zone must be kept open for public or the Owner's use during construction, the Contractor shall be responsible for protection and maintenance of such elements as well.
- E. Except in connection with the safety or protection of persons or the Work or property at the site or adjacent thereto, all Work at the site shall be restricted to the following hours:
 - 1. Monday through Friday (except legal holidays): 7:00 a.m. to 5:00 p.m.
 - 2. Saturday, Sundays or legal holidays with written approval of the Owner.
- F. The Contractor must limit noise levels throughout the day as the building is continuously occupied during construction. Noise levels and permissions per hour are as follows:
 - 1. Low Levels of Noise:
 - a. The noise is minimal to light; including light drilling, wire pulls, intermittent pipe cutting, dry walling, etc.
 - 1) Permitted: Any time.
 - 2. Moderate Levels of Noise:
 - a. The noise is intermittently loud, but not sustained; including hammering or screwing into studs, some intermittent banging, installing barricade walls, etc.
 - 1) Permitted: Throughout the day tolerated throughout the day, evenings, and weekends.
 - 3. High Levels of Noise:
 - a. The noise will be very loud, the floor may vibrate, or the drilling may be for a sustained duration; including coring through concrete and structural vibrations,
 - 1) Permitted: Work must be preplanned and will occur in the at times that will not disrupt the occupied space adjacent to, below, or near the work zone. It is likely that this work must occur in the evenings, over midnights, or on weekends.
 - 4. At any time the Owner may discontinue or temporarily stop the work if deemed too loud or disruptive.

1.7 OCCUPANCY REQUIREMENTS

- A. Owner Occupancy During Construction:
 - 1. The Owner will occupy or utilize the premises during the entire period of construction. Coordinate with the Owner to minimize conflict and to facilitate the Owner's operations.
 - 2. Access to Abutting Properties: Provide at all times.
 - 3. Access for Emergency Vehicles:
 - a. Provide at all times.
 - b. Provide at least one clear lane during nonwork periods.
 - 4. Fire Hydrants: Provide access to at all times.
 - 5. Do not block fire access routes from buildings.
 - 6. Limit parking for construction vehicles to an area designated by the Owner.

PART 2 - PRODUCTS

2.1 OTHER MATERIALS

- A. General: All other materials which are not specified herein and are not indicated on the Drawings, but are required for proper and complete performance of the Work.
- B. Procedure:
 - 1. Select new, first quality material.
 - 2. Obtain the Architect's review.
 - 3. Provide and install.

PART 3 - EXECUTION

Not used.

END OF SECTION 01 11 00

SECTION 01 18 13 – PROTECTION, RESTORATION AND NOTIFICATION

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 responsibilities for the protection, restoration and notification requirements for surface and subsurface structures, underground facilities and surface improvements.

1.3 NOTIFICATION AND INTERRUPTIONS

- A. Prior to Start of Construction:
 - 1. Notify MISS DIG at least 72 hours in advance at 800.482.7171 for exterior identification if applicable.
 - 2. Contact each utility owner.
 - 3. Arrange for the identification of the locations of existing underground facilities at or contiguous to the site.
- B. Utility Interruptions:
 - 1. Provide 7 days notice to the affected occupants of the time and duration of the anticipated shut off.
 - 2. See University approval prior to performing shut off.

1.4 PROTECTION AND RELOCATION

- A. Be responsible for:
 - 1. Protection of structures and utilities at or contiguous to the site in accordance with the General Conditions.
 - 2. Cost of cleaning, repair, relocation, raising, lowering, or replacement of structures and utilities which are damaged as a result of the Contractor's operations.
 - 3. Cost of cleaning, repair, relocation, raising, lowering, or replacement of structures and utilities which are identified on the Drawings for relocation.
 - 4. Temporary sheeting, bracing, poles, cables, sand fill or other means used to support a structure or utility exposed or endangered by the Contractor's operations.
 - 5. Relocating, raising or lowering of a structure or utility for the Contractor's convenience.

1.5 RESTORATION

- A. Acceptable Standards for Restoration:
 - 1. Restore to the better of the following:
 - a. Original condition.
 - b. Requirements of the Contract Documents.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

Not used.

END OF SECTION 01 18 13

SECTION 01 21 13 – CASH ALLOWANCES

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 provides for cash allowances which are included in the Contract Sum.

1.3 SCHEDULE OF ALLOWANCES

- A. Include in the Contract Sum the following amounts:
 - 1. The amount of \$ 5,000 for temporary ground protection, temporary dumpster cover (if required) and the repair of landscaping, lawn, and other foliage once the construction dumpster is removed at the completion of the Project.

1.4 CASH ALLOWANCES

- A. Costs Associated With Allowances:
 - 1. All costs which are associated with allowances, but are not specifically defined in the Schedule of Allowances, paragraph 1.3 of this Section, shall be included in the Base Bid.
 - 2. Associated costs not specifically defined in the Schedule of Allowances may include, but are not necessarily limited to:
 - a. Unloading.
 - b. Handling on the Site.
 - c. Labor.
 - d. Installation.
 - e. Overhead.
 - f. Profit.

1.5 ADJUSTMENT OF COSTS

- A. Change Order: To adjust Contract Sum if final cost is different from allowance.
- B. Documentation:
 - 1. Submit:
 - a. Within 60 days after completion of the work under the allowance.
 - b. Documentation of actual costs.
 - 2. Failure to submit claims within the designated time will constitute a waiver of claims for additional costs.
 - 3. At Contract closeout, reflect all approved changes in Contract amounts in the final statement of accounting.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

Not used.

END OF SECTION 01 21 13

SECTION 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 Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

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

1.3 DEFINITION

- A. Unit Price: A unit price is an amount proposed by Bidders and stated on the Bid Form as a price per unit of measurement for materials or services that will be added to or deducted from the Contract Sum by Change Order if estimated quantities of Work required by the Contract Documents are increased or decreased

1.4 PROCEDURES

- A. Unit prices include necessary material, overhead, profit and applicable taxes.
- B. Refer to individual Sections
 - 1. For demolition or construction activities requiring establishment of unit prices.
 - 2. For requirements for materials and methods described under each unit price.
- C. Owner reserves the right to reject the Contractor's measurement of Work-in-place that involves the use of established unit prices, and to have this Work measured by an independent surveyor acceptable to the Contractor at the Owner's expense.
- D. List of Unit Prices: A schedule of unit prices is included in the Form of Proposal.
- E. List of Unit Prices: A schedule of unit prices is included in Part 3.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

- A. Schedule of Unit Price Items:
 - 1. Unit Price No. 1: Panel Joint at Inside Corner.
 - a. Provide a price to furnish and install a Flannery, Inc. Inside corner in the color champagne.
 - b. Unit of Measure: One joint.
 - c. Quantity: 1.
 - 2. Unit Price No. 2: Panel Joint.
 - a. Provide a price to furnish and install a Flannery, Inc. "H" channel in the color champagne.
 - b. Unit of Measure: One joint.
 - c. Quantity: 1.

END OF SECTION 01 22 00

SECTION 01 25 13 – PRODUCT SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. General provisions of the Contract, including Owner's Division 00, General and Supplementary Conditions, and Division 01 Specification Sections, apply to this Section.
- B. Division 01 provisions of the Construction Specification, and the Construction Drawings, apply to this Section.

1.2 SUMMARY

- A. This Section includes the administration of substitutions and Product options.

1.3 SUBMITTALS

- A. List of all products proposed for installation:
 - 1. Submit 5 copies within 30 days after the Effective Date of Agreement unless otherwise indicated elsewhere in the Contract Documents.
 - 2. Tabulate the list by each Specification Section.

1.4 CONTRACTOR'S OPTIONS

- A. Products specified only by reference standards or by description:
 - 1. Select any Product meeting the standards or description by any Supplier unless otherwise required elsewhere in the Contract Documents.
 - 2. Submit for Architect's review:
 - a. Name and address of Supplier.
 - b. Trade name.
 - c. Model or catalog designation.
 - d. Manufacturer's data including:
 - 1) Performance and test data
 - 2) Compliance with reference standards.
- B. Products specified by naming one or more suppliers without an "or equal" clause:
 - 1. Use specified Product of one of the Suppliers named.
 - 2. No substitutions.
- C. Products specified by naming one or more suppliers with an "or equal" clause:
 - 1. Indicates the option of selecting equivalent Products by stating "or equal" after the specified Suppliers.
 - 2. Architect may waive some or all of the requirements specified for substitutions if, at Architect's sole discretion, the proposed equivalent Product is considered an "or equal".
 - 3. If, at Architect's sole discretion, the proposed equivalent Product does not qualify as an "or equal", it will be considered as a proposed substitute and a substitution request submittal will be required.

1.5 SUBSTITUTIONS

- A. Substitutions after the effective date of agreement:
 - 1. Within 30 days after the Effective Date of Agreement.
 - 2. Architect will consider formal requests for substitution of Products in place of those specified unless otherwise prohibited elsewhere in the Contract Documents.
- B. Substitution Request Submittals: Submit 5 copies of the request for substitution including the following:
 - 1. Complete data substantiating compliance of the proposed substitution with the Contract Documents.
 - 2. For Products:
 - a. Names and addresses of Manufacturer and Supplier.
 - b. Product identification.

- c. Manufacturer's literature, including:
 - 1) Product description.
 - 2) Performance and test data
 - 3) Reference standards.
 - d. Samples.
 - e. Name and address of similar projects on which the Product was used and date of installation.
 - 3. For Construction Methods:
 - a. Detailed description of the proposed method.
 - b. Drawings illustrating methods.
 - 4. Itemized comparison of proposed substitution with Product or method specified.
 - 5. Data relating to changes in the construction schedule.
 - 6. Accurate cost data on the substitution and comparison with the Product or method specified.
 - 7. Changes to the Work which would be caused by the substitution.
- C. Contractor's Responsibilities: In making a request for a substitution, Contractor represents:
- 1. Contractor has personally investigated the proposed Product or method and determined that it is equal or superior in all respects to that which is specified.
 - 2. Contractor will provide the same guarantee for the substitution as for the Product or method specified.
 - 3. Contractor will coordinate installation of the accepted substitution into the Work making such changes as may be required for the Work to be completed in all respects.
 - 4. Contractor waives all claims for additional cost related to the substitution which consequently become apparent.
 - 5. Cost data is complete and includes all related costs under Contractor's contract, but excludes costs under separate contracts and Architect's redesign costs.
- D. Substitutions Not Considered: Substitutions will not be considered if:
- 1. They are indicated or implied on Shop Drawings or Product data submittals without formal request submitted in accordance with this Section.
 - 2. Acceptance will require substantial revision of the Contract Documents.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

Not used.

END OF SECTION 01 25 13

SECTION 01 26 13 – REQUESTS FOR INFORMATION

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 procedures for Contractor to give notice of conflicts, errors, ambiguities, or discrepancies in the Contract Documents.

1.3 DEFINITIONS

- A. Abbreviation: Request for Information (RFI).

1.4 REQUESTS FOR INFORMATION

- A. Format:
 - 1. Use the enclosed RFI form or, at Contractor's option, generate form.
 - 2. Minimum required content of Contractor's RFI form:
 - a. Project name.
 - b. Name and address of Contractor.
 - c. RFI number.
 - d. RFI date.
 - e. Name of initiator.
 - f. Complete written request, with sketches as required.
 - g. Signature of initiator.
 - h. Space for written response by Architect/Engineer, with signature and date of Architect/Engineer's representative.
- B. Procedures:
 - 1. Maintain a log of RFIs, including the RFI date and the date of the response.
 - 2. Allow at least 10 full working days for Architect/Engineer's response following Architect/Engineer's receipt of RFI.
 - 3. Submit written justification for shorter response time.
 - 4. Do not submit RFIs for information already included in the Contract Documents.
 - 5. Illegitimate RFIs may be cause for deductions in the Contract amount. See the Supplementary Conditions.
 - 6. RFIs submitted directly by subcontractors or vendors will be rejected.
 - 7. Changes in Contract Price or Contract Times not permitted within an RFI form.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.1 SCHEDULES

- A. Attached is the following form suggested for use on this project:
 - 1. Request for Information.

REQUEST FOR INFORMATION
PAGE 1 OF 1

CONTRACT FOR:	PROJECT NO.:
OWNER:	
CONTRACTOR:	
ARCHITECT/ ENGINEER:	
THE CONTRACTOR SHALL COMPLY WITH THE PROCEDURES IN DIVISION 01 SECTION "REQUESTS FOR INFORMATION."	

RFI No.: _____

FTCH Project Manager: _____

REQUEST		
RFI From:	Signature:	Date:

RESPONSE		
Response From:	Signature:	Date:

END OF SECTION 01 26 13

SECTION 01 31 13 – PROJECT COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. General provisions of the Contract, including Owner's Division 00, General and Supplementary Conditions, and Division 01 Specification Sections, apply to this Section.
- B. Division 01 provisions of the Construction Specification, and the Construction Drawings, apply to this Section.

1.2 SUMMARY

- A. This Section includes provisions for coordination of the Work.

1.3 GENERAL COORDINATION

- A. Coordinate scheduling, submittals and work of the various Sections of the Specifications to:
 - 1. Ensure efficient and orderly sequence of installation of interdependent construction elements.
 - 2. Provide for items to be installed later.
- B. Interrelated Operating Equipment:
 - 1. Verify that characteristics of elements are compatible.
 - 2. Coordinate work of various sections having interdependent responsibilities for:
 - a. Installation.
 - b. Connection.
 - c. Placing in service.
- C. Shutdown of Existing Systems: Complete the WSU Building Notification Form regarding all impacts to the building and forward for approval 7 calendar days in advance of any shutdown of, or impact to, existing building systems.
- D. In finished areas, except as otherwise indicated:
 - 1. Conceal pipes, ducts and wiring in the construction.
 - 2. Coordinate locations of fixtures and outlets with finish elements.

1.4 ACCEPTANCE OF CONDITIONS

- A. Inspection:
 - 1. Prior to performing any work under a section:
 - a. Carefully inspect the installed work.
 - b. Verify that all such work is complete to the point where the work under that Section may properly commence.
 - c. Starting of work indicates acceptance of the condition of components to which the work will be applied.
 - 2. Verify that all materials, equipment and Products to be installed under a Section may be installed in strict accordance with the original design and reviewed Shop Drawings.
- B. Discrepancies:
 - 1. Resolve all discrepancies and conflicts between the trades.
 - 2. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

1.5 SLEEVES AND INSERTS

- A. Function: For pipes, conduits and similar items in forms, walls, partitions and floors.
- B. Trades: Furnish required sleeves and inserts.

- C. Place sleeve and inserts in ample time so as to not delay work.
- D. Except as approved by Architect, do not place sleeves vertically through:
 - 1. Beams.
 - 2. Girders.
 - 3. Similar construction.
- E. Maintain in proper position during subsequent work.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

Not used.

END OF SECTION 01 31 13

SECTION 01 31 19 – PROJECT MEETINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. General provisions of the Contract, including Owner's Division 00, General and Supplementary Conditions, and Division 01 Specification Sections, apply to this Section.
- B. Division 01 provisions of the Construction Specification, and the Construction Drawings, apply to this Section.

1.2 SUMMARY

- A. This Section includes scheduling and administering of preconstruction and progress meetings.
- B. Scheduling and Administration of Meetings:
 - 1. Responsibility:
 - a. Preconstruction Meeting: Owner.
 - b. Progress Meetings: Contractor.
 - 2. Procedures:
 - a. Prepare agenda.
 - b. Distribute written notice and agendas of meetings 4 days in advance of the meeting date.
 - c. Make physical arrangements for the meetings.
 - d. Preside at meetings.
 - e. Record minutes and include significant proceedings and decisions.
 - f. Distribute copies of the minutes within 4 days after meetings to:
 - 1) Participants.
 - 2) Others affected by proceedings.

1.3 PRECONSTRUCTION MEETING

- A. Schedule: Preconstruction meeting will be scheduled by Owner:
 - 1. Before starting the Work at the Site.
- B. Attendance: Representatives of the following parties are to be in attendance at the meeting:
 - 1. Owner.
 - 2. Architect/Engineer.
 - 3. Contractor.

1.4 PROGRESS MEETINGS

- A. Types of Progress Meetings:
 - 1. Regular.
 - 2. Called.
- B. Schedule meetings as follows unless otherwise approved by Architect:
 - 1. Regular: Bi-Weekly.
 - 2. Called: As the progress of the Work dictates.
- C. Location: Hold meetings at Site or as indicated in the notice.
- D. Attendance: Representatives of the following parties are to be in attendance at the meeting:
 - 1. Architect/Engineer.
 - 2. Contractor.
 - 3. Owner's representative as appropriate.

- E. Minimum Agenda: The minimum agenda for progress meetings shall consist of the following:
1. Review and approve minutes of previous meetings.
 2. Review safety procedures and protocols.
 3. Review progress of the Work since the previous meeting.
 4. Note field observations, problems and decisions.
 5. Identify problems which impede planned progress.
 6. Develop corrective measures and procedures to regain approved schedule.
 7. Revise construction schedule as indicated.
 8. Review submittal schedules; expedite as required to maintain schedule.
 9. Maintenance of quality and work standards.
 10. Review changes proposed by Owner for their effect on the construction schedule and completion date.
 11. Identify all claims and potential claims.
 12. Pending changes and substitutions.
 13. Complete other current business.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

Not used.

END OF SECTION 01 31 19

SECTION 01 32 16 – CONSTRUCTION PROGRESS SCHEDULE

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 preparation, furnishing, distribution and periodic revision of construction progress schedules.

PART 2 - PRODUCTS

2.1 FORM OF SCHEDULE

- A. Preparation:
 - 1. Prepare in the form of a horizontal bar chart, CPM network, or other form as approved by the Architect prior to submission.
 - 2. Provide a separate horizontal bar column or path for each trade or operation.
 - 3. Prepare the schedule in the chronological order of the beginning of each item of work.
 - 4. Identify each column or path by:
 - a. Major Specification Section number.
 - b. Distinct graphic delineation.
 - 5. Use a horizontal time scale and identify the first work day of each week.
 - 6. Allow space for updating.
- B. Size: The schedule sheets shall be 11 inches x 17 inches unless otherwise approved by the Architect.

2.2 CONTENT OF SCHEDULES

- A. Construction Sequence:
 - 1. Provide a complete sequence of construction by activity Milestones.
 - 2. For Shop Drawings, project data and Samples indicate the following:
 - a. Submittal dates.
 - b. Dates review copies will be required.
 - 3. Show decision dates for selection of finishes.
 - 4. Show Product procurement and delivery dates.
 - 5. Show dates for beginning and completion of each element of construction.
- B. Percentage Completion: Show the projected percentage of completion for each item of work as of the first day of each month.
- C. Subschedules:
 - 1. Provide separate subschedules showing submittals, review times, procurement schedules and delivery days.
 - 2. Provide subschedules to define critical portions of the entire schedule.

PART 3 - EXECUTION

3.1 SUBMITTAL

- A. Preliminary Schedule:
 - 1. Submit the preliminary schedule within 10 days after the date of the Owner's signature on the Agreement Supplement.
 - 2. The Architect will review schedule and will return the reviewed copy within 15 days after receipt.
 - 3. If required, resubmit within 7 days after receipt of a returned review copy.
 - 4. Upon request, meet with the Architect at least 10 days prior to the submission of the first Application for Payment to review the schedule.
- B. Periodic Adjustment: Monthly, submit a revised schedule accurately depicting adjustments and progress to the first day of each month.
- C. Number of Copies: Submit the number of copies required by the Contractor, plus 4 copies to be retained by the Architect.

3.2 DISTRIBUTION

- A. Reviewed Schedules: Distribute copies of the reviewed schedules to:
 - 1. Job site file.
 - 2. Subcontractors.
 - 3. Other concerned parties.
- B. Instructions to Recipients: Instruct recipients to report inability to comply with the schedule, and provide detailed explanations with suggested remedies.

3.3 ADJUSTMENT OF PROGRESS SCHEDULE

- A. Changes: Show changes occurring since previous submission of the schedule.
- B. Progress: Indicate progress of each activity and show completion dates.
- C. Other Items:
 - 1. Include major changes in scope.
 - 2. Include activities modified since previous updating.
 - 3. Include revised projections due to changes.
 - 4. Include other identifiable changes.
- D. Narrative Report:
 - 1. Provide a narrative report including:
 - a. A discussion of problem areas including current and anticipated delay factors and their impact.
 - b. Direct action taken, or proposed, and its effect.
 - c. A description of revisions including:
 - 1) Their effect on the schedule due to change of scope.
 - 2) Revisions in duration of activities.
 - 3) Other changes that may affect the schedule.
 - d. The status of completion of Milestones.

END OF SECTION 01 32 16

SECTION 01 33 00 – SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. General provisions of the Contract, including Owner's Division 00, General and Supplementary Conditions, and Division 01 Specification Sections, apply to this Section.
- B. Division 01 provisions of the Construction Specification, and the Construction Drawings, apply to this Section.

1.2 SUMMARY

- A. This Section includes procedures for the submittal of Shop Drawings, Product Data, Samples, Operation and Maintenance Manuals, and other information.
- B. Related Sections include pertinent Sections of these Specifications for the individual Submittals required.
- C. Submittal of samples to be in duplicate with Owner and A/E each receiving full submittal.

1.3 DEFINITIONS

- A. Submittal: Information sent by Contractor to convey information about systems, equipment, materials, products, and administrative matters for the Work.
- B. Resubmittal: Submittal sent for review a second or further time.
- C. Product Data: Illustrations, standard schedules, diagrams, performance charts, instructions, brochures, or manufacturer's literature that describe the physical size, appearance, and other characteristics of materials or equipment for a portion of the Work.
- D. Shop Drawings: Drawings, diagrams, illustrations, schedules, and other data or information which are specifically prepared or assembled by or for Contractor and submitted by Contractor to illustrate some portion of the Work.
- E. Samples: Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and which establish the standards by which such portion of the Work will be judged.
- F. Action Submittals: Submittals that require A/E's response.
- G. Informational Submittals: Submittals that do not require A/E's response.
- H. Delegated-Design: In certain individual Specification Sections, design services or certifications by a design professional that are specifically delegated to the Contractor. Performance and design criteria are defined in the individual Specification Sections or on the Drawings. Contractor is solely responsible for design of those items or systems, and achieving specified performance.
- I. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

1.4 SUBMITTAL PROCEDURES

A. Submittal Schedule:

1. Prepare and submit a Submittal schedule that identifies the following for each Submittal:
 - a. Submittal number
 - b. Submittal description
 - c. Projected date Submittal will be submitted; based on when material is required on the job and in support of the project completion date.
2. An electronic copy (MS Excel file) of a blank Submittal schedule, in the preferred format, will be furnished by Architect at the preconstruction meeting.
3. Submittal Numbers:
 - a. Use the applicable Specification Section number followed by a decimal point and then a sequential number (e.g., 06 10 00.1). Where a Submittal is required via a Drawing (instead of a Specification Section), use the applicable Drawing Number followed by a decimal point and then a sequential number (e.g., M501.1.1).
 - b. Resubmittals shall include a letter suffix after another decimal point (e.g., 06 10 00.1.A).
 - c. Submittals that are not numbered correctly may be rejected.

B. Delivery Method:

1. Submittals may be delivered as paper copies or electronic files at Contractor's option.
2. Advise A/E of delivery method to be used at the preconstruction meeting.
3. Where Submittals include information that is intended to be printed on sheets larger than 11 inches x 17 inches, or where scale or drawing size are critical for proper review, submit 3 paper copies for review.
4. Paper Copies:
 - a. Unless indicated otherwise, submit 3 copies of each Submittal.
 - b. One copy of each Action Submittal will be returned to Contractor.
 - c. Extra copies submitted by Contractor will be discarded.
5. Electronic Files:
 - a. Unless indicated otherwise, submit 1 copy of each Submittal in PDF format.
 - b. Scanned Submittals shall be produced in such a way as to not compromise the graphic quality or accuracy of scale, where applicable; and text shall be searchable.
 - c. One copy of each Action Submittal will be returned to Contractor.
 - d. Submittals may be transmitted via electronic mail (e-mail) or on a CD or DVD. Submittals that are transmitted electronically may be returned electronically at the Architect's discretion.
6. Transmit Submittals to party and address identified by Architect/Engineer at preconstruction meeting.

C. Coordination and Timing: Coordinate preparation and processing of Submittals with performance of construction activities. Contractor is responsible for cost of delays caused by lack of coordination or tardiness of Submittals. Incomplete Submittals will be rejected.

1. Coordinate each Submittal with fabrication, purchasing, testing, delivery, other Submittals, and related activities that require sequential activity.
2. Coordinate transmittal of different types of Submittals for related parts of the Work so processing will not be delayed because of need to review Submittals concurrently for coordination.
 - a. Architect reserves the right to withhold action on a Submittal requiring coordination with other Submittals until related Submittals are received.

D. Processing Time: Allow 15 full working days for Architect to review each Submittal, including Resubmittals. Time for review shall commence on Architect's receipt of Submittal. No extension of the Contract Time will be authorized because of failure to transmit Submittals enough in advance of the Work to permit processing, including Resubmittals. Architect/Engineer will advise Contractor when a Submittal being processed must be delayed for coordination.

E. Identification: Place a permanent label on each Submittal or generate a separate cover sheet.

1. Indicate name of firm or entity that prepared Submittal.
2. Provide space to record Contractor's review and approval markings and action taken by Architect.
3. Include the following information:
 - a. Project name.
 - b. Date.
 - c. Name and address of Architect.

- d. Name and address of Contractor.
 - e. Name and address of Subcontractor(s).
 - f. Name and address of Supplier(s).
 - g. Name of Manufacturer.
 - h. Submittal number, including revision identifier.
 - i. Drawing number and detail references, as applicable.
 - j. Location(s) where product is to be installed, as applicable.
 - k. Other necessary identification.
 - F. Deviations: Encircle or otherwise specifically identify deviations from the Contract Documents on Submittals. Submittals that include deviations that are not identified may be rejected. Architect may or may not consider deviations. Deviations are not substitutions. Refer to Division 01 Section "Product Substitution Procedures" for procedures regarding requests for substitutions.
 - G. Transmittal: Package each Submittal individually and appropriately for transmittal and handling. Transmit each Submittal using a transmittal form. Architect will reject Submittal(s) received from sources other than Contractor.
 - H. Resubmittals: Make Resubmittals in same form and number of copies as initial Submittal.
 - 1. Note date and content of previous Submittal.
 - 2. Clearly identify additions and revisions.
 - 3. Resubmit Submittals until they are marked, "Reviewed, No Exceptions Noted" or "Reviewed With Corrections Noted."
 - I. Distribution: Furnish copies of Submittals with mark indicating, "Reviewed, No Exceptions Noted" or "Reviewed With Corrections Noted," to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities.
 - J. Use for Construction: Unless otherwise indicated by Architect, use only Submittals with mark indicating, "Reviewed, No Exceptions Noted" or "Reviewed With Corrections Noted."
- 1.5 CONTRACTOR'S USE OF ARCHITECT'S ELECTRONIC DRAWING FILES
- A. At Contractor's written request, copies of Architect's electronic Drawing files of the floor plans may be provided to Contractor for Contractor's use in connection with Project, including Submittal preparation. Electronic files may be furnished by Architect for the convenience of the Contractor. Conclusions or information obtained or derived from such electronic files will be at the Contractor's sole risk. Materials furnished by Architect that may be relied upon are limited to printed Contract Documents.
 - B. When Contractor uses Architect's electronic Drawing files to facilitate Submittal preparation, prepare Submittals to be project specific. Submittals that are not project specific, including Architect's Drawing files submitted on a new title block, will be rejected.

PART 2 - PRODUCTS

2.1 ACTION SUBMITTALS

- A. General: Prepare and submit project specific Action Submittals required by individual Specification Sections. Do not use highlighting that would not be reproducible.
- B. Product Data: Collect information into a single Submittal for each element of construction and type of product or equipment.
 - 1. If information must be specially prepared for Submittal because standard printed data are not suitable for use, submit as Shop Drawings, not as Product Data.
 - 2. Mark each copy of each Submittal to indicate which products and options are applicable.
 - 3. Include the following information, as applicable:
 - a. Manufacturer's written recommendations.
 - b. Manufacturer's product specifications.
 - c. Manufacturer's installation instructions.

- d. Color charts as required by individual Specification Sections.
 - e. Manufacturer's catalog cuts.
 - f. Wiring diagrams showing factory-installed wiring.
 - g. Printed performance curves.
 - h. Operational range diagrams.
 - i. Mill reports.
 - j. Standard product operation and maintenance manuals.
 - k. Compliance with specified referenced standards.
 - l. Testing by recognized testing agency.
 - m. Application of testing agency labels and seals.
 - n. Notation of coordination requirements.
 4. Submit Product Data before or concurrent with Samples.
 5. Maintain copy of returned Submittal for Project records.
- C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale where appropriate. Scale shall be sufficiently large to indicate pertinent features of the item and its method of connection to the Work.
 1. Preparation: Fully illustrate requirements of the Contract Documents. Include the following information, as applicable:
 - a. Dimensions.
 - b. Identification of products.
 - c. Fabrication and installation drawings.
 - d. Colors and materials as applicable.
 - e. Roughing-in and setting diagrams.
 - f. Wiring diagrams showing field-installed wiring, including power, signal, control, and communication wiring. Differentiate between Manufacturer-installed and field-installed wiring.
 - g. Manufacturing instructions.
 - h. Templates and patterns.
 - i. Schedules.
 - j. Calculations.
 - k. Compliance with specified standards.
 - l. Notation of coordination requirements.
 - m. Notation of dimensions established by field measurement.
 - n. Relationship to adjoining construction clearly indicated.
 2. Sheet Size: Submit Shop Drawings on sheets at least 8-1/2 inches x 11 inches but no larger than 36 inches x 48 inches.
 3. Maintain copy of returned Submittal for Project records.
- D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements, and for a comparison of these characteristics between Submittal and actual component as delivered and installed.
 1. Transmit Samples that contain multiple, related components, such as accessories, together in one Submittal package.
 2. Identification: On unexposed side of Samples, attach label that includes the following:
 - a. Generic description of Sample.
 - b. Product name and name of Manufacturer.
 - c. Sample source.
 - d. Number and title of appropriate Specification Section.
 3. Samples for Initial Selection: Submit Manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available. Where Contract Documents indicate custom color or material, coordinate production of custom Samples with the Architect and Manufacturer prior to submittal.
 - a. Number of Samples: Unless indicated otherwise, submit 3 full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from Manufacturer's product line. A/E will return 1 Sample with options selected.
 4. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, physically identical with material or product proposed for use, and that show full range of color and texture variations expected.
 5. Samples include, but are not limited to, the following: Partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.

6. Number of Samples: Unless indicated otherwise, submit 3 sets of Samples to A/E and 1 set to Owner. A/E will retain 1 Sample set; remainder will be returned. Owner will retain samples.
 - a. Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
 - b. If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.
 7. Disposition: Maintain sets of approved Samples at Site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used by A/E to determine final acceptance of construction associated with each set.
 - a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples shall be in an undamaged condition at time of Substantial Completion.
 - b. Samples not incorporated into the Work, or otherwise designated to become Owner's property, are the property of Contractor.
- E. Operation and Maintenance Manuals:
1. General:
 - a. Where manuals are required to be submitted covering items included in the Work, prepare such manuals in durable plastic binders approximately 8-1/2 inches X 11 inches in size and with at least the following:
 - 1) Identification on, or readable through, the front cover stating general nature of the manual.
 - 2) Neatly typewritten index near the front of the manual.
 - 3) Complete instructions regarding operation and maintenance of equipment involved, including:
 - a) Equipment function, normal operating characteristics, and limiting conditions.
 - b) Assembly, installation, alignment, adjustment, and checking instructions.
 - c) Operating instructions for start-up, routine and normal operating, regulation and control, shutdown, and emergency conditions.
 - d) Maintenance instructions, including lubrication requirements where applicable.
 - e) Guide to "troubleshooting".
 - f) Parts lists and predicted life of parts subject to wear.
 - g) Project specific outline and cross sections, assembly drawings, Architecting data, and wiring diagrams. Wiring diagrams shall reflect final, as-installed conditions and include wire numbers.
 - h) Test data and performance curves.
 - 4) Complete nomenclature of all replaceable parts, their part numbers, current costs, and name and address of nearest vendor of parts.
 - 5) Copies of guarantees and warranties issued.
 - 6) Copies of the reviewed Submittals.
 - 7) Copies of data concerning changes made during construction.
 2. Extraneous Data: Where contents of the manuals include Manufacturer's catalog pages, clearly indicate the precise items included in this installation and delete all Manufacturers' data with which this installation is not concerned. Do not use highlighting that would not be reproducible.
 3. Number of Copies Required: Unless otherwise specifically directed by A/E, or stipulated in the pertinent Section of these Specifications:
 - a. For review, submit 1 paper and 1 electronic copy.
 - b. For record, deliver 4 paper and 1 electronic copies to A/E and Owner.
 4. Schedule delivery of record copies of operation and maintenance manuals at least 60 days prior to startup of respective equipment, unless otherwise specified.

2.2 INFORMATIONAL SUBMITTALS

- A. General: Prepare and submit Informational Submittals required by individual Specification Sections. Do not use highlighting that would not be reproducible.
- B. Certificates and Certifications: Provide a notarized statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.

- C. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, names and addresses of architects/Architects and owners, and other information specified.
- D. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification (WPS) and Procedure Qualification Record (PQR) on AWS forms. Include names of firms and personnel certified.
- E. Installer Certificates: Prepare written statements on Manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by Manufacturer for this Project.
 - 1. Special attention to Low Voltage Electrical System installer.
- F. Manufacturer Certificates: Prepare written statements on Manufacturer's letterhead certifying that Manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
- G. Product Certificates: Prepare written statements on Manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- H. Material Certificates: Prepare written statements on Manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- I. Material Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
- J. Product Test Reports: Prepare written reports indicating current product produced by Manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by Manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
- K. Research/Evaluation Reports: Prepare written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
 - 1. Name of evaluation organization.
 - 2. Date of evaluation.
 - 3. Time period when report is in effect.
 - 4. Product and manufacturers' names.
 - 5. Description of product.
 - 6. Test procedures and results.
 - 7. Limitations of use.
- L. Preconstruction Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
- M. Compatibility Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
- N. Field Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents; such as, but not limited to WSU C&IT test report requirements.

- O. **Manufacturer's Instructions:** Prepare written or published information that documents Manufacturer's recommendations, guidelines, and procedures for installing or operating a product or equipment. Include name of product and name, address, and telephone number of Manufacturer. Include the following, as applicable:
 - 1. Preparation of substrates.
 - 2. Required substrate tolerances.
 - 3. Sequence of installation or erection.
 - 4. Required installation tolerances.
 - 5. Required adjustments.
 - 6. Recommendations for cleaning and protection.
- P. **Manufacturer's Field Reports:** Prepare written information documenting tests and inspections of factory-authorized service representative. Include the following, as applicable:
 - 1. Name, address, and telephone number of factory-authorized service representative making report.
 - 2. Statement of substrate condition and acceptability of substrate for installation or application of product.
 - 3. Statement that products at Site comply with requirements.
 - 4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
 - 5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 - 6. Statement whether conditions, products, and installation will affect warranty.
 - 7. Document settings in writing.
 - 8. Other required items indicated in individual Specification Sections.
- Q. **Material Safety Data Sheets (MSDSs):** Submit information directly to Owner; do not submit to A/E.
 - 1. A/E will not review Submittals that include MSDSs and will return the entire Submittal for Resubmittal.

2.3 DELEGATED-DESIGN SUBMITTALS

- A. Where design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
- B. Performance type design documents and calculations shall be prepared by a design professional as required by the individual Specification Section, licensed in the State where the Project is being constructed. Design documents shall be signed and sealed by the responsible design professional. Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Identify name and version of software, if any, used for calculations.
- C. In addition to Shop Drawings, Product Data, and other required Submittals, submit two copies of a statement, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

- A. Review each Submittal and check for coordination with other work of the Contract and for compliance with the Contract Documents. Verify field dimensions and conditions; note corrections as necessary. Mark with approval stamp before submitting to A/E.
 - 1. **Approval Stamp:** Stamp each Submittal with an approval stamp. Use the same stamp format for each Submittal. Include Project name and location, Submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that Submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

- B. Submittals that are not approved and stamped by Contractor will be rejected.

3.2 POSTING

- A. Contractor to post reviewed submittals and shop drawings to a FTP site; and provide access to Owner, Architect, and all other project team members.

3.3 A/E'S REVIEW

- A. Action Submittals: A/E will review Action Submittals, make marks to indicate corrections or modifications required, and return Submittal. A/E will stamp each Submittal with an action stamp and will mark stamp appropriately to indicate action taken, as follows:
 - 1. Reviewed, No Exceptions Noted: Submittal appears to conform to the information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.
 - 2. Reviewed With Corrections Noted: Upon incorporation of review comments, it appears that Submittal will conform to the information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.
 - 3. Revise and Resubmit: Submittal has one or more specific segments that are incomplete, do not appear to conform to the information given in the Contract Documents, or are incompatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. Contractor shall resubmit information for review to demonstrate understanding of comments and portions of Work to be provided. Except as noted, Contractor shall not proceed with work related to Submittal.
 - 4. Rejected, Resubmit: Submittal as a whole is incomplete, does not appear to conform to the information given in the Contract Documents, or is incompatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. Contractor shall resubmit information for review to demonstrate understanding of comments and portions of Work to be provided. Contractor shall not proceed with work related to Submittal.
- B. Informational Submittals: Other Submittals required by the Contract Documents are for information only. A/E will acknowledge receipt of Informational Submittals. Such Submittals include, but are not limited to:
 - 1. Qualifications Data.
 - 2. Certificates.
 - 3. Test Reports.
 - 4. Manufacturer's Instructions.
 - 5. Maintenance Data.
 - 6. Field Reports.
- C. Delegated-Design Submittals: Review of Delegated-Design Submittals by A/E shall not relieve Contractor of Contractor's sole responsibility for design and achieving specified performance.
- D. Submittals not required by the Contract Documents will be returned without being reviewed.
- E. Partial Submittals are not acceptable, will be considered non-responsive, and will be rejected.

3.4 RE-REVIEW COSTS

- A. Compensation:
 - 1. Should A/E be required to review a Submittal more than twice because of failure of the Submittal to meet the requirements of the Contract Documents, A/E will record A/E's expenses for performing additional reviews.
 - 2. Owner will compensate A/E for these additional services and deduct the amount paid from payments to Contractor.

END OF SECTION 01 33 00

SECTION 01 42 00 – REFERENCES

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 provisions for references throughout the Contract Documents.

1.3 DEFINITIONS

- A. Abbreviations:
 1. AASHTO - American Association of State Highway and Transportation Officials, 444 North Capitol Street, N.W., Suite 249, Washington, DC 20001.
 2. ACI - American Concrete Institute, 38800 Country Club Dr., Box 9094, Farmington Hills, MI 48333.
 3. AISC - American Institute of Steel Construction, Inc., One East Wacker Dr., Suite 3100, Chicago, IL 60601-2001.
 4. AITC - American Institute of Timber Construction, 7012 S. Revere Pkwy., Suite 140, Englewood, CO 80112.
 5. ANSI - American National Standards Institute, 11 West 42nd St., 13th Floor, New York, NY 10018.
 6. APA - American Plywood Association, P.O. Box 11700, Tacoma, WA 98411.
 7. ASTM - American Society for Testing and Materials, 100 Barr Harbor Dr., West Conshohocken, PA 19428-2959.
 8. AWS - American Welding Society, Inc., 550 LeJeune Road, Miami, FL 33126.
 9. AWWA - American Water Works Association, 6666 West Quincy Avenue, Denver, CO 80235.
 10. CPA – Composite Panel Association, 19465 Deerfield Avenue, Suite 306, Leesburg, VA 20176.
 11. CRSI - Concrete Reinforcing Steel Institute, 933 Plum Grove Road, Schaumburg, IL 60173-4758.
 12. EGLE – Michigan Department of Environment, Great Lakes and Energy, P.O. Box 30473, Lansing, MI 48909
 13. MDNR - Michigan Department of Natural Resources, P.O. Box 30028, Lansing, MI 48909.
 14. MDOT - Michigan Department of Transportation, State Transportation Bldg., 425 W. Ottawa St., Lansing, MI 48909.
 15. MDPH - Michigan Department of Public Health, P.O. Box 30035, Lansing, MI 48909.
 16. MIOSHA - Michigan Safety Standards Division, State Secondary Complex, 7150 Harris Drive, P.O. Box 30015, Lansing, MI 48909.
 17. NCMA - National Concrete Masonry Association, 2302 Horse Pen Rd., Herndon, VA 22070-3406.
 18. NEC - National Electrical Code (see NFPA 70).
 19. NEMA - National Electrical Manufacturers' Association, 13100 N. 17th Street N.W., Suite 1846, Washington, DC 20037.
 20. NFPA - National Fire Protection Association, One Batterymarch Park, Quincy, MA 02269-9101.
 21. PCI - Precast Concrete Institute, 209 West Jackson Blvd., Suite 500, Chicago, IL 60606.
 22. SDI - Steel Deck Institute, P.O. Box 25, Fox River Grove, IL 60021.
 23. SJI - Steel Joist Institute, 3127 10th Avenue N., Myrtle Beach, SC 29577-6760.
 24. UL - Underwriters' Laboratories, Inc., 333 Pfingsten Road, Northbrook, IL 60062.

1.4 REFERENCES

- A. The provisions of the Contract Documents shall govern over any conflicting provisions of the referenced documents.
- B. The provisions of laws and regulations shall govern over any conflicting provisions of the referenced documents.

- C. Comply with the referenced document that is in effect as of the Bid date, except when a specific date is specified.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

Not used.

END OF SECTION 01 42 00

SECTION 01 50 00 – TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. General provisions of the Contract, including Owner's Division 00, General and Supplementary Conditions, and Division 01 Specification Sections, apply to this Section.
- B. Division 01 provisions of the Construction Specification, and the Construction Drawings, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following items to facilitate construction:
 - 1. Temporary Utilities: Water, electricity, and telephone.
 - 2. Contractor's field offices.
 - 3. Sanitary facilities.
 - 4. Temporary heat.
 - 5. Temporary partitions.
 - 6. Storage areas.
 - 7. Project signs.

1.3 SUBMITTALS

- A. Samples: For construction project identification sign.
 - 1. Required Sample:
 - a. 11 x 17 color proofs of sign representing actual appearance of sign producer's final product.
 - b. Created by sign producer.
 - 2. Submit and obtain review by Architect prior to printing final version of vinyl.

1.4 STORAGE AREAS

- A. Locations:
 - 1. Interior: There will be no predesignated interior storage area(s) for contractor use.
 - a. Storage needs beyond what can be accommodated within the limits of the area under construction will be considered by the Owner on an individual basis.

PART 2 - PRODUCTS

2.1 UTILITIES

- A. Temporary Utilities:
 - 1. Water: Obtain water by connection to Owner's existing water system.
 - 2. Electricity:
 - a. Obtain electrical power by connecting to Owner's existing system.
 - b. Furnish, install, remove and pay for all temporary wiring, equipment switches, panels, connections and transformers.
 - c. Furnish, install, remove, and pay for area distribution boxes so located that power and artificial lighting are located at all points where required by the Work.
 - 3. Construction Telephones: Responsibility of General Contractor.
 - 4. Construction Lighting: Responsibility of General Contractor.
 - a. Provide lighting levels meeting minimum requirements for proper performance and observation of the work.
 - b. Existing lighting fixtures to be demolished may remain in place if not prohibiting execution of work.
 - 5. Sanitary Facilities: Specific restrooms within the building will be designated for contractor use.
 - a. Condition of facilities to be maintained in clean and orderly fashion.

2.2 FIELD OFFICES

- A. Contractor's Field Office:
 - 1. No trailer will be allowed on University property.
 - 2. Contractor's office functions to be handled within limits of construction.

2.3 CONSTRUCTION HEATING

- A. Permanent Heating Equipment:
 - 1. Prior to use in areas of construction, provide adequate means to keep internal duct and acoustic liner surfaces clean and in a like-new condition.
 - 2. Filters:
 - a. Securely supported at each return and exhaust air open duct end and grille.
 - b. Support filter length at required intervals to prevent filter deformation.
 - c. Replaced at intervals required to keep internal duct and acoustic liner surfaces free of construction debris and dust.
 - 3. At substantial completion of space(s) being served in the work area, ductwork used by Contractor shall be cleaned to Engineer's satisfaction.
- B. Temperatures:
 - 1. Except as otherwise called for, a minimum temperature of 50 degrees F and a maximum temperature of 75 degrees F in construction areas shall be maintained at all times.
 - a. Maintain typical temperatures in areas of general building use.
 - 2. See requirements of various other Sections of these Specifications for minimum temperature to be maintained for the application of work under the various trades.

2.4 TEMPORARY PARTITIONS

- A. Provide separation between public areas and work area, where existing door or wall is temporarily removed.
 - 1. Wall must have smoke/fire rating as required by Code and AHJ.
 - 2. Wall must not damage existing surfaces to remain.
 - 3. See Drawings for specific requirements.

2.5 STORAGE AREAS

- A. Construction materials and supplies to be kept within the confines of the work areas.

2.6 PROJECT IDENTIFICATION SIGNAGE

- A. No signage announcing names of parties involved with construction process will be allowed on University property.

PART 3 - EXECUTION

3.1 REMOVAL

- A. Maintain all temporary facilities and controls as long as needed for the safe and proper completion of the Work. Remove all such temporary facilities and controls as rapidly as progress of the Work will permit. Remove exterior sign when directed to by Owner.

END OF SECTION 01 50 00

SECTION 01 66 00 – PRODUCT STORAGE AND HANDLING REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. General provisions of the Contract, including Owner's Division 00, General and Supplementary Conditions, and Division 01 Specification Sections, apply to this Section.
- B. Division 01 provisions of the Construction Specification, and the Construction Drawings, apply to this Section.

1.2 SUMMARY

- A. This Section includes provisions for the storage and protection of Products.

1.3 STORAGE AND PROTECTION

- A. Delivery: All contractor deliveries to be supervised, received at the loading dock, and routed coordinated in advance with the Dock manager. Large material deliveries and large items are not allowed through the main entrance.
- B. Storage:
 - 1. Maintain ample way for foot traffic at all times, except as otherwise approved by A/E or Owner.
 - 2. Repair or replace property damaged by reason of storing of material at no additional cost to Owner.
 - 3. Packaged Materials:
 - a. Delivered in original, unopened containers.
 - b. Stored until ready for use.
 - 4. Materials shall meet the requirements of these Specifications at the time that they are used in the Work.
 - 5. Store Products in accordance with Manufacturer's instructions.
- C. Protection:
 - 1. Use all means necessary to protect the:
 - a. Products of every Section before, during and after installation.
 - b. Installed work and materials of all trades.
 - 2. All materials shall be delivered, stored and handled to prevent:
 - a. The inclusion of foreign materials.
 - b. Damage by water, breakage or other causes.
- D. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of Architect/Engineer and at no additional cost to Owner.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

Not used.

END OF SECTION 01 66 00

SECTION 01 71 36 – MONITORING OF EXISTING CONDITIONS

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 monitoring of building cracks.

1.3 SYSTEM DESCRIPTION

- A. Crack Monitoring: Instrumentation permitting the widths of existing cracks to be measured and reported.

1.4 PERFORMANCE REQUIREMENTS

- A. Contractor's Responsibilities:
 - 1. Contractor will be held responsible for damage to structures or buildings due to contractual activities.
 - 2. Repair or replace damaged structures or buildings in a timely fashion and to the satisfaction of the property owner and Owner and at no cost to property owner or Owner.
- B. Contractor's Responsibilities:
 - 1. Contractor will be held responsible for damage to structures or buildings due to contractual activities.
 - 2. Repair or replace damaged structures or buildings in a timely fashion and to the satisfaction of the property owner and Owner and at no cost to property owner or Owner.
- C. Measuring and Reporting: By Contractor.

1.5 SEQUENCING AND SCHEDULING

- A. Install monitoring systems and take initial readings prior to commencement of construction activities.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. All materials and workmanship shall conform to the requirements of other Sections of the Specifications.
 - 1. Where no materials are specified in these specifications, use materials of an equivalent type, quality, and size to match those existing in other areas of the facility.
 - 2. If none exist, use materials and workmanship recognized as of the highest quality in the industry.
 - 3. Obtain Architect's review of all such material and workmanship.
- B. Settlement Markers: Stainless steel nails or stainless steel screw anchors.
- C. Crack Monitors:
 - 1. Avongard Calibrated Crack Monitors; or approved equal.
 - 2. Capable of measuring crack displacement and rotation to 1 mm.
 - 3. May include use of steel pins or other appropriate devices driven or grouted into concrete.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Preconstruction Survey:
 - 1. Conducted by Contractor and witnessed by Architect following award of Contract and before beginning construction.
 - 2. At Contractor's expense and documented by Contractor in the form of:
 - a. Pictures.
 - b. Field notes.
 - 3. Include an assessment of existing structural conditions and documentation of cracks as identified by Architect and Contractor.

3.2 INSTALLATION AND MONITORING

- A. Crack Monitoring:
 - 1. For bidding purposes, make provisions for 5crack monitors at locations to be identified by Architect following the preconstruction survey to be conducted by Contractor.
 - 2. Monitor crack monitors as follows:
 - a. Daily for 1 week prior to beginning activities that may affect cracks.
 - b. Daily during activities that may affect cracks.
 - c. Daily for 1 week after completion of activities that may affect cracks.
 - 3. At end of construction, remove monitors and repair surfaces to match existing.

3.3 CLEANING

- A. Clean materials installed under this Section in accordance with Division 01 Section "Cleaning and Waste Management."

END OF SECTION 01 71 36

SECTION 01 73 29 – CUTTING AND PATCHING

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 provisions for cutting and patching work.
- B. Requirements:
 - 1. Cutting and patching may be described in various Sections of these Specifications
 - 2. Execute cutting or patching of work required to:
 - a. Make several parts fit properly.
 - b. Uncover work to provide for installation of ill-timed work.
 - c. Remove and replace defective work.
 - d. Remove and replace work not conforming to the requirements of the Contract Documents.
 - e. Remove Samples of the installed work as specified for testing.
 - f. Install specified work in existing construction.
- C. Requirements Upon Architect/Engineer's Instructions:
 - 1. In addition to Contract requirements, upon written instruction of Architect/Engineer:
 - a. Uncover work to provide for Architect/Engineer's observation of covered work.
 - b. Remove Samples of installed materials for testing.
 - c. Remove work to provide for alteration of existing work.
- D. Protection of Work:
 - 1. Do not endanger any work by cutting or altering the work or any part of it.
 - 2. Do not cut or alter the work of another trade without written consent of Architect/Engineer.

1.3 SUBMITTALS

- A. Written Notice:
 - 1. Prior to cutting which may affect the structural integrity of the Project or the work of another trade, submit written notice to Architect/Engineer and Owner requesting consent to proceed with cutting.
 - 2. Required Information:
 - a. Identification of Project.
 - b. Description of all related defective work.
 - c. Necessity for cutting.
 - d. Affect on other work or on the structural integrity of the Project.
 - e. Description of the proposed work including:
 - 1) Scope of cutting and patching.
 - 2) Subcontractor and trades to execute work.
 - 3) Products proposed to be used.
 - 4) Extent of refinishing.
 - f. Alternatives to cutting and patching.
 - g. Designation of party responsible for the cost of cutting and patching.
- B. Changes of Materials or Methods:
 - 1. Should conditions of the Work, or the schedule, indicate change of materials or methods, submit a written recommendation to Architect/Engineer including:
 - a. Conditions indicating the change.
 - b. Recommendations for alternative materials or methods.
 - c. Submittals as required for substitutions.

- C. Uncovered Work: Submit written notice to Architect/Engineer's designating the time work will be uncovered to provide for observation.

1.4 DIVISION OF WORK

- A. Work:
 - 1. In accordance with the General Conditions, Contractor is responsible for dividing the Work among the Subcontractors and Suppliers and for delineating the work to be performed by specific trades.
 - 2. The following are suggestions as to how the Work may be divided. This is not a complete list of all the Work:
 - a. Each trade shall be financially responsible for all cutting and patching for sleeves, penetrations and installation of isolated components as necessary for its work unless herein specifically stated to the contrary.
 - b. On renovation projects, Contractor shall cut and patch walls, floors, ceilings to allow for continuous runs of recessed utilities and ductwork.
 - c. All patching shall be done by the trade whose work is damaged.
 - d. Any cost caused by defective or ill-timed work shall be borne by the party responsible.
 - e. Each trade shall do all fitting of its own work as required to make its several components fit together or to receive the work of other contractors.
 - f. Holes cut in exterior walls or roofs for installation of mechanical or electrical equipment shall be waterproofed. If existing roofing is to remain, obtain and submit to Owner original roofing manufacturer's approval and warranty on new roof penetrations and where removing existing roof penetrations and curbs.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. All materials and workmanship shall conform to the requirements of other Sections of the Specifications. Where no materials are specified in these specifications, use materials of an equivalent type, quality, and size to match those existing in other areas of the facility. If none exist, use materials and workmanship recognized as of the highest quality in the industry. Obtain Architect/Engineer's review of all such material and workmanship.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Existing Conditions: Inspect existing conditions of the Work, including elements subject to movement or damage during cutting and patching or excavating and backfilling.
- B. Uncovered Work: After uncovering work, inspect conditions affecting the installation of new Products.

3.2 PREPARATION

- A. Shoring and Bracing: Provide shoring, bracing and support as required to maintain structural integrity of the Project.
- B. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

3.3 PERFORMANCE

- A. Adjustments to Products: Execute fitting and adjustments of Products to provide finished installation.

- B. Refinishing:
 - 1. Prepare existing surfaces for finishes by scraping, sanding, filling, acid etching, and sand blasting to ensure bonding and a smooth finish.
 - 2. Refinish entire surfaces as necessary to provide an even finish.
 - 3. Refinish continuous surfaces to the nearest intersection.
 - 4. Refinish entire assemblies.
- C. 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.
- D. 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. 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. 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.

3.4 CLEANING

- A. Clean materials installed under this Section in accordance with Division 01 Section "Cleaning and Waste Management."

END OF SECTION 01 73 29

SECTION 01 74 00 – CLEANING AND WASTE MANAGEMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes provisions for maintaining structures in a standard of cleanliness.
- B. Related Sections: In addition to standards described in this Section, comply with requirements for cleaning as described in various other Sections of these Specifications.

1.3 QUALITY ASSURANCE

- A. Inspection:
 - 1. Daily and more often if necessary.
 - 2. Conduct inspections to verify that requirements of cleanliness are being met.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Hazards Control:
 - 1. Volatile Wastes:
 - a. Store in covered metal containers.
 - b. Remove from premises daily.
 - c. Provide secondary containment for storage of hazardous materials, as required by Owner, governing authorities and agencies.
 - 2. Prevent accumulation of wastes which create hazardous conditions.
 - 3. Provide adequate ventilation during use of volatile or noxious substances.

1.5 PROJECT CONDITIONS

- A. Cleaning and Disposal:
 - 1. Conduct operations to comply with local ordinances and anti-pollution laws.
 - 2. Dumpster shall be located near building dumpster.
 - a. Dumpster shall not be placed concrete pad or sidewalk.
 - b. Allowance for associated dumpster located in Division 01 Section "Cash Allowances."
 - 3. Not Allowed:
 - a. Burning or burying of rubbish or waste materials on Site.
 - b. Disposal of volatile wastes in storm or sanitary sewers: Volatile wastes include, but are not limited to, mineral spirits, oil and paint thinner.
 - c. Disposal of wastes into streams or waterways.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Compatibility:
 - 1. Compatible with the surface being cleaned.
 - 2. Recommended by the Manufacturer of the material being cleaned.
 - 3. As reviewed by Architect/Engineer.

PART 3 - EXECUTION

3.1 PROGRESS CLEANING

- A. General:
 - 1. Store Materials:
 - a. In an orderly arrangement allowing maximum access.
 - b. Provide for the required protection of materials.
 - 2. Do not allow accumulation of scrap, debris, waste material and other items not required for construction of the Work.
 - a. Provide adequate storage for materials awaiting removal.
 - 3. Observe requirements for fire protection and protection of the environment.
- B. Buildings and Other Structures:
 - 1. Weekly, and more often if necessary:
 - a. Inspect.
 - b. Pick up scrap, debris and waste material; remove such items to the place designated for their storage.
 - c. Sweep interior spaces clean. Clean shall be defined to be free from dust and other material capable of being removed by reasonable diligence using a hand-held broom.
 - 2. Preparation for installation of succeeding material:
 - a. Clean the building or other structure or pertinent portion thereof:
 - 1) To the degree of cleanliness recommended by the Manufacturer of the succeeding material.
 - 2) Using equipment and materials required to achieve the required cleanliness.
 - 3. After installation of finish floor material:
 - a. Clean the finish floor daily at all times while work is being performed in the space in which finish materials have been installed.
 - 1) Clean as used above shall be defined to be free from all foreign material which, in the opinion of Architect/Engineer, may be injurious to the finish floor material.
 - 4. Schedule cleaning operations so that dust and other contaminants resulting from cleaning operations will not fall on wet, recently painted surfaces.

3.2 FINAL CLEANING

- A. Definitions for Clean: The level of cleanliness generally provided by commercial building maintenance subcontractors using commercial quality building maintenance equipment and materials.
- B. Prior to Completion of the Work:
 - 1. Remove from the Site all tools, surplus materials, equipment, scrap, debris and waste.
 - 2. Conduct final progress cleaning as described in Article 3.1 above.
- C. Project Areas, Adjacent Spaces, and General Building Areas:
 - 1. Interior:
 - a. Visually inspect interior surfaces.
 - b. Remove traces of soil, waste material, smudges and other foreign matter.
 - c. Remove traces of splashed materials from adjacent surfaces.
 - d. Remove paint droppings, spots, stains and dirt from finished surfaces using only the specified cleaning materials and equipment.
 - 2. Glass: Clean glass inside and outside.
 - 3. Polished Surfaces: To surfaces requiring the routine application of buffed polish, apply the specified polish as recommended by the Manufacturer of the material being polished.
- D. Timing: Schedule final cleaning as approved by Owner to enable Owner to accept a completely clean Project.

3.3 OWNER OCCUPANCY PRIOR TO SUBSTANTIAL COMPLETION AND ACCEPTANCE

- A. If Owner occupies the Work, or a portion of the Work, prior to Substantial Completion and acceptance, then the responsibilities for interim and final cleaning shall be determined by Architect in accordance with the Contract Documents.

END OF SECTION 01 74 00

SECTION 01 75 00 – STARTING AND ADJUSTING

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 provisions for the facility start-up and demonstration of the systems as follows:
 - 1. Equipment.
 - 2. Mechanical systems.

1.3 SUBMITTALS

- A. Preliminary Schedules:
 - 1. Submit 2 weeks prior to earliest proposed date.
 - 2. List time and date for the following for each system:
 - a. Start-up.
 - b. Demonstration to Owner's representative.
- B. Completion Reports:
 - 1. Submit within 1 week after each system demonstration.
 - 2. List time, date and persons present for the following for each system:
 - a. Start-up.
 - b. Demonstration to Owner's representative.
 - 3. Include Manufacturer's representative's report indicating:
 - a. Approval of installation.
 - b. Satisfactory start-up.
 - c. Functioning correctly.
 - 4. Indicate that demonstration and instructions were satisfactorily completed.

1.4 QUALITY CONTROL

- A. Manufacturer's Field Services:
 - 1. Provide when required by individual Section.
 - 2. Provide the following services except where indicated otherwise in individual Sections.
 - a. Inspect, check and approve system installation.
 - b. Supervise system start-up.
 - c. Provide written report indicating that system:
 - 1) Has been properly installed and lubricated.
 - 2) Is in accurate alignment.
 - 3) Is free from undue stress imposed by connecting lines or anchor bolts.
 - 4) Has been satisfactorily operated under full load conditions.
 - d. Demonstrate operation of system to the Owner's personnel.
 - e. Instruct the Owner's personnel on operation and maintenance of system.

1.5 PROJECT CONDITIONS

- A. Verify that:
 - 1. Excess packing and shipping bolts have been removed.
 - 2. Interdependent systems have been checked and are operational.

1.6 CORRECTION PERIOD

- A. Provide periodic continuing warranty services as necessary to ensure proper functioning of mechanical systems after occupancy of the Project, and for a period of 1 year after date of Substantial Completion.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 STARTING OF SYSTEMS

- A. Inspection:
1. Verify that Project conditions comply with requirements.
 2. Verify that status of Work meets requirements for starting of systems.
- B. Preparation:
1. Coordinate sequence for start-up of various systems including Owner-provided equipment if any.
 2. Notify the Architect/Engineer 7 days prior to start-up of each system.
 3. Have at hand during entire start-up process:
 - a. Contract Documents.
 - b. Shop Drawings.
 - c. Product Data.
 - d. Operation and Maintenance Data.
 4. Verify that each piece of equipment has been checked for:
 - a. Proper lubrication.
 - b. Drive rotation.
 - c. Belt tension.
 - d. Control sequence.
 - e. Other conditions which may cause damage.
 5. Verify control systems are fully operational in automatic mode.
 6. Verify that tests, meter readings and specific electrical characteristics agree with those specified by electrical equipment Manufacturer.
 7. Bearings:
 - a. Inspect for cleanliness, clean and remove foreign materials.
 - b. Verify alignment.
 - c. Replace defective bearings and those which run rough or noisy.
 - d. Grease as necessary and in accordance with Manufacturer's recommendations.
 8. Drives:
 - a. Adjust tension in V-belt drives, and adjust vari-pitch sheaves and drives for proper equipment speed.
 - b. Adjust drives for alignment of sheaves and V-belts.
 - c. Clean, remove foreign materials before starting operation.
 9. Motors:
 - a. Check each motor for amperage comparison to nameplate value.
 - b. Correct conditions which produce excessive current flow and which exist due to equipment malfunction.
 10. Control Valves:
 - a. Inspect both hand and automatic control valves; clean bonnets and stems.
 - b. Tighten packing glands to ensure no leakage, but permit valve stems to operate without galling.
 - c. Replace packing in valves to retain maximum adjustment after system is judged complete.
 - d. Replace packing on any valve which continues to leak.
 - e. Remove and repair bonnets which leak.
 - f. Coat packing gland threads and valve stems with a surface preparation of "Moly-Cote" or "Fel-Pro" after cleaning.
 - g. Verify that control valve seats are free from foreign material and are properly positioned for intended service.

11. Flanges:
 - a. Tighten flanges after system has been placed in operation.
 - b. Replace flange gaskets which show any sign of leakage after tightening.
12. Screwed Joints:
 - a. Inspect screwed joints for leakage.
 - b. Promptly remake each joint which appears to be faulty; do not wait for rust to form.
 - c. Clean threads on both parts, apply compound and remake joints.
13. Cleaning:
 - a. After system has been placed in operation, clean strainers, dirt pockets, orifices, valve seats and headers in fluid systems, to ensure being free of foreign materials.
 - b. Open steam traps and air vents; remove operating elements. Clean thoroughly, replace internal parts, and put back into operation.
 - c. Remove rust, scale and foreign materials from equipment and renew defaced surfaces.
14. Draft Gages: Set and calibrate draft gages of air filters and other equipment.
15. Control Circuits: Check each electrical control circuit to ensure that operation complies with Specifications and requirements to provide desired performance.
16. Pressure gages:
 - a. Inspect each pressure gage and thermometer for calibration.
 - b. Replace items which are defaced, broken or which read incorrectly.
17. Repair damaged insulation.
18. Leaks: Check piping for leaks at every joint and at every screwed, flanged or welded connection using "Leak-Tek" or other approved compound.

C. Start-up:

1. Execute start-up under supervision of responsible persons in accordance with Manufacturer's instructions.
2. Place equipment in operation in proper sequence.

3.2 SYSTEMS DEMONSTRATION

A. Preparation:

1. Verify That System:
 - a. Has been inspected and put in service.
 - b. Is fully operational.
2. Operation and Maintenance Manuals:
 - a. Completed.
 - b. Sufficient copies available for use in demonstrations and instructions.

B. Demonstrations and Instructions:

1. Demonstration Of and Instruction On Operation and Maintenance of System:
 - a. To the Owner's personnel.
 - b. Two weeks prior to Substantial Completion.
2. Equipment Requiring Seasonal Operation: Demonstrate within 6 months of Substantial Completion.
3. Instruction:
 - a. Operation and maintenance manual as basis.
 - b. Review contents of manual in detail.
 - c. Explain all aspects of operation and maintenance.
4. Demonstrate:
 - a. Start-up.
 - b. Operation.
 - c. Control.
 - d. Adjustment.
 - e. Troubleshooting.
 - f. Servicing.
 - g. Maintenance.
 - h. Shutdown.

3.3 PERFORMANCE TEST

- A. Performance Test:
 - 1. Test the entire Work, including all of its individual systems for 2 weeks before final payment will be made.
 - 2. Make final tests in the presence of the Owner and the Architect.
 - 3. If any part of the Work or equipment does not meet Specifications:
 - a. Correct the situation.
 - b. Obtain approval of the Architect before final payment is made.
 - 4. Provide the personnel and bear all costs for correcting all malfunctions.
 - 5. The Owner will provide operating personnel and utilities.

END OF SECTION 01 75 00

SECTION 01 77 00 – CLOSEOUT PROCEDURES

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 instructions for and the responsibilities of each party in contract closeout.
- B. Related Section includes Certificate of Substantial Completion.

1.3 SUBSTANTIAL COMPLETION

- A. Contractor: When Contractor considers that the Work or any portion of the Work is ready for its intended use, Contractor shall submit:
 - 1. Written certification to Architect/Engineer and Owner that the Work, or designated portion of the Work, is substantially complete.
 - 2. A list of major items to be completed or corrected.
 - 3. Request that Architect/Engineer issue a certificate of Substantial Completion.
- B. Architect/Engineer's Inspection: Architect/Engineer will make an inspection:
 - 1. Within 10 full working days after receipt of request, or on a date mutually agreed upon with all attendees.
 - 2. Together with Owner and Contractor.
- C. Architect/Engineer's Determination of Substantial Completion:
 - 1. Should Architect/Engineer consider the Work or designated portion of the Work substantially complete, the following steps shall be taken:
 - a. Contractor shall prepare and submit to Architect/Engineer, a list of items to be completed or corrected as determined by the inspection.
 - b. Architect/Engineer will prepare and deliver to Owner:
 - 1) A tentative certificate of Substantial Completion.
 - 2) A tentative list of items to be completed or corrected before final payment.
 - c. Owner shall have 7 full working days after receipt of the tentative certificate during which to make written objection to Architect/Engineer as to any provisions of the certificate or attached list.
 - d. Architect/Engineer will, within 14 full working days after delivery of tentative certificate to Owner, decide:
 - 1) Not Substantially Complete: Architect/Engineer will issue written notice to Contractor stating reasons.
 - 2) Substantially Complete: Architect/Engineer will issue definitive certificate of Substantial Completion and a revised list of items to be corrected or completed.
 - 2. Should Architect/Engineer consider that the Work or designated portion of the Work is not substantially complete, the following steps shall be taken:
 - a. Architect/Engineer shall notify Contractor in writing stating Architect/Engineer's reasons.
 - b. Contractor shall complete the Work and send a second written notice to Architect/Engineer certifying that the Project, or designated portion of the Project, is substantially complete.
 - c. Architect/Engineer and Owner will reinspect the Work.
- D. Division of Responsibilities:
 - 1. Architect/Engineer:
 - a. At the time of delivery of tentative certificate of Substantial Completion.
 - b. Deliver to Owner and Contractor a written recommendation as to division of responsibilities pending final payment with respect to:
 - 1) Security.
 - 2) Operation.

- 3) Safety.
 - 4) Protection of the Work.
 - 5) Maintenance.
 - 6) Heat.
 - 7) Utilities.
 - 8) Insurance.
 - 9) Warranties.
2. Architect/Engineer's written recommendation on division of responsibilities shall be binding on Owner and Contractor until final payment unless Owner and Contractor agree otherwise in writing and so notify Architect prior to Architect's issuance of a definitive certificate of Substantial Completion.

1.4 FINAL INSPECTION

- A. Contractor Certification: Prior to final inspection, Contractor shall submit written certification that:
1. The Contract Documents have been reviewed.
 2. The Project has been inspected in compliance with the Contract Documents.
 3. Work has been completed in accordance with the Contract Documents.
 4. Equipment and systems have been tested in the presence of the Owner's representative and are operational.
 5. The Project is complete and ready for final inspection.
- B. Architect/Engineer's Inspection: The Architect/Engineer will make final inspection:
1. Within 10 full working days after receipt of certification.
 2. Together with Owner and Contractor.
- C. Architect/Engineer's Determination of Final Completion:
1. Should Architect/Engineer consider the Work complete and ready for final payment in accordance with the requirements of the Contract Documents, Architect/Engineer shall request Contractor to make Project closeout submittals.
 2. Should Architect/Engineer consider the Work not complete and ready for final payment:
 - a. Architect/Engineer shall notify Contractor in writing stating the reasons.
 - b. Contractor:
 - 1) Take immediate steps to remedy the stated deficiencies.
 - 2) Send a second written notice to Architect/Engineer certifying that the Work is complete.
 - c. Architect/Engineer and Owner will reinspect the Work.

1.5 REINSPECTION COSTS

- A. Should Architect/Engineer be required to perform second inspections because of failure of the Work to comply with the original certifications of Contractor, Owner will compensate Architect/Engineer for additional services and deduct the amount paid from payment or payments to Contractor, according to the Preferred Vendor agreement.

1.6 ADDITIONAL INSPECTION COSTS

- A. Substantial Completion: Owner will compensate Architect/Engineer for inspection services rendered between the scheduled date of Substantial Completion and the actual date of Substantial Completion and deduct the amounts paid from payment or payments to Contractor.
- B. Final Completion: Owner will compensate Architect/Engineer for inspection services rendered between the scheduled date of final completion and the actual date of final completion and deduct the amounts paid from payment or payments to Contractor.

1.7 CLOSEOUT SUBMITTALS

- A. Contractor:
 - 1. Provide closeout submittals as required in the Contract Documents.
 - 2. These submittals shall include, but not necessarily be limited to:
 - a. Project record documents.
 - b. Operation and maintenance manuals.
 - c. Guarantees.
 - d. Spare parts and maintenance materials.
 - e. Instruction in operation of all systems.
 - 1) Record all training per WSU standards and create DVD. Provide two copies with close-out documentation.

1.8 EVIDENCE OF PAYMENTS AND RELEASE OF LIENS

- A. Affidavits:
 - 1. Submit with final Application for Payment an affidavit of payment of debts and release of claims.
 - 2. Affidavit shall include:
 - a. Contractor's release or waiver of lien.
 - b. Consent of surety of final payment.
 - c. Separate releases or waivers of liens for Subcontractors, Suppliers and others with lien rights against property of Owner together with a list of those parties.
- B. Execution: All submittals shall be duly executed before delivery to Architect/Engineer.

1.9 FINAL ADJUSTMENT OF ACCOUNTS

- A. Final Statement: Submit a final statement of accounting, which reflects all adjustments, to Architect/Engineer. This statement shall contain the following:
 - 1. Original Contract Price.
 - 2. Additions and deductions.
 - 3. Total Contract Price as adjusted.
 - 4. Previous payments.
 - 5. Sum remaining due.
- B. Final Change Order: Architect may prepare a final Change Order reflecting approved adjustments to the Contract Price not previously made by Change Orders.

1.10 FINAL APPLICATION FOR PAYMENT

- A. Contractor shall submit a final Application for Payment in accordance with the requirements of the Contract Documents.
- B. Disposition of Final Application for Payment:
 - 1. If the final Application for Payment and the Work are acceptable in accordance with the Contract Documents:
 - a. Architect/Engineer, within 10 full working days after receipt of the Application for Payment:
 - 1) Submit to Owner a written recommendation for payment.
 - 2) Submit to Owner and Contractor a written notice that the Work is acceptable subject to the provisions of the General Conditions.
 - b. Owner will, within 30 calendar days after receipt of the Application for Payment and Architect/Engineer's recommendation in accordance with the Contract Documents, pay to Contractor the amount recommended.
 - 2. If the Application for Payment, the Work or both are unacceptable:
 - a. Architect/Engineer will return the Application for Payment to Contractor, indicating in writing the reasons for refusing to recommend final payment.
 - b. Contractor shall make the necessary corrections and resubmit the Application for Payment.

3. Final Completion Delayed:
 - a. Upon receipt of Contractor's final Application for Payment and recommendation by Architect/Engineer, Owner shall make payment of the balance due for that portion of the Work fully completed and accepted if Architect/Engineer confirms that final completion of the Work is significantly delayed through no fault of Contractor.
 - b. Payment shall be made under the terms and conditions governing final payment, except that it shall not constitute a waiver of claims.
 - c. Contractor shall submit with the Application for Payment written consent of surety if the remaining balance to be held by Owner for Work not fully completed or corrected is less than the retainage stipulated in the Agreement.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

Not used.

END OF SECTION 01 77 00

SECTION 01 78 39 – PROJECT RECORD DOCUMENTS

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 procedures for the maintenance, recording and submittal of Project record documents.

1.3 MAINTENANCE OF DOCUMENTS AND SAMPLES

- A. Storage:
 - 1. Store documents and Samples in Contractor's field office apart from documents used for construction.
 - 2. Provide files and racks for storage of documents.
 - 3. Provide locked cabinet or secure storage space for storage of Samples.
- B. Filing: File record documents in accordance with CSI Masterformat.
- C. Maintenance:
 - 1. Maintain documents in a clean, dry, legible condition and in good order.
 - 2. Do not use record documents for construction purposes.
- D. Availability: Make documents and Samples available at all times for inspection by Architect.
 - 1. Reviewed submittals and shop drawings to be maintained on a FTP site accessible to project team members.

1.4 RECORDING

- A. Labeling: Label each document "PROJECT RECORD" in neat large printed letters.
- B. Recording:
 - 1. Record actual revisions to the Work.
 - 2. Record information concurrently with construction progress.
 - 3. Do not conceal any work until required information is recorded.
- C. Drawings:
 - 1. Legibly mark, with notes or graphic representations, to record actual construction.
 - a. Location of internal utilities and appurtenances concealed in the construction, referenced to visible and accessible features of the structure.
 - b. Field changes of dimension and detail.
 - c. Changes made by Field Order, Work Change Directive or Change Order.
 - d. Details not on original Contract Drawings.
 - 2. After Architect/Engineer's review of the record drawings, transfer all marks to electronic documents provided by Architect/Engineer.
- D. Specifications and Addenda:
 - 1. Legibly mark each Section to record:
 - a. Manufacturer, trade name, catalog number, and Supplier of each Product and item of equipment actually installed.
 - b. Changes made by Field Order, Work Change Directive or Change Order.

1.5 SUBMITTAL

- A. Delivery: At Contract closeout, deliver record documents to Architect/Engineer for Owner.
 - 1. Provide electronic as well as 3 hard copies.
 - 2. Provide two copies of DVDs recorded of all training per WSU standards.
- B. Transmittal Letter:
 - 1. Accompany submittal with transmittal letter in duplicate, containing:
 - a. Date.
 - b. Project title and number.
 - c. Contractor's name and address.
 - d. Title and number of each Record Document.
 - e. Signature of Contractor or their authorized representative.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

Not used.

END OF SECTION 01 78 39

SECTION 02 01 26 – MINOR ALTERATION WORK

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 minor alteration work and the major items listed below:
 - 1. Cutting and patching.
 - 2. Temporarily relocating lighting devices for installation of temporary wall.
 - 3. Storing and reinstalling ceiling panels.

1.3 QUALITY ASSURANCE

- A. General:
 - 1. Test repair materials for compatibility with existing materials.
 - 2. Obtain Engineer's approval of test.
 - 3. Do not use incompatible materials.
- B. Fabrication and Installation Personnel Qualifications:
 - 1. Trained and experienced in the fabrication and installation of the materials and equipment.
 - 2. Knowledgeable of the design and the reviewed Shop Drawings.

1.4 SEQUENCING AND SCHEDULING

- A. Show activities in a schedule as required by Division 01 Section "Construction Progress Schedule."

PART 2 - PRODUCTS

2.1 MATERIALS FOR ALTERATIONS, PATCHING AND REPAIRS

- A. General:
 - 1. Provide new materials or acceptable salvaged materials.
 - 2. Acceptable salvaged material: As specified herein or as indicated on Drawings.
- B. Acceptable Salvaged Materials:
 - 1. Cleaned prior to reinstallation.
 - 2. In good condition without objectionable defects.
 - 3. Operate properly if an operable item.
- C. New Materials:
 - 1. Compatible with existing adjacent materials.
 - 2. Same types, sizes, qualities and colors as existing materials.
 - 3. Provide new materials when acceptable salvaged materials:
 - a. Are not available in sufficient quantity, or
 - b. Reuse is specifically not permitted.

PART 3 - EXECUTION

3.1 ALTERATIONS, PATCHING AND REPAIRS

- A. General: Not discernible from normal viewing distance.

- B. Restore Surfaces:
 - 1. Where damaged or defaced by:
 - a. Cutting.
 - b. Patching.
 - c. Demolition.
 - d. Alteration.
 - e. Repair work.
 - 2. To a condition equal to that before the Work began.
 - 3. With continuous and uniform finishes.

END OF SECTION 02 01 26

SECTION 02 41 19 – SELECTIVE 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. This Section includes the modification, alteration, conversion, and renovation of existing structures:
 - 1. Be aware of the many incidental items which exist which must be demolished, relocated, or replaced in order to accomplish the remodeling work of trades.
 - 2. Include the price of such demolition, relocating, and replacement in the base Bid.
 - 3. These incidental items may or may not be indicated in the Contract Documents.
 - 4. Contractor and Subcontractors performing remodeling work are expected to be familiar with the unknown nature of existing utilities serving an area to be remodeled and shall calculate the base Bid to include the demolition, removal, relocation, and replacement of these utilities.
 - 5. Contractor to perform a walk-through with the Owner to review any requested salvaged items prior to demolition.
 - 6. The Owner will perform testing for asbestos containing materials and perform any necessary abatement prior to the start of construction.

1.3 REFERENCES

- A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the pertinent provisions of the following:
 - 1. American National Standards Institute: ANSI A10.6 - Safety Requirements for Demolition Operations.
 - 2. ASTM: D1557 - Laboratory Compaction Characteristics of Soil Using Modified Effort.
 - 3. EPA: Rule 406(b) of the Toxic Substances Control Act of 1992.
 - 4. NFPA: NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations.

1.4 DEFINITIONS

- A. Terms:
 - 1. Abandon:
 - a. Remove an item to the extent that it is not visible and does not interfere with new construction.
 - b. Portions of the abandoned item may be left in place.
 - c. No abandoned items shall be left below new footings.
 - 2. Demolish:
 - a. Remove existing items from their present location in the Project area and haul to an area outside of the Project area.
 - b. Remove utilities serving these items.
 - 3. Relocate:
 - a. Move existing items from their present location to another location in the Project area.
 - b. Extend utilities serving the present location to the new location.
 - 4. Remove:
 - a. Except for items indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, demolished materials shall become Contractor's property.
 - b. Remove existing items from their present location in the Project area and haul to an area outside of the Project area.
 - c. Remove utilities serving these items.
 - 5. Replace:
 - a. Remove existing items from their present location in the Project area, haul them to an area outside of the Project area, and furnish and install new items in the same or another location.
 - b. Extend utilities serving the present location to the new location.
 - 6. Reuse: Move existing items from their present location to another location in the Project area. Extend utilities serving the present location to the new location.

1.5 DIVISION OF WORK

- A. Work: In accordance with the General Conditions, Contractor is responsible for dividing the Work among the Subcontractors and Suppliers and for delineating the work to be performed by specific trades. The following are suggestions as to how the Work may be divided. This is not a complete list of the work:
1. Contractor:
 - a. Cut and patch walls, floors, and ceilings to allow for recessed utilities and ductwork.
 - b. Remove and reinstall existing suspended ceilings to allow for above ceiling construction.
 - c. Replace damaged units.
 - d. Install new ceilings as indicated on the Drawings.
 - e. Place sleeves in new concrete structures.
 - f. Install fire stop and smoke stop systems at penetrations for ratings indicated in accordance with local building codes.
 2. Mechanical and Electrical Subcontractors:
 - a. Furnish sleeves for use in new concrete construction.
 - b. Install fire stop and smoke stop systems at utility penetrations in accordance with local building codes.
 - c. Furnish and install sleeves in gypsum board and masonry construction.
 - d. Core drill existing concrete for new utilities and sleeves after obtaining Architect's review of locations.
 - e. Remove and reinstall existing fire protection heads to allow for ceiling removal and installation.
 3. Miscellaneous:
 - a. Each trade shall be financially responsible for cutting and patching for sleeves, penetrations, and installation of isolated components as necessary for its work unless herein specifically stated to the contrary.
 - b. On renovation projects, cut and patch walls, floors, and ceilings to allow for continuous runs of recessed utilities and ductwork.
 - c. Patching shall be done by the trade whose work is damaged.
 - d. Costs caused by defective or ill-timed work shall be borne by the party responsible.
 - e. Each trade shall do fitting of its own work as required to make its several components fit together or to receive the work of other trades.

1.6 QUALITY ASSURANCE

- A. Qualifications: Engage an experienced firm that has specialized in demolition work similar to material and extent indicated for this Project.
- B. Regulatory Requirements:
1. Comply with governing EPA notification regulations before beginning selective demolition.
 2. Comply with hauling and disposal regulations of authorities having jurisdiction.
 3. Comply with ANSI A10.6 and NFPA 241.
 4. Comply with 29 CFR 1926.62-(OSHA Paint Standard).
- C. Pre-Demolition Conference:
1. Conduct pre-demolition conference at Site in accordance with in Division 01 Section "Project Meetings."
 2. Review methods and procedures related to selective demolition including, but not limited to, the following:
 - a. Inspect and discuss condition of construction to be selectively demolished.
 - b. Review structural load limitations of existing structure.
 - c. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and to avoid delays.
 - d. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.

1.7 PROJECT CONDITIONS

- A. Owner Occupancy:
 - 1. Owner will occupy portions of building immediately adjacent to selective demolition area.
 - 2. Conduct selective demolition so Owner's operations will not be disrupted.
 - 3. Provide not less than 72 hours notice to Owner of activities that will affect Owner's operations.
- B. Access:
 - 1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities.
 - 2. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from authorities having jurisdiction.
- C. Conditions:
 - 1. Owner and Architect assume no responsibility for condition of areas to be selectively demolished.
 - 2. Conditions existing at time of inspection for bidding purposes will be maintained by Owner as far as practicable.
 - 3. Before selective demolition begins, Owner will remove the following items:
 - a. Furnishings and fixtures.
 - b. Movable equipment.
- D. Storage or sale of removed items or materials on Site will not be permitted.
- E. Maintenance of Utilities:
 - 1. Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
 - 2. Maintain fire-protection facilities in service during selective demolition operations.
- F. Known Hazardous Materials:
 - 1. The Owner has tested for hazardous materials and they are assumed not present in building to be selectively demolished.
 - 2. Hazardous materials remediation is the responsibility of the Owner.
 - 3. If hazardous materials are discovered, do not disturb hazardous materials or items suspected of containing hazardous materials except, notify Architect and Owner's representative immediately for required actions.

1.8 WARRANTIES

- A. Existing Warranties:
 - 1. Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.
 - 2. If possible, retain original installer or fabricator to patch exposed work that is damaged during selective demolition.
 - 3. If it is not possible to engage original installer or fabricator, engage another recognized, experienced, and specialized firm.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General:
 - 1. Materials and workmanship shall conform to the requirements of other Sections of the Specifications.
 - 2. Where no materials are specified in these specifications, use materials of an equivalent type, quality, and size to match those existing in other areas of the facility.
 - 3. If none exist, use materials and workmanship recognized as of the highest quality in the industry.
 - 4. Obtain Architect's review of such material and workmanship.
- B. Piping: Existing piping which is removed from its present location shall not be reused where new piping is required unless specifically noted on the Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped.
- B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- C. Inventory and record the condition of items to be removed and reinstalled, and of items to be removed and salvaged.
- D. Conflicts:
 - 1. 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.
 - 2. Promptly submit written report to Engineer.
- E. Survey, or engage a competent person to survey condition of the building, in accordance with requirements of OSHA, to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of the structure or adjacent structures during selective demolition operations.
- F. Perform additional surveys as the work progresses to detect hazards resulting from operations to date.

3.2 UTILITY SERVICES

- A. Maintain existing services indicated to remain and protect them against damage during selective demolition operations.
- B. Interruptions:
 - 1. Do not interrupt existing utilities serving occupied or operating facilities unless authorized in writing by Owner and other authorities having jurisdiction.
 - 2. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and to authorities having jurisdiction.
 - 3. Provide at least 72 hours notice to Owner if shutdown of service is required during changeover.
- C. Utility Requirements:
 - 1. Locate, identify, disconnect, and seal or cap off indicated utilities serving areas to be selectively demolished.
 - 2. Owner will arrange to shut off indicated utilities when requested by Contractor.
 - 3. Arrange to shut off indicated utilities with utility companies.
 - 4. If utility services are required to be removed, relocated, or abandoned, before proceeding with selective demolition, provide temporary utilities that bypass areas of selective demolition and that maintain continuity of service to other parts of building.
 - 5. Cut off pipe or conduit in walls or partitions to be removed.
 - 6. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.

3.3 PREPARATION

- A. Dangerous Materials: Drain, purge, or otherwise remove, collect, and dispose of chemicals, gases, explosives, acids, flammables, or other dangerous materials before proceeding with selective demolition operations.
- B. Site Access and Temporary Controls:
 - 1. Conduct selective demolition and debris removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 - 2. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and other authorities having jurisdiction.
 - 3. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.
 - 4. Erect temporary walls for protection and separation where required by authorities having jurisdiction.

C. Temporary Facilities:

1. Protection:
 - a. Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent areas.
 - b. Provide protection to ensure safe passage of people around selective demolition area, and to and from occupied portion of building.
 - c. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
 - d. Cover and protect furniture, furnishings, and equipment that have not been removed.
2. Shoring and Bracing:
 - a. Provide and maintain shoring, bracing, or structural support to preserve stability and prevent movement, settlement, or collapse of construction to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
 - b. Strengthen or add new supports when required during progress of selected demolition.

3.4 POLLUTION CONTROLS

A. Dust Control:

1. Use water mist, temporary closures, and other suitable methods to limit spread of dust and dirt.
2. Do not use water when it may damage existing construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.
3. Wet mop floors to eliminate trackable dirt and wipe down walls and doors of demolition enclosure.
4. Vacuum carpeted areas.
5. Comply with governing environmental protection regulations.

B. Disposal:

1. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
2. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.

3.5 GENERAL

A. Demolish and remove existing construction only to the extent required by new construction and as indicated.

B. Burn permit required by WSU Office of Risk Management in advance of any burning, grinding, (etc) work.

C. Methods:

1. Use methods required to complete the work within limitations of governing regulations.
2. Level by Level:
 - a. Proceed with selective demolition systematically, from higher to lower level.
 - b. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
3. Cutting Openings:
 - a. Neatly cut openings and holes plumb, square, and true to dimensions required.
 - b. Use cutting methods least likely to damage construction to remain or to adjoining construction.
 - c. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces.
 - d. Temporarily cover openings to remain.
4. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
5. Flame Cutting:
 - a. Do not use cutting torches until work area is cleared of flammable materials.
 - b. At concealed spaces, such as duct and pipe chases, verify condition and contents of hidden space before starting flame-cutting operations.
 - c. Maintain fire watch and portable fire suppression devices during flame-cutting operations.
 - d. Maintain adequate ventilation when using cutting torches.
6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials, and promptly and legally 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.
 9. Return elements of construction and surfaces that are to remain to condition existing before selective demolition operations began.
- D. Existing Facilities: Comply with Owner's requirements for using and protecting elevators, stairs, walkways, loading docks, building entries, and other building facilities during the selective demolition operations.
- E. Removed and Salvaged Items:
1. Clean salvaged items.
 2. Pack or crate items after cleaning and identify contents of containers.
 3. Store items in a secure area until delivery to Owner.
 4. Transport items to Owner's storage area designated by Owner.
 5. Protect items from damage during transport and storage.
- F. Removed and Reinstalled Items:
1. Clean and repair items to functional condition adequate for intended reuse.
 2. Paint equipment to match new equipment.
 3. Pack or crate items after cleaning and repairing, and identify contents of containers.
 4. Protect items from damage during transport and storage.
 5. Reinstall items in locations indicated.
 6. Comply with requirements for new materials and equipment.
 7. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- G. Existing Items to Remain:
1. Protect construction indicated to remain against damage and soiling during selective demolition.
 2. When permitted by Architect, items may be removed to a suitable, protected storage location and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.6 DEMOLITION

- A. Structures:
1. Cut, repair, reuse, excavate, demolish or otherwise remove parts of the existing structures or appurtenances, as indicated on the Drawings, herein specified and necessary to permit completion of the Work.
 2. Dispose of demolished materials in an approved manner.
 3. Include necessary cutting, bending, and welding of reinforcing steel, structural steel, or miscellaneous metal work found embedded in the existing structures.
 4. When removing materials or portions of existing structures, shore up, underpin, and protect adjacent structures.
 5. Concrete:
 - a. Demolish in small sections.
 - b. Cut concrete to a depth of at least 3/4-inch at junctures with construction to remain, using a power driven saw.
 - c. Dislodge concrete from reinforcement to remain at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete indicated.
 - d. Neatly trim openings to dimensions indicated.
 6. Engineer's review of cutting: No existing structure, equipment or appurtenance shall be shifted, cut, removed or otherwise altered without obtaining review of Engineer.
- B. Equipment:
1. Dismantle, remove, and relocate existing equipment, piping, and other appurtenances required for the completion of the Work.
 2. Cut existing pipelines for the purpose of making connections thereto.
 3. Cut off anchor bolts for equipment and structural steel indicated to be removed 1-inch below the concrete surface.
 4. Patch remaining concrete surface to smooth even finish.
 5. Remove air conditioning equipment without releasing refrigerants, if applicable.

- C. Piping, Fire Protection, and Electrical Components:
1. When a new connection is made to an existing pipeline, install additional new piping, extending to and including the most convenient new valve.
 2. Piping, conduit, and wiring indicated or required to be demolished shall be done so to the nearest reasonable connection outside of the Project area or as directed by Engineer.
 3. Where necessary or required for the purpose of making connections, cut existing pipelines in a manner to provide an approved joint.
 4. Weld beads, flanges, and provide Dresser couplings on existing and new piping.
 5. Remove and reinstall existing fire protection heads to allow for new construction.
 6. Comply with applicable fire protection codes.
 7. Furnish new heads, piping, and connections as required for completion of the Work.
 8. Remove junction boxes and electrical outlets which will no longer be in use.
 9. At existing walls which are made thicker, extend piping and wiring to accommodate additional wall thickness.
 10. Remove and reinstall fixtures and electrical outlets, switches, etc.
- D. Ductwork:
1. Remove portions of existing ductwork systems to the nearest branch outside the project area, except as indicated otherwise on drawings.
 2. Remove existing ductwork in a manner to minimize dispersion of dust in the duct system.
 3. Repair and replace existing insulation and duct liner disturbed by this Work to provide a continuous smooth surface.
 4. New connections to existing ductwork shall comply with the requirements of Division 23 Section "Metal Ducts."
- E. Masonry Walls: Where masonry walls are to be removed and replaced, and where filling existing openings, allow for toothing in of the new masonry at alternate courses so that the existing running bond pattern is maintained.
- F. Conceal Utilities: Recess new piping, conduit, and other utilities into floors, wires, and ceilings in finished areas.
- G. Ownership of Salvaged Materials:
1. Materials and equipment removed shall remain the property of Owner at Owner's option.
 2. Items not salvageable, as determined by Architect and Owner, and items Owner elects not to keep shall become the property of Contractor to be properly disposed of off the Site.
 3. Salvaged equipment shall be thoroughly cleaned, lubricated, and greased for protection during prolonged storage.
- H. Nonshrink Grout: Use nonshrink grout for setting wall castings, sleeves, leveling pump bases, doweling anchors into existing concrete and elsewhere as indicated.
- I. Protect Facility from Water Damage: Provide flumes, hoses, piping, suitable plugs, bulkheads, or other means to divert or hold back the flow of wastewater, water, or other liquids, as required for proper performance of the Work.
- J. Blasting: Not permitted.
- K. Sleeves:
1. Subcontractors for mechanical, electrical, and other trades shall furnish sleeves and inserts for pipes, conduits, and similar items in forms, walls, partitions, and floors.
 2. Perform work in cooperation with Contractor.
 3. Place items in ample time so as not to delay operations.
 4. Do not place sleeves so they pass through beams, girders, and similar construction.
- L. Firestopping and Smokestopping: Install firestop and smokestop systems at utility penetrations in accordance with local building codes and Division 07 Section "Penetration Firestopping".

- M. Miscellaneous: At existing walls which are made thicker, reinstall fire extinguisher cabinets, clocks, thermostats, and other wall hung items in new wall to accommodate additional wall thickness.

3.7 PATCHING AND REFINISHING

- A. Promptly repair damage to adjacent construction caused by selective demolition operations.
- B. Patching:
 - 1. Patch and repair existing surfaces from which items have been removed leaving holes, fasteners, and surface blemishes exposed to view.
 - 2. Where repairs to existing surfaces are required, patch to produce surfaces suitable for new materials.
 - 3. Completely fill holes and depressions in existing masonry walls that are to remain with an approved masonry patching material applied according to Manufacturer's written recommendations.
 - 4. Comply with Division 01 Section "Cutting and Patching."
- C. Refinishing:
 - 1. Prepare existing surfaces for finishes by scraping, sanding, filling, acid etching, and sand blasting to ensure bonding and a smooth finish.
 - 2. Refinish entire surfaces as necessary to provide an even finish.
 - 3. Refinish continuous surfaces to the nearest intersection and entirely finish assemblies.
 - 4. Restore exposed finishes of patched areas and extend restoration into adjoining construction in a manner that eliminates evidence of patching and refinishing.
 - 5. Refinish entire surfaces if necessary to remediate existing lead painted surfaces.
- D. Floors and Walls:
 - 1. Where floors or partitions that are demolished extend one finished area into another, patch and repair floor and wall surfaces in the new space.
 - 2. Provide an even surface of uniform finish, color, texture, and appearance.
 - 3. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 - 4. Patch with durable seams that are as invisible as possible.
 - 5. Provide materials and comply with installation requirements specified in other Sections of these Specifications.
 - 6. Where patching occurs in a painted surface, apply primer and intermediate coats over the patch and apply final coat over entire unbroken surface containing patch.
 - 7. Provide additional coats until patch blends with adjacent surfaces.
 - 8. Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
- E. Ceilings: Patch, repair, or rehang existing materials as necessary to provide even plane surface of uniform appearance.

3.8 CLEANING

- A. Clean materials installed under this Section in accordance with Division 01 Section "Cleaning and Waste Management."
- B. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations.
- C. Return adjacent areas to conditions existing before selective demolition operations began.

END OF SECTION 02 41 19

SECTION 06 10 00 - ROUGH CARPENTRY

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Rough opening framing for doors, windows, and roof openings.
- B. Fire retardant treated wood materials.

1.2 REFERENCE STANDARDS

- A. ASTM C557 - Standard Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing; 2003 (Reapproved 2017).
- B. ASTM D3498 - Standard Specification for Adhesives for Field-Gluing Wood Structural Panels (Plywood or Oriented Strand Board) to Wood Based Floor System Framing; 2018a.
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2018b.
- D. AWPA U1 - Use Category System: User Specification for Treated Wood; 2017.
- E. PS 20 - American Softwood Lumber Standard; 2015.

1.3 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.
- B. Fire Retardant Treated Wood: Prevent exposure to precipitation during shipping, storage, or installation.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
 - 1. If no species is specified, provide any species graded by the agency specified; if no grading agency is specified, provide lumber graded by any grading agency meeting the specified requirements.
 - 2. Grading Agency: Any grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee (www.alsc.org) and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.

2.2 DIMENSION LUMBER FOR CONCEALED APPLICATIONS

- A. Sizes: Nominal sizes as indicated on drawings, S4S.
- B. Moisture Content: S-dry or MC19.
- C. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
 - 1. Lumber: S4S, No. 2 or Standard Grade.
 - 2. Boards: Standard or No. 3.

2.3 ACCESSORIES

- A. Fasteners and Anchors:
 - 1. Drywall Screws: Bugle head, hardened steel, power driven type, length three times thickness of sheathing.
 - 2. Anchors: Toggle bolt type for anchorage to hollow masonry.
- B. Construction Adhesives: Adhesives complying with ASTM C557 or ASTM D3498.
 - 1. Manufacturers:
 - a. Franklin International, Inc; Titebond Fast Set Polyurethane Construction Adhesive: www.titebond.com/#sle.

2.4 FACTORY WOOD TREATMENT

- A. Treated Lumber and Plywood: Comply with requirements of AWWA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.
 - 1. Fire-Retardant Treated Wood: Mark each piece of wood with producer's stamp indicating compliance with specified requirements.
- B. Fire Retardant Treatment:
 - 1. Manufacturers:
 - 2. Interior Type A: AWWA U1, Use Category UCFA, Commodity Specification H, low temperature (low hygroscopic) type, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes.
 - a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
 - b. Do not use treated wood in applications exposed to weather or where the wood may become wet.

PART 3 EXECUTION

3.1 INSTALLATION - GENERAL

- A. Select material sizes to minimize waste.
- B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.
- C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

3.2 BLOCKING, NAILERS, AND SUPPORTS

- A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.
- B. In framed assemblies that have concealed spaces, provide solid wood fireblocking as required by applicable local code, to close concealed draft openings between floors and between top story and roof/attic space; other material acceptable to code authorities may be used in lieu of solid wood blocking.
- C. In metal stud walls, provide continuous blocking around door and window openings for anchorage of frames, securely attached to stud framing.
- D. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.

- E. Provide the following specific non-structural framing and blocking:
 - 1. Cabinets and shelf supports.
 - 2. Wall brackets.
 - 3. Wall-mounted door stops.
 - 4. Wall paneling and trim.
 - 5. Joints of rigid wall coverings that occur between studs.

3.3 TOLERANCES

- A. Framing Members: 1/4 inch (6 mm) from true position, maximum.
- B. Variation from Plane (Other than Floors): 1/4 inch in 10 feet (2 mm/m) maximum, and 1/4 inch in 30 feet (7 mm in 10 m) maximum.

3.4 CLEANING

- A. Do not leave any wood, shavings, sawdust, etc. on the ground or buried in fill.
- B. Prevent sawdust and wood shavings from entering the storm drainage system.

END OF SECTION 06 10 00

SECTION 06 41 00 - ARCHITECTURAL WOOD CASEWORK

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Specially fabricated cabinet units.
- B. Hardware.

1.2 REFERENCE STANDARDS

- A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014, with Errata (2016).
- B. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.1; 2016, with Errata (2017).
- C. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

1.3 SUBMITTALS

- A. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
 - 1. Scale of Drawings: 1-1/2 inch to 1 foot (125 mm to 1 m), minimum.
 - 2. Provide the information required by AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS).
 - 3. Include certification program label.
- B. Product Data: Provide data for hardware accessories.
- C. Samples: Submit actual samples of architectural cabinet construction, minimum 12 inches (300 mm) square, illustrating proposed countertop and benches substrate and finish.
- D. Certificate: Submit labels and certificates required by quality assurance and quality control programs.

1.4 QUALITY ASSURANCE

- A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.
 - 1. Accredited participant in the specified certification program prior to the commencement of fabrication and throughout the duration of the project.
- B. Quality Certification:
 - 1. Provide labels or certificates indicating that the installed work complies with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade or grades specified.
 - 2. Provide designated labels on shop drawings as required by certification program.
 - 3. Provide designated labels on installed products as required by certification program.
 - 4. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.
 - 5. Replace, repair, or rework all work for which certification is refused.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect units from moisture damage.

1.6 FIELD CONDITIONS

- A. During and after installation of custom cabinets, maintain temperature and humidity conditions in building spaces at same levels planned for occupancy.

PART 2 PRODUCTS

2.1 BENCH

- A. Quality Standard: Premium Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
- B. Plastic Laminate Faced: Premium grade.
- C. Upholstery Seat: Refer to drawings.
- D. Wood Products: All shall be made of non-combustible and of fire-retardant treated products.

2.2 WOOD-BASED COMPONENTS

- A. Wood fabricated from old growth timber is not permitted.

2.3 LAMINATE MATERIALS

- A. Manufacturers: Wilsonart LLC; www.wilsonart.com/#sle.
- B. High Pressure Decorative Laminate (HPDL): NEMA LD 3, types as recommended for specific applications.
 - 1. Fire Rating: Class A.
- C. Provide specific types as indicated on drawings

2.4 ACCESSORIES

- A. Adhesive: Type recommended by fabricator to suit application.
- B. Aluminum Edge Banding: Extruded shape; smooth surface finish; self locking serrated tongue; of width to match component thickness; as indicated on drawings finish.
- C. Fasteners: Size and type to suit application.
- D. Concealed Joint Fasteners: Threaded steel.

2.5 HARDWARE

- A. Fixed Countertop Brackets:
 - 1. Material: Steel.
 - 2. Color: Selected by Architect from manufacturer's standard range.
 - 3. Manufacturers: Rakks/Rangine Corporation; EH Series Brackets: www.rakks.com/#sle

2.6 FABRICATION

- A. Assembly: Shop assemble cabinets for delivery to site in units easily handled and to permit passage through building openings.
- B. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.

- C. Fitting: When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide matching trim for scribing and site cutting.
- D. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners.
 - 1. Apply laminate backing sheet to reverse side of plastic laminate finished surfaces.

2.7 FIRE-RETARDANT-TREATED MATERIALS

- A. Where fire-retardant-treated materials are indicated, use materials that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency..
 - 1. Use treated materials that comply with requirements of referenced quality standard. Do not use materials that are warped, discolored, or otherwise defective.
 - 2. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants to distinguish treated materials from untreated materials.
 - 3. Identify fire-retardant-treated materials with appropriate classification marking of qualified testing agency in the form of removable paper label or imprint on surfaces that will be concealed from view after installation.
- B. Fire-Retardant-Treated Lumber and Plywood: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.
 - 1. Kiln-dry lumber and plywood after treatment to a maximum moisture content of 19 and 15 percent, respectively.
 - 2. Mill lumber after treatment within limits set for wood removal that do not affect listed fire-test-response characteristics, using a woodworking shop certified by testing and inspecting agency.
 - 3. Mill lumber before treatment and implement procedures during treatment and drying processes that prevent lumber from warping and developing discolorations from drying sticks or other causes, marring, and other defects affecting appearance of architectural cabinets.
- C. Fire-Retardant Fiberboard: MDF panels complying with ANSI A208.2, made from softwood fibers, synthetic resins, and fire-retardant chemicals mixed together at time of panel manufacture to achieve flame-spread index of 25 or less and smoke-developed index of 200 or less per ASTM E 84.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Flakeboard Company Limited.
 - b. SierraPine.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Set and secure custom cabinets in place, assuring that they are rigid, plumb, and level.
- B. Use fixture attachments in concealed locations for wall mounted components.
- C. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch (0.79 mm). Do not use additional overlay trim for this purpose.
- D. Secure bench to floor using appropriate angles and anchorages.

3.2 ADJUSTING

- A. Adjust installed work.
- B. Adjust moving or operating parts to function smoothly and correctly.

3.3 CLEANING

- A. Clean casework, counters, shelves, hardware, fittings, and fixtures.

END OF SECTION 06 41 00

SECTION 06 42 00 - WOOD PANELING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Custom paneling.

1.2 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2018b.
- B. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014, with Errata (2016).
- C. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.1; 2016, with Errata (2017).
- D. AWPA U1 - Use Category System: User Specification for Treated Wood; 2017.

1.3 SUBMITTALS

- A. Product Data: Provide data on fire retardant treatment materials and application instructions.
- B. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
 - 1. Scale of Drawings: 1-1/2 inch to 1 foot (125 mm to 1 m), minimum.
 - 2. Provide plan of panel number sequencing.
 - 3. Provide information as required by AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS).
 - 4. Include certification program label.
- C. Samples: Submit two samples of finished plywood, 4 x 4 inch (100 x 100 mm) in size, illustrating grain and finish.
- D. Mock-up: Construct mock-up in accordance with approved shop drawings, project manual, and Contract Drawings, using exact materials and methods approved for the Project, including required accessories.
 - 1. Millwork Panel Mock-ups: Coordinate production, materials, and products for which mock-ups are required in individual Specification Sections and supporting materials.
 - a. Contractor shall provide 2 mock-ups which are to be 1'-0" wide by 2'-0" tall minimum.
 - (1) Mock-up shall include a butt jointed panel with a concealed spline and a butt jointed inside corner. This mock-up will also include the base metal trims as indicated on Drawing A501.
 - (2) Mock-up shall include a panel joint trim and panel joint at inside corner as indicated on Drawing A501.
 - b. This should demonstrate the contractor's ability to provide a tight, aesthetically pleasing, joint conforming to the contract documents.
 - c. Mock-ups shall be complete in all respects and shall represent the final complete wall panels system including back-up wall system, z-clips, laminated panel, joinery detail, sealants and metal finishes trims.
- E. Certificate: Submit labels and certificates required by quality assurance and quality control programs.

1.4 QUALITY ASSURANCE

- A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.
 - 1. Accredited participant in the specified certification program prior to the commencement of fabrication and throughout the duration of the project.
 - 2. Single Source Responsibility: Provide and install this work from single fabricator.

- B. Quality Certification:
 - 1. Provide labels or certificates indicating that the installed work complies with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade or grades specified.
 - 2. Provide designated labels on shop drawings as required by certification program.
 - 3. Provide designated labels on installed products as required by certification program.
 - 4. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.

1.5 MOCK-UP

- A. Construct mock-up, ± 8 feet (2.44 m) long by 7'-9" feet (2.36 m) wide, illustrating full panel sheet, edge trim, joint trim, applied finish.
- B. Approved mock-up may remain as part of the Work.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect work from moisture damage.
- B. Do not deliver wood materials to project site until building is fully enclosed and interior temperature and humidity are in accordance with recommendations of AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS).

PART 2 PRODUCTS

2.1 PANELING

- A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless otherwise indicated.
- B. Flat Paneling:
 - 1. Plastic Laminated Faced Panels: AWI Premium Grade.
 - 2. Finish: As indicated on Drawings.
 - 3. Visible Edges and Reveals: Trim as indicated on Drawings.
 - 4. Outside Corners: Trim as indicated on Drawings.
 - 5. Mounting: Basis of Design: Aluminum Z Clips (Panel Clips) - Monarch Metal.
 - 6. Joinery between panels: Concealed spline.
 - 7. Fire Rating: Class A.

2.2 LAMINATE MATERIALS

- A. Manufacturers: Wilsonart LLC; www.wilsonart.com/#sle.
- B. High Pressure Decorative Laminate (HPDL): NEMA LD 3, types as recommended for specific applications.
 - 1. Fire Rated: Class A.
- C. Provide specific types as indicated on drawings

2.3 FABRICATION

- A. Prepare panels for delivery to site, permitting passage through building openings.
- B. Finish exposed edges of panels as specified by grade requirements.

2.4 ACCESSORIES

- A. Lumber for Shimming, Blocking: Softwood lumber of pine species.
- B. Wood Filler: Tinted to match surface finish color.

- C. Adhesive: Type recommended by fabricator to suit application.
- D. Fasteners: Size and type to suit application.
- E. Concealed Joint Fasteners: Threaded steel.

2.5 FIRE-RETARDANT-TREATED MATERIALS

- A. Where fire-retardant-treated materials are indicated, use materials that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency..
 - 1. Use treated materials that comply with requirements of referenced quality standard. Do not use materials that are warped, discolored, or otherwise defective.
 - 2. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants to distinguish treated materials from untreated materials.
 - 3. Identify fire-retardant-treated materials with appropriate classification marking of qualified testing agency in the form of removable paper label or imprint on surfaces that will be concealed from view after installation.
- B. Fire-Retardant-Treated Lumber and Plywood: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.
 - 1. Kiln-dry lumber and plywood after treatment to a maximum moisture content of 19 and 15 percent, respectively.
 - 2. Mill lumber after treatment within limits set for wood removal that do not affect listed fire-test-response characteristics, using a woodworking shop certified by testing and inspecting agency.
 - 3. Mill lumber before treatment and implement procedures during treatment and drying processes that prevent lumber from warping and developing discolorations from drying sticks or other causes, marring, and other defects affecting appearance of architectural cabinets.
- C. Fire-Retardant Fiberboard: MDF panels complying with ANSI A208.2, made from softwood fibers, synthetic resins, and fire-retardant chemicals mixed together at time of panel manufacture to achieve flame-spread index of 25 or less and smoke-developed index of 200 or less per ASTM E 84.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Flakeboard Company Limited.
 - b. SierraPine.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated on shop drawings.
- B. Verify adequacy of backing and support framing.
- C. Verify mechanical, electrical, and building items affecting work of this section are placed and ready to receive this work.

3.2 INSTALLATION

- A. Install work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade indicated.
- B. Do not begin installation until wood materials have been fully acclimated to interior conditions.
- C. Set and secure materials and components in place, plumb and level, using concealed fasteners wherever possible.

3.3 TOLERANCES

- A. Maximum Variation from True Position: 1/16 inch (1.6 mm).
- B. Maximum Offset from True Alignment with Abutting Materials: 1/32 inch (0.8 mm).

END OF SECTION 06 42 00

SECTION 07 84 13 – PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Penetrations in fire-resistance-rated walls.
 - 2. Penetrations in horizontal assemblies.
 - 3. Penetrations in smoke barriers.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Product Schedule: For each penetration firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.
 - 1. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping system, submit illustration, with modifications marked, approved by penetration firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly. Obtain approval of authorities having jurisdiction prior to submittal.

1.4 INFORMATIONAL SUBMITTALS

- A. Product test reports.

1.5 CLOSEOUT SUBMITTALS

- A. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics:
 - 1. Perform penetration firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
 - 2. Test per testing standards referenced in "Penetration Firestopping Systems" Article. Provide rated systems complying with the following requirements:
 - a. Penetration firestopping systems shall bear classification marking of a qualified testing agency.
 - 1) UL in its "Fire Resistance Directory."
 - 2) Intertek Group in its "Directory of Listed Building Products."
 - 3) FM Global in its "Building Materials Approval Guide."

2.2 PENETRATION FIRESTOPPING SYSTEMS

- A. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. 3M Fire Protection Products.
 - b. Hilti, Inc.
 - c. Tremco, Inc.
- B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
 - 1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.
- C. Penetrations in Horizontal Assemblies: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
 - 1. F-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated.
 - 2. T-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
 - 3. W-Rating: Provide penetration firestopping systems showing no evidence of water leakage when tested according to UL 1479.
- D. Penetrations in Smoke Barriers: Penetration firestopping systems with ratings determined per UL 1479, based on testing at a positive pressure differential of 0.30-inch wg.
 - 1. L-Rating: Not exceeding 5.0 cfm/sq. ft. of penetration opening at and no more than 50-cfm cumulative total for any 100 sq. ft. at both ambient and elevated temperatures.
- E. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per ASTM E 84.
- F. VOC Content: Penetration firestopping sealants and sealant primers shall comply with the following limits for VOC content:
 - 1. Sealants: 250 g/L.
 - 2. Sealant Primers for Nonporous Substrates: 250 g/L.
 - 3. Sealant Primers for Porous Substrates: 775 g/L.
- G. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.
- B. General: Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications.
- C. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings.
 - 1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.

- D. Install fill materials by proven techniques to produce the following results:
 - 1. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve required fire-resistance ratings.
 - 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
 - 3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.2 IDENTIFICATION

- A. Wall Identification: Permanently label walls containing penetration firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches high and with minimum 0.375-inch strokes.
 - 1. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 feet from end of wall and at intervals not exceeding 30 feet.
- B. Penetration Identification: Identify each penetration firestopping system with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
 - 1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
 - 2. Contractor's name, address, and phone number.
 - 3. Designation of applicable testing and inspecting agency.
 - 4. Date of installation.
 - 5. Manufacturer's name.
 - 6. Installer's name.

3.3 FIELD QUALITY CONTROL

- A. Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E 2174.
- B. Where deficiencies are found or penetration firestopping system is damaged or removed because of testing, repair or replace penetration firestopping system to comply with requirements.
- C. Proceed with enclosing penetration firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

END OF SECTION 07 84 13

SECTION 07 92 00 – JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Urethane joint sealants.
 - 2. Mildew-resistant joint sealants.
 - 3. Latex joint sealants.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

- A. Product Data: For each joint sealant product.
- B. Samples: For each kind and color of joint sealant required.
- C. Joint Sealant Schedule: Include the following information:
 - 1. Joint sealant application, joint location, and designation.
 - 2. Joint sealant manufacturer and product name.
 - 3. Joint sealant formulation.
 - 4. Joint sealant color.

1.4 INFORMATIONAL SUBMITTALS

- A. Product test reports.
- B. Preconstruction laboratory test reports.
- C. Preconstruction field-adhesion-test reports.
- D. Field-adhesion-test reports.
- E. Sample warranties.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM C 1021 to conduct the testing indicated.

1.6 PRECONSTRUCTION TESTING

- A. Preconstruction Laboratory Testing: Submit to joint sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.
 - 1. Adhesion Testing: Use ASTM C 794 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
 - 2. Compatibility Testing: Use ASTM C 1087 to determine sealant compatibility when in contact with glazing and gasket materials.
- B. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates. Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1.1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.

1.7 WARRANTY

- A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 JOINT SEALANTS, GENERAL

- A. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 URETHANE JOINT SEALANTS

- A. Urethane, S, NS, 25, NT: Single-component, nonsag, nontraffic-use, plus 25 percent and minus 25 percent movement capability, urethane joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF Construction Chemicals - Building Systems; Sonalastic TX1.
 - b. Bostik, Inc.; Chem-Calk GPS1.
 - c. ER Systems, an ITW Company; Pacific Polymers Elasto-Thane 230 MP.
 - d. Pecora Corporation; Dynatrol I-XL.
 - e. Polymeric Systems, Inc.; Flexiprene 1000.
 - f. Sika Corporation U.S.; Sikaflex Textured Sealant.
 - g. Tremco Incorporated; Dymonic.

2.3 MILDEW-RESISTANT JOINT SEALANTS

- A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.
- B. Silicone, Mildew Resistant, Acid Curing, S, NS, 25, NT: Mildew-resistant, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Corning Corporation; 786-M White.
 - b. GE Construction Sealants; Momentive Performance Materials Inc.; SCS1700 Sanitary.
 - c. May National Associates, Inc., a subsidiary of Sika Corporation U.S.; Bondaflex Sil 100 WF.
 - d. Soudal USA; RTV GP.
 - e. Tremco Incorporated; Tremsil 200.
- C. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF Construction Chemicals - Building Systems; Sonolac.
 - b. May National Associates, Inc., a subsidiary of Sika Corporation U.S.; Bondaflex 600.
 - c. Pecora Corporation; AC-20.
 - d. Tremco Incorporated; Tremflex 834.

2.4 JOINT SEALANT BACKING

- A. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BASF Construction Chemicals - Building Systems.
 - b. Construction Foam Products, a division of Nomaco, Inc.

- B. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer.

2.5 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - PRODUCTS

3.1 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint sealant manufacturer's written instructions and the following requirements:
 - 1. Remove laitance and form-release agents from concrete.
 - 2. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion.
- B. Joint Priming: Prime joint substrates where recommended by joint sealant manufacturer or as indicated by preconstruction joint sealant substrate tests or prior experience.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces.

3.2 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with ASTM C 1193 and joint sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
- C. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- D. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
 - 1. Place sealants so they directly contact and fully wet joint substrates.
 - 2. Completely fill recesses in each joint configuration.
 - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants to form smooth, uniform beads of configuration indicated. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 - 1. Provide concave joint profile per Figure 8A in ASTM C 1193 unless otherwise indicated.

3.3 JOINT SEALANT SCHEDULE

- A. Joint Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.
 - 1. Joint Locations:
 - a. Control joints on exposed interior surfaces of exterior walls.
 - b. Control joints.

- c. Vertical joints on exposed surfaces of unit masonry, concrete, walls, and partitions.
 - d. Other joints as indicated on Drawings.
 - 2. Joint Sealant: Urethane, S, NS, 25, NT.
 - 3. Joint Sealant Color: As selected by Architect from manufacturer's full range of colors.
- B. Joint Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces not subject to significant movement.
 - 1. Joint Locations:
 - a. Control joints on exposed interior surfaces of exterior walls.
 - b. Perimeter joints between interior wall surfaces and frames of interior doors windows and elevator entrances.
 - c. Other joints as indicated on Drawings.
 - 2. Joint Sealant: Acrylic latex.
 - 3. Joint Sealant Color: As selected by Architect from manufacturer's full range of colors.
- C. Joint Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.
 - 1. Joint Locations:
 - a. Joints between plumbing utilities and non-rated adjoining walls, floors, and counters.
 - b. Perimeter joints between counters and adjacent walls, angles, and panels.
 - c. Other joints as indicated on Drawings.
 - 2. Joint Sealant: Silicone, mildew resistant, acid curing, S, NS, 25, NT.
 - 3. Joint Sealant Color: As selected by Architect from manufacturer's full range of colors.
- D. Joint Sealant Application: Concealed mastics.
 - 1. Joint Locations:
 - a. Thresholds.
 - b. Sill plates.
 - c. Other joints as indicated on Drawings.
 - 2. Joint Sealant: Butyl-rubber based.
 - 3. Joint Sealant Color: As selected by Architect from manufacturer's full range of colors.

END OF SECTION 07 92 00

SECTION 08 11 13 – HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Extent of steel doors and frames is indicated on drawings and in schedules.
- B. Types of hollow metal work includes:
 - 1. Steel doors.
 - 2. Steel door frames.

1.3 SUBMITTALS

- A. Product Data: Mfr's standard details and specifications for steel doors and door and window frames.
- B. Shop Drawings: Indicate application of products to project.

1.4 QUALITY ASSURANCE

- A. Standards: Comply with Steel Door Institute (SDI-100-91) "Recommended Specifications for Standard Steel Doors and Frames" for materials quality, metal gages, and construction details for Grades and Models indicated in Part 2 of this Section, and shall meet ANSI Grade A requirements

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide products of one of the following:
 - 1. Amweld Building Products, Inc.
 - 2. Ceco Corp.
 - 3. Curries Co.
 - 4. Pioneer Builders. Products Corp./Div. CORE Industries, Inc.
 - 5. Republic Builders Products
 - 6. Steelcraft/Div. American Standard Co.

2.2 STEEL DOORS AND FRAMES

- A. Materials: Steel doors and frames; hot-rolled, pickled and oiled per ASTM A 569 and A 568; cold-rolled per ASTM A 366 and A 568.
- B. Steel Doors, General: Provide doors complying with material and construction requirements of ANSI/SDI-100 for the indicated Grades and Models:
 - 1. Grade II, heavy-duty (Level B); 1-3/4-inch thick; min. 18 gage face sheets.
 - 2. Model 3, Seamless - Hollow Steel Construction.
- C. Steel Frames, General: Provide frames complying with material and construction requirements of ANSI/SDI-111A, and as follows:
 - 1. Metal Thickness: Min. 14 gage.
 - 2. Type: Welded (partitions).
- D. Fire-rated Assemblies: Provide units that are labeled and listed for rating indicated, by Underwriters' Laboratories or Warnock-Hersey.

- E. Anchors and Accessories: Manufacturer's standard units.

2.3 FABRICATION

- A. Fabricate units to be rigid, neat in appearance, and free from defects, warp or buckle. Weld exposed joints continuously, grind, dress, and make smooth, flush and invisible.
- B. Cut-Outs: Regardless of cut-out locations shown on Drawings, provide flush panel at the bottom 10 inches of each door, in compliance with State of Michigan barrier-free requirements.
- C. Prepare steel doors and frames to receive mortised and concealed finish hardware, including cutouts, reinforcing, drilling and tapping, complying with ANSI A 115 "Specifications for Door and Frame Preparation for Hardware".
 - 1. Prepare frames to receive 3 silencers on strike jambs of single-swing frames and on heads of double-swing frames.
- D. Locate finish hardware per DHI "Recommended Locations for Builder's Hardware".
- E. Shop paint exposed surfaces of doors and frame units, including galvanized surfaces, using mfr's standard baked-on rust inhibitive primer.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Placing Frames: Comply with provisions of SDI 105, unless otherwise indicated. Set frames, with spreaders, accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is completed, remove temporary braces and spreaders, leaving surfaces smooth and undamaged.
 - 1. Except for frames located in existing concrete, masonry, or gypsum board assembly construction, place frames before constructing enclosing walls and ceilings.
 - 2. In masonry construction, install at least 3 wall anchors per jamb adjacent to hinge location on hinge jamb and at corresponding heights on strike jamb. Acceptable anchors include masonry wire anchors and masonry T-shaped anchors.
 - 3. At existing concrete or masonry construction, install at least 3 completed opening anchors per jamb adjacent to hinge location on hinge jamb and at corresponding heights on strike jamb. Set frames and secure to adjacent construction with bolts and masonry anchorage devices.
 - 4. Install fire-rated frames according to NFPA 80.
- B. Door Installation: Fit hollow-metal doors accurately in frames, within clearances specified in ANSI/SDI 100.
 - 1. Fitting Clearances for Non-Rated Doors: Provide 1/8-inch at jambs and heads; 1/16-inch per leaf at meeting stiles for pairs of doors; and 1/2-inch from bottom of door to top of decorative floor finish or covering. Where threshold is shown or scheduled, provide 1/8-inch clearance from bottom of door to top of threshold.
 - 2. Fire-Rated Doors: Smoke and draft control door assemblies must be tested in accordance with UL 1784. Provide fitting clearances as required to meet the testing requirements of UL 1784 without the use of applied gasketing. Installation and clearances shall be in accordance with NFPA 80.
 - 3. Smoke-Control Doors: Comply with NFPA 105.

3.2 ADJUSTING AND CLEANING

- A. Prime Coat Touchup: Immediately after erection, sand smooth any rusted or damaged areas of prime coat and apply touchup of compatible air-drying primer.

- B. Protection Removal: Immediately before final inspection, remove protective wrappings from doors and frames.

END OF SECTION 08 11 13

SECTION 08 33 00 - ROLLING COUNTER FIRE SHUTTERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes electric operated automatic closing rolling fire door and counter fire doors.
- B. Related Sections:
 - 1. Division 06 Section "Rough Carpentry" door opening jamb and head members.
 - 2. Division 26 - Electrical for wiring and conduit, fuses, disconnect switches, connection of operator to power supply, installation of control station and wiring, and connection to alarm system.
- C. Products that may be supplied, but are not installed under this Section:
 - 1. Control station.
 - 2. Electrical disconnect.
 - 3. Annunciators.
 - 4. Primary and control wiring.
 - 5. Conduit and fittings.

1.2 SYSTEM DESCRIPTION

- A. Performance Requirements:
 - 1. Provide doors with Underwriters' Laboratories, Inc. label for the fire rating classification, 1-1/2 hr
 - 2. Provide doors with Underwriters' Laboratories, Inc. label for "Leakage Rated Assembly" or "S" label demonstrating product tested to UL 1784.
 - a. Comply with NFPA 105 air leakage requirements.

1.3 SUBMITTALS

- A. Reference Division 01 Section "Submittal Procedures"; submit the following items:
 - 1. Product Data.
 - 2. Shop Drawings: Include special conditions not detailed in Product Data. Show interface with adjacent work.
 - 3. Quality Assurance/Control Submittals:
 - a. Provide proof of manufacturer ISO 9001:2015 registration.
 - b. Provide proof of manufacturer and installer qualifications - see 1.4 below.
 - c. Provide manufacturer's installation instructions.
 - 4. Closeout Submittals:
 - a. Operation and Maintenance Manual.
 - b. Certificate stating that installed materials comply with this Specification.

1.4 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Manufacturer Qualifications: ISO 9001:2015 registered and a minimum of 5 years experience in producing counter fire doors and smoke control units of the type specified.
 - 2. Installer Qualifications: Manufacturer's approval.

1.5 DELIVERY STORAGE AND HANDLING

- A. Reference Division 01 Section "Product Storage and Handling Requirements."
- B. Follow manufacturer's instructions.

1.6 WARRANTY

- A. Standard Warranty: Two years from date of shipment against defects in material and workmanship.
- B. Maintenance: Submit for owner's consideration and acceptance of a maintenance service agreement for installed products.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Manufacturer:
 - 1. Cornell: 24 Elmwood Avenue Mountain Top, PA 18707. Telephone: (800) 233-8366.
 - a. Model: ERC10.
 - 2. Cookson.
 - 3. Clopay Building Products.
 - 4. Amarr.
 - 5. Substitutions: Permitted under Division 01 Section "Product Substitution Procedures."

2.2 MATERIALS

- A. Curtain:
 - 1. Slat Configuration:
 - a. Galvanized Steel with Finish as Described Below: No. 1F, interlocked flat-faced slats, 1-1/2 inches (38 mm) high by 1/2 inch (13 mm) deep, minimum 22 gauge ASTM A 653, Commercial Quality, galvanized steel with plain steel bottom bar and vinyl astragal
 - 2. Finish:
 - a. GalvaNex™ Coating System (Stock Colors): ASTM A 653 galvanized base coating treated with dual process rinsing agents in preparation for chemical bonding baked-on base coat and tan baked-on polyester enamel finish coat.
 - 1) Galvanized Tan.
- B. Endlocks: Fabricate continuous interlocking slat sections with high strength galvanized steel endlocks riveted to slats per UL requirements
- C. Guides:
 - 1. Configuration and Finish:
 - a. Steel: minimum 12 gauge formed shapes.
 - 1) Powder Coat (Stock Colors): Zirconium treatment followed by a tan baked-on polyester powder coat; minimum 2.5 mils (0.065 mm) cured film thickness
- D. Counterbalance Shaft Assembly:
 - 1. Barrel: Steel pipe capable of supporting curtain load with maximum deflection of 0.03 inch per foot (2.5 mm per meter) of width
 - 2. Spring Balance: Oil-tempered, heat-treated steel helical torsion spring assembly designed for proper balance of door to ensure that maximum effort to operate will not exceed 25 lbs (110 N). Provide wheel for applying and adjusting spring torque.
- E. Brackets:
 - 1. Fabricate from reinforced steel plate with permanently lubricated ball or roller bearings at rotating support points to support counterbalance shaft assembly and form end closures.
 - 2. Finish:
 - a. Powder Coat (Stock Colors): Zirconium treatment followed by a tan baked-on polyester powder coat; minimum 2.5 mils (0.065 mm) cured film thickness.

- F. Hood and Mechanism Covers:
1. 24 gauge galvanized steel] with reinforced top and bottom edges. Provide minimum 1/4 inch (6.35 mm) steel intermediate support brackets as required to prevent excessive sag.
 2. Finish:
 - a. GalvaNex™ Coating System (Stock Colors):
 - 1) ASTM A 653 galvanized base coating treated with dual process rinsing agents in preparation for chemical bonding baked-on base coat and tan baked-on polyester finish coat.
- G. Smoke Seals and UL Smoke Label:
1. Bottom Bar: UL tested brush seal.
 2. Guides and Head: Replaceable, UL Listed, brush seals sealing against fascia side of curtain.

2.3 OPERATION

- A. Motor Operation:
1. AlarmGard Advanced Fire Shutter Motor Operation: UL, cUL listed NEMA 1 enclosure, horsepower as recommended by manufacturer, 115v single phase service. Provide a totally enclosed non ventilated motor, removable without affecting the setting of limit switches; thermal overload protection, planetary gear reduction, adjustable rotary limit switch mechanism and a transformer with 24v secondary output. All internal electrical components are to be prewired to terminal blocks.
 - a. Provide a failsafe motor operated door assembly requiring no ancillary or externally mounted release devices, cables, chains, pulleys, reset handles or mechanisms.
 - b. Provide an internal electrical failsafe release device that requires no additional wiring, external cables or mounting locations.
 - c. Provide an internal solenoid brake mechanism to hold the door at any position during normal door operation.
 - d. Provide logic for 1 fully monitored safety reversing devices such that the failure of any single monitored device will cause the motor operator to automatically revert to constant pressure to close.
 - e. Electrically activate door system automatic closure by notification from central alarm system.
 - f. Provide an automatic alarm closure selectable time delay of zero or ten seconds.
 - g. Control automatic closure speed with an internal, totally enclosed, variable rate centrifugal governor without the use of electrical pulsation, constant rate viscosity, oscillation type or other exposed governing devices.
 - h. Maintain automatic closure speed at not more than 9 inches (229 mm) per second.
 - i. Enable safety edge function during alarm closing while power is present for 0cycle[s]. Enable door to rest upon obstruction following this sequence.
 - j. Electrically reset internal failsafe release device and door operating system upon restoration of electrical power and upon clearing of the alarm signal without requiring human supervision.
 - k. Provide selectable ability for the door system to automatically self-cycle to the fully open position following automatic reset without requiring human supervision.
 - l. Provide an integral, non-resettable cycle counter.
 - m. Ensure that manual resetting of spring tension, release devices, linkages or mechanical dropouts will not be required.
 - n. Provide minimum #50 roller chain for drive connection from motor drive assembly to the door drive shaft.
 - o. Install system only with manufacturer supplied or specified fasteners.
 - p. Notify electrical contractor to mount control station(s) and supply the appropriate disconnect switch, all conduit and wiring per the door system wiring instructions.
 - q. Drop test and reset door system twice by all means of activation and comply fully with NFPA 80 Section 5.
- B. Control Station:
1. Flush Mounted: "Open/Close" key switch with "Stop" push button; NEMA 1B.
- C. Control Operation:
1. Constant pressure to close: No sensing device required.

2.4 ACCESSORIES

- A. Locking: None.
- B. Photoelectric Smoke/Heat Detector (when not connected to central alarm system): UL listed.
- C. Operator and Full Bracket Mechanism Cover: 24 gauge galvanized steel sheet metal cover to enclose exposed moving operating components at coil area of unit. Finish to match door hood.
- D. Sill Angle at Counter Installation:
 - 1. Sill angle provide by manufacturer for closure at counter.
 - 2. GalvaNex™ Coating System (Stock Colors):
 - a. ASTM A 653 galvanized base coating treated with dual process rinsing agents in preparation for chemical bonding baked-on base coat and tan baked-on polyester finish coat.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates upon which work will be installed and verify conditions are in accordance with approved shop drawings.
- B. Coordinate with responsible entity to perform corrective work on unsatisfactory substrates.
- C. Commencement of work by installer is acceptance of substrate.

3.2 INSTALLATION

- A. Install door and operating equipment with necessary hardware, anchors, inserts, hangers and supports.
- B. Comply with NFPA 80 and follow manufacturer's installation instructions.

3.3 ADJUSTING

- A. Following completion of installation, including related work by others, lubricate, test, and adjust doors for ease of operation, free from warp, twist, or distortion.

3.4 FIELD QUALITY CONTROL

- A. Site Test: Test doors for normal operation and automatic closing. Coordinate with authorities having jurisdiction to witness test and sign Drop Test Form.

3.5 CLEANING

- A. Clean surfaces soiled by work as recommended by manufacturer.
- B. Remove surplus materials and debris from the site.

3.6 DEMONSTRATION

- A. Demonstrate proper operation to Owner's Representative.
- B. Instruct Owner's Representative in maintenance procedures.

END OF SECTION 08 33 00

SECTION 08 51 13 - ALUMINUM WINDOWS

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- A. Section 06 1000 - Rough Carpentry: Rough opening framing.
- B. Section 07 9200 - Joint Sealants: Sealing joints between window frames and adjacent construction.
- C. Section 08 8000 - Glazing.

1.2 REFERENCE STANDARDS

- A. AAMA/WDMA/CSA 101/I.S.2/A440 - North American Fenestration Standard/Specification for windows, doors, and skylights; 2017.
- B. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum (Combined Document); 2015.
- C. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2014 (2015 Errata).

1.3 SUBMITTALS

- A. Product Data: Provide component dimensions, information on glass and glazing, internal drainage details, and descriptions of hardware and accessories.
- B. Shop Drawings: Indicate opening dimensions, elevations of different types, framed opening tolerances, method for achieving air and vapor barrier seal to adjacent construction, anchorage locations, and installation requirements.
- C. Samples: Submit two samples, 12 by 12 inch (300 by 300 mm) in size illustrating typical corner construction, accessories, and finishes.
- D. Grade Substantiation: Prior to submitting shop drawings or starting fabrication, submit one of the following showing compliance with specified grade:
 - 1. Evidence of AAMA Certification.
 - 2. Evidence of WDMA Certification.
 - 3. Evidence of CSA Certification.
 - 4. Test report(s) by independent testing agency itemizing compliance and acceptable to authorities having jurisdiction.
- E. Test Reports: Prior to submitting shop drawings or starting fabrication, submit test report(s) by independent testing agency showing compliance with performance requirements in excess of those prescribed by specified grade.
- F. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design: Tubelite.
- B. Other Acceptable - Aluminum Windows Manufacturers:
 - 1. Arcadia, Inc; www.arcadiainc.com/#sle.
 - 2. Boyd Aluminum; www.boydaluminum.com/#sle.
 - 3. Manko Window Systems, Inc; www.mankowindows.com/#sle.
 - 4. Peerless Products, Inc; www.peerlessproducts.com/#sle.
 - 5. TRACO; www.traco.com/#sle.
 - 6. Wausau Window and Wall Systems; www.wausauwindow.com/#sle.
 - 7. Winco Window Company, Inc; Series 1450HR: www.wincowindow.com/#sle.

2.2 BASIS OF DESIGN - WINDOW SYSTEM

- A. Fixed, Non-Thermally-Broken:
 - 1. Basis of Design: 4500 Series Storefront.

2.3 ALUMINUM WINDOWS

- A. Aluminum Windows: Extruded aluminum frame and sash, factory fabricated, factory finished, with operating hardware, related flashings, and anchorage and attachment devices.
 - 1. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors; fasteners and attachments concealed from view; reinforced as required for operating hardware and imposed loads.
 - 2. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.
 - 3. Movement: Accommodate movement between window and perimeter framing and deflection of lintel, without damage to components or deterioration of seals.
 - 4. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
- B. Fixed, Non-Operable Type:
 - 1. Construction: Non-thermally broken.
 - 2. Glazing: Single; clear; transparent.
 - 3. Exterior Finish: Class I color anodized.
 - 4. Interior Finish: Class I color anodized.

2.4 COMPONENTS

- A. Glazing: As specified in Section 08 8000.
- B. Glazing Materials: As specified in Section 08 8000.
- C. Sealant for Setting Sills and Sill Flashing: Non-curing butyl type.

2.5 FINISHES

- A. Class I Color Anodized Finish: AAMA 611 AA-M12C22A42 Integrally colored anodic coating not less than 0.7 mils (0.018 mm) thick.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install windows in accordance with manufacturer's instructions.
- B. Attach window frame and shims to perimeter opening to accommodate construction tolerances and other irregularities.
- C. Align window plumb and level, free of warp or twist. Maintain dimensional tolerances and alignment with adjacent work.
- D. Install sill.
- E. Install glass and infill panels in accordance with requirements specified in Section 08 8000.

3.2 CLEANING

- A. Remove protective material from factory finished aluminum surfaces.
- B. Wash surfaces by method recommended and acceptable to window manufacturer; rinse and wipe surfaces clean.
- C. Upon completion of installation, thoroughly clean aluminum surfaces in accordance with AAMA 609 & 610.
- D. Remove excess glazing sealant by moderate use of mineral spirits or other solvent acceptable to sealant and window manufacturer.

END OF SECTION 08 51 13

SECTION 08 71 11 – DOOR HARDWARE (DESCRIPTIVE SPECIFICATION)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes:
 - 1. Mechanical and electrified door hardware for:
 - a. Swinging doors.
 - 2. Electronic access control system components, including:
 - a. Biometric access control reader.
 - b. Electronic access control devices.
 - 3. Field verification, preparation and modification of existing doors and frames to receive new door hardware.
 - 4. Lead-lining door hardware items required for radiation protection at door openings.
- B. Exclusions: Unless specifically listed in hardware sets, hardware is not specified in this section for:
 - 1. Windows
 - 2. Cabinets (casework), including locks in cabinets
 - 3. Signage
 - 4. Overhead doors

1.3 REFERENCES

- A. UL - Underwriters Laboratories
 - 1. UL 10B - Fire Test of Door Assemblies
 - 2. UL 10C - Positive Pressure Test of Fire Door Assemblies
 - 3. UL 1784 - Air Leakage Tests of Door Assemblies
 - 4. UL 305 - Panic Hardware
- B. DHI - Door and Hardware Institute
 - 1. Sequence and Format for the Hardware Schedule
 - 2. Recommended Locations for Builders Hardware
 - 3. Key Systems and Nomenclature
- C. ANSI - American National Standards Institute
 - 1. ANSI/BHMA A156.1 - A156.29, and ANSI/BHMA A156.31 - Standards for Hardware and Specialties

1.4 SUBMITTALS

- A. General:
 - 1. Submit in accordance with Conditions of Contract and Division 01 requirements.
 - 2. Highlight, encircle, or otherwise specifically identify on submittals deviations from Contract Documents, issues of incompatibility or other issues which may detrimentally affect the Work.
 - 3. Prior to forwarding submittal, comply with procedures for verifying existing door and frame compatibility for new hardware, as specified in PART 3, "EXAMINATION" article, herein.
- B. Action Submittals:
 - 1. Product Data: Product data including manufacturers' technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.

2. Riser and Wiring Diagrams: After final approval of hardware schedule, submit details of electrified door hardware, indicating:
 - a. Wiring Diagrams: For power, signal, and control wiring and including:
 - 1) Details of interface of electrified door hardware and building safety and security systems.
 - 2) Schematic diagram of systems that interface with electrified door hardware.
 - 3) Point-to-point wiring.
 - 4) Risers.
 3. Samples for Verification: If requested by Architect, submit production sample or sample installations of each type of exposed hardware unit in finish indicated, and tagged with full description for coordination with schedule.
 - a. Samples will be returned to supplier in like-new condition. Units that are acceptable to Architect may, after final check of operations, be incorporated into Work, within limitations of key coordination requirements.
 4. Door Hardware Schedule: Submit schedule with hardware sets in vertical format as illustrated by Sequence of Format for the Hardware Schedule as published by the Door and Hardware Institute. Indicate complete designations of each item required for each door or opening, include:
 - a. Door Index; include door number, heading number, and Architects hardware set number.
 - b. Opening Lock Function Spreadsheet: List locking device and function for each opening.
 - c. Type, style, function, size, and finish of each hardware item.
 - d. Name and manufacturer of each item.
 - e. Fastenings and other pertinent information.
 - f. Location of each hardware set cross-referenced to indications on Drawings.
 - g. Explanation of all abbreviations, symbols, and codes contained in schedule.
 - h. Mounting locations for hardware.
 - i. Door and frame sizes and materials.
 - j. Name and phone number for local manufacturer's representative for each product.
 - k. Operational Description of openings with any electrified hardware (locks, exits, electromagnetic locks, electric strikes, automatic operators, door position switches, magnetic holders or closer/holder units, and access control components). Operational description should include how door will operate on egress, ingress, and fire and smoke alarm connection.
 - 1) Submittal Sequence: Submit door hardware schedule concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate fabrication of other work that is critical in Project construction schedule.
 5. Key Schedule:
 - a. After Keying Conference, provide keying schedule listing levels of keying as well as explanation of key system's function, key symbols used and door numbers controlled.
 - b. Use ANSI/BHMA A156.28 "Recommended Practices for Keying Systems" as guideline for nomenclature, definitions, and approach for selecting optimal keying system.
 - c. Provide 3 copies of keying schedule for review prepared and detailed in accordance with referenced DHI publication. Include schematic keying diagram and index each key to unique door designations.
 - d. Index keying schedule by door number, keyset, hardware heading number, cross keying instructions, and special key stamping instructions.
 - e. Provide one complete bitting list of key cuts and one key system schematic illustrating system usage and expansion.
 - 1) Forward bitting list, key cuts and key system schematic directly to Owner, by means as directed by Owner.
 - f. Prepare key schedule by or under supervision of supplier, detailing Owner's final keying instructions for locks.
 6. Templates: After final approval of hardware schedule, provide templates for doors, frames and other work specified to be factory prepared for door hardware installation.
- C. Informational Submittals:
1. Qualification Data: For Supplier, Installer and Architectural Hardware Consultant.
 2. Product Certificates for electrified door hardware, signed by manufacturer:
 - a. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.

3. Certificates of Compliance:
 - a. Certificates of compliance for fire-rated hardware and installation instructions if requested by Architect or Authority Having Jurisdiction.
 - b. Installer Training Meeting Certification: Letter of compliance, signed by Contractor, attesting to completion of installer training meeting specified in "QUALITY ASSURANCE" article, herein.
 - c. Electrified Hardware Coordination Conference Certification: Letter of compliance, signed by Contractor, attesting to completion of electrified hardware coordination conference, specified in "QUALITY ASSURANCE" article, herein.
 4. Product Test Reports: For compliance with accessibility requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by qualified testing agency, for door hardware on doors located in accessible routes.
 5. Warranty: Special warranty specified in this Section.
- D. Closeout Submittals:
1. Operations and Maintenance Data: Provide in accordance with Division 01 and include:
 - a. Complete information on care, maintenance, and adjustment; data on repair and replacement parts, and information on preservation of finishes.
 - b. Catalog pages for each product.
 - c. Name, address, and phone number of local representative for each manufacturer.
 - d. Parts list for each product.
 - e. Final approved hardware schedule, edited to reflect conditions as-installed.
 - f. Final keying schedule
 - g. Copies of floor plans with keying nomenclature
 - h. As-installed wiring diagrams for each opening connected to power, both low voltage and 110 volts.
 - i. Copy of warranties including appropriate reference numbers for manufacturers to identify project.

1.5 QUALITY ASSURANCE

- A. Product Substitutions: Comply with product requirements stated in Division 01 and as specified herein.
1. Where specific manufacturer's product is named and accompanied by "No Substitute," including make or model number or other designation, provide product specified. (Note: Certain products have been selected for their unique characteristics and particular project suitability.)
 - a. Where no additional products or manufacturers are listed in product category, requirements for "No Substitute" govern product selection.
 2. Where products indicate "acceptable manufacturers" or "acceptable manufacturers and products", provide product from specified manufacturers, subject to compliance with specified requirements and "Single Source Responsibility" requirements stated herein.
- B. Supplier Qualifications and Responsibilities: Recognized architectural hardware supplier with record of successful in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this Project and that provides certified Architectural Hardware Consultant (AHC) available to Owner, Architect, and Contractor, at reasonable times during the Work for consultation.
1. Warehousing Facilities: In Project's vicinity.
 2. Scheduling Responsibility: Preparation of door hardware and keying schedules.
 3. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
 4. Coordination Responsibility: Coordinate installation of electronic security hardware with Architect and electrical engineers and provide installation and technical data to Architect and other related subcontractors.
 - a. Upon completion of electronic security hardware installation, inspect and verify that all components are working properly.
- C. Installer Qualifications: Qualified tradesmen, skilled in application of commercial grade hardware with record of successful in-service performance for installing door hardware similar in quantity, type, and quality to that indicated for this Project.

- D. Architectural Hardware Consultant Qualifications: Person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and meets these requirements:
1. For door hardware, DHI-certified, Architectural Hardware Consultant (AHC).
 2. Can provide installation and technical data to Architect and other related subcontractors.
 3. Can inspect and verify components are in working order upon completion of installation.
 4. Capable of producing wiring diagrams.
 5. Capable of coordinating installation of electrified hardware with Architect and electrical engineers.
- E. Single Source Responsibility: Obtain each type of door hardware from single manufacturer.
1. Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated.
 2. Manufacturers that perform electrical modifications and that are listed by testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.
- F. Fire-Rated Door Openings: Provide door hardware for fire-rated openings that complies with NFPA 80 and requirements of authorities having jurisdiction. Provide only items of door hardware that are listed and are identical to products tested by Underwriters Laboratories, Intertek Testing Services, or other testing and inspecting organizations acceptable to authorities having jurisdiction for use on types and sizes of doors indicated, based on testing at positive pressure and according to NFPA 252 or UL 10C and in compliance with requirements of fire-rated door and door frame labels.
- G. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.
1. Air Leakage Rate: Maximum air leakage of 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at tested pressure differential of 0.3-inch wg (75 Pa) of water.
- H. Means of Egress Doors: Latches do not require more than 15 lbf (67 N) to release latch. Locks do not require use of key, tool, or special knowledge for operation.
- I. Accessibility Requirements: For door hardware on doors in an accessible route, comply with governing accessibility regulations cited in "REFERENCES" article, herein.
1. Provide operating devices that do not require tight grasping, pinching, or twisting of wrist and that operate with force of not more than 5 lbf (22.2 N).
 2. Maximum opening-force requirements:
 - a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf (22.2 N) applied perpendicular to door.
 - b. Sliding or Folding Doors: 5 lbf (22.2 N) applied parallel to door at latch.
 - c. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
 3. Bevel raised thresholds with slope of not more than 1:2. Provide thresholds not more than 1/2 inch (13 mm) high.
 4. Adjust door closer sweep periods so that, from open position of 70 degrees, door will take at least 3 seconds to move to 3 inches (75 mm) from latch, measured to leading edge of door.
- J. Keying Conference: Conduct conference at Project site to comply with requirements in Division 01.
1. Attendees: Owner, Contractor, Architect, Installer, and Supplier's Architectural Hardware Consultant.
 2. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including:
 - a. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
 - b. Preliminary key system schematic diagram.
 - c. Requirements for key control system.
 - d. Requirements for access control.
 - e. Address for delivery of keys.

- K. Pre-installation Conference: Conduct conference at Project site
 - 1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 2. Inspect and discuss preparatory work performed by other trades.
 - 3. Inspect and discuss electrical roughing-in for electrified door hardware.
 - 4. Review sequence of operation for each type of electrified door hardware.
 - 5. Review required testing, inspecting, and certifying procedures.
- L. Coordination Conferences:
 - 1. Installation Coordination Conference: Prior to hardware installation, schedule and hold meeting to review questions or concerns related to proper installation and adjustment of door hardware.
 - a. Attendees: Door hardware supplier, door hardware installer, Contractor.
 - b. After meeting, provide letter of compliance to Architect, indicating when meeting was held and who was in attendance.
 - 2. Electrified Hardware Coordination Conference: Prior to ordering electrified hardware, schedule and hold meeting to coordinate door hardware with security, electrical, doors and frames, and other related suppliers.
 - a. Attendees: electrified door hardware supplier, doors and frames supplier, electrified door hardware installer, electrical subcontractor, Owner, Architect and Contractor.
 - b. After meeting, provide letter of compliance to Architect, indicating when coordination conference was held and who was in attendance.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up for hardware delivered to Project site.
- B. Tag each item or package separately with identification coordinated with final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.
 - 1. Deliver each article of hardware in manufacturer's original packaging.
- C. Project Conditions:
 - 1. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.
 - 2. Provide secure lock-up for door hardware delivered to Project, but not yet installed. Control handling and installation of hardware items so that completion of Work will not be delayed by hardware losses both before and after installation.
- D. Protection and Damage:
 - 1. Promptly replace products damaged during shipping.
 - 2. Handle hardware in manner to avoid damage, marring, or scratching. Correct, replace or repair products damaged during Work.
 - 3. Protect products against malfunction due to paint, solvent, cleanser, or any chemical agent.
- E. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.
- F. Deliver keys to Owner by registered mail or overnight package service.

1.7 COORDINATION

- A. Coordinate layout and installation of floor-recessed door hardware with floor construction.
- B. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- C. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.

- D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.
- E. Existing Openings: Where hardware components are scheduled for application to existing construction or where modifications to existing door hardware are required, field verify existing conditions and coordinate installation of door hardware to suit opening conditions and to provide proper door operation.
- F. Direct shipments not permitted, unless approved by Contractor.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Years from date of Substantial Completion, for durations indicated.
 - a. Closers:
 - 1) Mechanical: 10 years
 - 2) Electrified: 2 years.
 - b. Automatic Operators: 1 year.
 - c. Exit Devices:
 - 1) Mechanical: 3 years.
 - 2) Electrified: 1 year.
 - d. Locksets:
 - 1) Mechanical: 3 years.
 - 2) Electrified: 1 year.
 - e. Continuous Hinges: Lifetime warranty.
 - f. Key Blanks: Lifetime
 - 2. Warranty does not cover damage or faulty operation due to improper installation, improper use or abuse.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. The Owner requires use of certain products for their unique characteristics and particular project suitability to insure continuity of existing and future performance and maintenance standards. After investigating available product offerings Awarding Authority has elected to prepare proprietary specifications. These products are specified with the notation: "No Substitute."
 - 1. Where "No Substitute" is noted, submittals and substitution requests for other products will not be considered.
- B. Approval of manufacturers and/or products other than those listed as "Scheduled Manufacturer" or "Acceptable Manufacturers" in the individual article for the product category shall be in accordance with QUALITY ASSURANCE article, herein.
- C. Approval of products from manufacturers indicated in "Acceptable Manufacturers" is contingent upon those products providing all functions and features and meeting all requirements of scheduled manufacturer's product.
- D. Hand of Door: Drawings show direction of slide, swing, or hand of each door leaf. Furnish each item of hardware for proper installation and operation of door movement as shown.
- E. Where specified hardware is not adaptable to finished shape or size of members requiring hardware, furnish suitable types having same operation and quality as type specified, subject to Architect's approval.

2.2 MATERIALS

- A. Fasteners
 1. Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation.
 2. Furnish screws for installation with each hardware item. Finish exposed (exposed under any condition) screws to match hardware finish, or, if exposed in surfaces of other work, to match finish of this other work including prepared for paint surfaces to receive painted finish.
 3. Provide concealed fasteners for hardware units exposed when door is closed except when no standard units of type specified are available with concealed fasteners. Do not use thru-bolts for installation where bolt head or nut on opposite face is exposed in other work unless thru-bolts are required to fasten hardware securely. Review door specification and advise Architect if thru-bolts are required.
 4. Install hardware with fasteners provided by hardware manufacturer.
- B. Modification and Preparation of Existing Doors: Where existing door hardware is indicated to be removed and reinstalled.
 1. Provide necessary fillers, Dutchmen, reinforcements, and fasteners, compatible with existing materials, as required for mounting new opening hardware and to cover existing door and frame preparations.
 2. Use materials which match materials of adjacent modified areas.
 3. When modifying existing fire-rated openings, provide materials permitted by NFPA 80 as required to maintain fire-rating.
- C. Provide screws, bolts, expansion shields, drop plates and other devices necessary for hardware installation.
 1. Where fasteners are exposed to view: Finish to match adjacent door hardware material.
- D. Cable and Connectors: Hardwired Electronic Access Control Lockset and Exit Device Trim:
 1. Data: 24AWG, 4 conductor shielded, Belden 9843, 9841 or comparable.
 2. DC Power: 18 AWG, 2 conductor, Belden 8760 or comparable.
 3. Provide type of data and DC power cabling required by access control device manufacturer for this installation.
 4. Where scheduled in the hardware sets, provide each item of electrified hardware and wire harnesses with sufficient number and wire gauge with standardized Molex plug connectors to accommodate electric function of specified hardware. Provide Molex connectors that plug directly into connectors from harnesses, electric locking and power transfer devices. Provide through-door wire harness for each electrified locking device installed in a door and wire harness for each electrified hinge, electrified continuous hinge, electrified pivot, and electric power transfer for connection to power supplies.

2.3 HINGES

- A. Provide five-knuckle, ball bearing hinges.
 1. Manufacturers and Products:
 - a. Scheduled Manufacturer and Product: IVE.
 - b. Acceptable Manufacturers and Products: Hager BB series, McKinney TA/T4A series,
- B. Requirements:
 1. 1-3/4 inch (44 mm) thick doors, up to and including 36 inches (914 mm) wide:
 - a. Exterior: Standard weight, bronze or stainless steel, 4-1/2 inches (114 mm) high
 - b. Interior: Standard weight, steel, 4-1/2 inches (114 mm) high
 2. Provide three hinges per door leaf for doors 90 inches (2286 mm) or less in height, and one additional hinge for each 30 inches (762 mm) of additional door height.
 3. Where new hinges are specified for existing doors or existing frames, provide new hinges of identical size to hinge preparation present in existing door or existing frame.
 4. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:
 - a. Steel Hinges: Steel pins
 - b. Non-Ferrous Hinges: Stainless steel pins
 - c. Out-Swinging Exterior Doors: Non-removable pins
 - d. Out-Swinging Interior Lockable Doors: Non-removable pins
 - e. Interior Non-lockable Doors: Non-rising pins

5. Width of hinges: 4-1/2 inches (114 mm) at 1-3/4 inch (44 mm) thick doors, and 5 inches (127 mm) at 2 inches (51 mm) or thicker doors. Adjust hinge width as required for door, frame, and wall conditions to allow proper degree of opening.
6. Doors 36 inches (914 mm) wide or less furnish hinges 4-1/2 inches (114 mm) high; doors greater than 36 inches (914 mm) wide furnish hinges 5 inches (127 mm) high, heavy weight or standard weight as specified.
7. Provide hinges with electrified options as scheduled in the hardware sets. Provide with sufficient number and wire gage to accommodate electric function of specified hardware. Locate electric hinge at second hinge from bottom or nearest to electrified locking component.
8. Provide mortar guard for each electrified hinge specified, unless specified in hollow metal frame specification.
9. Provide spring hinges where specified. Provide two spring hinges and one bearing hinge per door leaf for doors 90 inches (2286 mm) or less in height. Provide one additional bearing hinge for each 30 inches (762 mm) of additional door height.

2.4 EXIT DEVICES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product: Von Duprin 98/99 series
2. Acceptable Manufacturers and Products: Sargent 80 series

B. Requirements:

1. Provide exit devices tested to ANSI/BHMA A156.3 Grade 1, and UL listed for Panic Exit or Fire Exit Hardware. Cylinders: Refer to "KEYING" article, herein.
2. Provide touchpad type exit devices, fabricated of brass, bronze, stainless steel, or aluminum, plated to standard architectural finishes to match balance of door hardware.
3. Touchpad: Extend minimum of one half of door width. Match exit device finish, stainless steel for US26, US26D, US28, US32, and US32D finishes; and for all other finishes, provide compatible finish to exit device. Provide compression springs in devices, latches, and outside trims or controls; tension springs also acceptable.
4. Provide exit devices with deadlatching feature for security and for future addition of alarm kits and/or other electrified requirements.
5. Provide exit devices with manufacturer's approved strikes.
6. Provide exit devices cut to door width and height. Locate exit devices at height recommended by exit device manufacturer, allowable by governing building codes, and approved by Architect.
7. Mount mechanism case flush on face of doors, or provide spacers to fill gaps behind devices. Where glass trim or molding projects off face of door, provide glass bead kits.
8. Provide hex key dogging at non-fire-rated exit devices, unless specified less dogging or cylinder dogging.
9. Removable Mullions: 2 inches (51 mm) x 3 inches (76 mm) steel tube. Where scheduled as keyed removable mullion that is removed by use of a keyed cylinder, which is self-locking when re-installed.
10. Where lever handles are specified as outside trim for exit devices, provide heavy-duty lever trims with forged or cast escutcheon plates. Provide vandal-resistant levers that will travel to 90-degree down position when more than 35 pounds of torque are applied, and which can easily be re-set.
 - a. Lever Style: Match lever style of locksets.
 - b. Tactile Warning (Knurling): Where required by authority having jurisdiction. Provide on levers on exterior (secure side) of doors serving rooms considered to be hazardous.
11. Provide UL labeled fire exit hardware for fire rated openings.
12. Provide factory drilled weep holes for exit devices used in full exterior application, highly corrosive areas, and where noted in hardware sets.
13. Provide electrified options as scheduled.

2.5 CYLINDERS

A. Manufacturers:

1. Scheduled Manufacturer: Best
2. Acceptable Manufacturers: No Substitute

B. Requirements:

1. Provide cylinders/cores, from the same manufacturer of locksets, compliant with ANSI/BHMA A156.5; latest revision, Section 12, Grade 1; permanent cylinders; cylinder face finished to match lockset, manufacturer's series as indicated. Refer to "KEYING" article, herein.
2. Nickel silver bottom pins.
3. Replaceable Construction Cores.
 - a. Provide temporary construction cores replaceable by permanent cores, furnished in accordance with the following requirements.
 - 1) 12 construction change (day) keys.
 - b. Owner or Owner's Representative will replace temporary construction cores with permanent cores.

2.6 KEYING

- A. Key to existing Best key system as directed by Owner. Hold Keying conference with Owner to determine keying requirements.

2.7 DOOR CLOSERS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product: LCN 4040XP series
2. Acceptable Manufacturers and Products: Norton 9500 series, Corbin Russwin DC8000 series

B. Requirements:

1. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. Stamp units with date of manufacture code.
2. Provide door closers with fully hydraulic, full rack and pinion action with high strength cast iron cylinder, and full complement bearings at shaft.
3. Cylinder Body: 1-1/2 inch (38 mm) diameter, with 5/8 inch (16 mm) diameter double heat-treated pinion journal.
4. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
5. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards.
6. Hydraulic Regulation: By tamper-proof, non-critical valves with separate adjustment for latch speed, general speed, and backcheck.
7. Provide closers with a solid forged steel main arms and factory assembled heavy-duty forged forearms for parallel arm closers.
8. Finish for Closer Cylinders, Arms, Adapter Plates, and Metal Covers: Powder coating finish which has been certified to exceed 100 hours salt spray testing as described in ANSI/BHMA Standard A156.4 and ASTM B117, or has special rust inhibitor (SRI).
9. Provide special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.

2.8 DOOR TRIM

A. Manufacturers:

1. Scheduled Manufacturer: Ives
2. Acceptable Manufacturers: Burns, Rockwood

B. Requirements:

1. Provide push plates 4 inches (102 mm) wide by 16 inches (406 mm) high by 0.050 inch (1 mm) thick and beveled 4 edges. Where width of door stile prevents use of 4 inches (102 mm) wide plate, adjust width to fit.
2. Provide push bars of solid bar stock, diameter and length as scheduled. Provide push bars of sufficient length to span from center to center of each stile. Where required, mount back to back with pull.
3. Provide offset pulls of solid bar stock, diameter and length as scheduled. Where required, mount back to back with push bar.
4. Provide flush pulls as scheduled. Where required, provide back-to-back mounted model.

5. Provide pulls of solid bar stock, diameter and length as scheduled. Where required, mount back to back with push bar.
6. Provide pull plates 4 inches (102 mm) wide by 16 inches (406 mm) high by 0.050 inch (1 mm) thick, beveled 4 edges, and prepped for pull. Where width of door stile prevents use of 4 inches (102 mm) wide plate, adjust width to fit.
7. Provide wire pulls of solid bar stock, diameter and length as scheduled.
8. Provide decorative pulls as scheduled. Where required, mount back to back with pull.

2.9 OVERHEAD STOPS AND OVERHEAD STOP/HOLDERS

- A. Manufacturers:
 1. Scheduled Manufacturers: Ives.
 2. Acceptable Manufacturers: Rixson, Sargent.
- B. Requirements:
 1. Provide heavy duty concealed mounted overhead stop or holder as specified for exterior and interior vestibule single acting doors.
 2. Provide heavy duty concealed mounted overhead stop or holder as specified for double acting doors.
 3. Provide heavy or medium duty and concealed or surface mounted overhead stop or holder for interior doors as specified. Provide medium duty surface mounted overhead stop for interior doors and at any door that swings more than 140 degrees before striking wall, open against equipment, casework, sidelights, and where conditions do not allow wall stop or floor stop presents tripping hazard.
 4. Where overhead holders are specified provide friction type at doors without closer and positive type at doors with closer.

2.10 DOOR STOPS AND HOLDERS

- A. Manufacturers:
 1. Scheduled Manufacturer: Ives
 2. Acceptable Manufacturers: Burns, Rockwood
- B. Provide door stops at each door leaf:
 1. Provide wall stops wherever possible. Provide convex type where mortise type locks are used and concave type where cylindrical type locks are used.
 2. Where a wall stop cannot be used, provide universal floor stops for low or high rise options.
 3. Where wall or floor stop cannot be used, provide medium duty surface mounted overhead stop.

2.11 THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BOTTOMS, AND GASKETING

- A. Manufacturers:
 1. Scheduled Manufacturer: Zero
 2. Acceptable Manufacturers: National Guard, Reese
- B. Requirements:
 1. Provide thresholds, weatherstripping (including door sweeps, seals, astragals) and gasketing systems (including smoke, sound, and light) as specified and per architectural details. Match finish of other items.
 2. Size of thresholds:
 - a. Saddle Thresholds: 1/2 inch (13 mm) high by jamb width by door width
 - b. Bumper Seal Thresholds: 1/2 inch (13 mm) high by 5 inches (127 mm) wide by door width
 3. Provide door sweeps, seals, astragals, and auto door bottoms only of type where resilient or flexible seal strip is easily replaceable and readily available.

2.12 SILENCERS

- A. Manufacturers:
 1. Scheduled Manufacturer: Ives
 2. Acceptable Manufacturers: Burns, Rockwood

- B. Requirements:
 - 1. Provide "push-in" type silencers for hollow metal or wood frames.
 - 2. Provide one silencer per 30 inches (762 mm) of height on each single frame, and two for each pair frame.
 - 3. Omit where gasketing is specified.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Prior to installation of hardware, examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Existing Door and Frame Compatibility: Field verify existing doors and frames receiving new hardware and existing conditions receiving new openings. Verify that new hardware is compatible with existing door and frame preparation and existing conditions.
- C. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Where on-site modification of doors and frames is required:
 - 1. Carefully remove existing door hardware and components being reused. Clean, protect, tag, and store in accordance with storage and handling requirements specified herein.
 - 2. Field modify and prepare existing door and frame for new hardware being installed.
 - 3. When modifications are exposed to view, use concealed fasteners, when possible.
 - 4. Prepare hardware locations and reinstall in accordance with installation requirements for new door hardware and with:
 - a. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.
 - b. Wood Doors: DHI WDHS.5 "Recommended Hardware Reinforcement Locations for Mineral Core Wood Flush Doors."
 - c. Doors in rated assemblies: NFPA 80 for restrictions on on-site door hardware preparation.

3.3 INSTALLATION

- A. Mounting Heights: Mount door hardware units at heights to comply with the following, unless otherwise indicated or required to comply with governing regulations.
 - 1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
 - 2. Custom Steel Doors and Frames: HMMA 831.
 - 3. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
- B. Install each hardware item in compliance with manufacturer's instructions and recommendations, using only fasteners provided by manufacturer.
- C. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.
- D. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.
- E. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

- F. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.
- G. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity recommended by manufacturer for application indicated or one hinge for every 30 inches (750 mm) of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.
- H. Intermediate Offset Pivots: Where offset pivots are indicated, provide intermediate offset pivots in quantities indicated in door hardware schedule but not fewer than one intermediate offset pivot per door and one additional intermediate offset pivot for every 30 inches (750 mm) of door height greater than 90 inches (2286 mm).
- I. Lock Cylinders: Install construction cores to secure building and areas during construction period.
 - 1. Replace construction cores with permanent cores as indicated in keying section.
- J. Lead Protection: Lead wrap hardware penetrating lead-lined doors. Levers and roses to be lead lined. Apply kick and armor plates on lead-lined doors with adhesive as recommended by manufacturer.
- K. Wiring: Coordinate with Division 26, ELECTRICAL sections for:
 - 1. Conduit, junction boxes and wire pulls.
 - 2. Connections to and from power supplies to electrified hardware.
 - 3. Connections to fire/smoke alarm system and smoke evacuation system.
 - 4. Connection of wire to door position switches and wire runs to central room or area, as directed by Architect.
 - 5. Testing and labeling wires with Architect's opening number.
- L. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.
- M. Door Closers: Mount closers on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Closers shall not be visible in corridors, lobbies and other public spaces unless approved by Architect.
- N. Closer/Holders: Mount closer/holders on room side of corridor doors, inside of exterior doors, and stair side of stairway doors.
- O. Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings or in equipment room, or alternate location as directed by Architect.
 - 1. Configuration: Provide least number of power supplies required to adequately serve doors with electrified door hardware.
- P. Thresholds: Set thresholds in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."
- Q. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they may impede traffic or present tripping hazard.
- R. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
- S. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
- T. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.4 FIELD QUALITY CONTROL

- A. Architectural Hardware Consultant: Engage qualified independent Architectural Hardware Consultant to perform inspections and to prepare inspection reports.
 - 1. Architectural Hardware Consultant will inspect door hardware and state in each report whether installed work complies with or deviates from requirements, including whether door hardware is properly installed and adjusted.

3.5 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
 - 1. Spring Hinges: Adjust to achieve positive latching when door is allowed to close freely from an open position of 30 degrees.
 - 2. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
 - 3. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
- B. Occupancy Adjustment: Approximately three months after date of Substantial Completion, Installer's Architectural Hardware Consultant shall examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors, door hardware, and electrified door hardware.

3.6 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.
- B. Clean operating items as necessary to restore proper function and finish.
- C. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Substantial Completion.

3.7 DEMONSTRATION

- A. Provide training for Owner's maintenance personnel to adjust, operate, and maintain door hardware and door hardware finishes.

3.8 DOOR HARDWARE SCHEDULE

- A. Locksets, exit devices, and other hardware items are referenced in the following hardware sets for series, type and function. Refer to the above-specifications for special features, options, cylinders/keying, and other requirements.

B. Hardware Sets:

Hardware Group No. 01

For use on mark/door #(s):

333.3 333.6

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	ITEMID	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5		BLK	IVE
1	EA	FIRE EXIT HARDWARE	98-L-F-17		313	VON
1	EA	CYLINDER	TO MATCH EXISTING		622	
1	EA	SURFACE CLOSER	4111 EDA MC		693	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		BLK	IVE
1	EA	WALL STOP	WS33/WS33X		626	IVE
1	EA	GASKETING	488SBK PSA		BK	ZER

CONFIRM LEVER STYLE AND CYLINDER TYPE WITH OWNER.

END OF SECTION 08 71 11

SECTION 08 80 00 - GLAZING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Glazing units.
- B. Glazing compounds and accessories.

1.2 REFERENCE STANDARDS

- A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; current edition.
- B. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test; 2015.
- C. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers; 2005 (Reapproved 2015).
- D. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2018.
- E. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016.
- F. GANA (SM) - GANA Sealant Manual; 2008.

1.3 SUBMITTALS

- A. Product Data on Glazing Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements, and identify available colors.
- B. Samples: Submit two samples 12 by 12 inch (305 by 305 mm) in size of glass units.
- C. Samples: Submit 12 inch (305 mm) long bead of glazing sealant, color as selected.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Float Glass Manufacturers:
 - 1. AGC Glass North America, Inc; www.agcglass.com/#sle.
 - 2. Cardinal Glass Industries; www.cardinalcorp.com/#sle.
 - 3. Guardian Glass, LLC; www.guardianglass.com/#sle.
 - 4. Pilkington North America Inc; www.pilkington.com/na/#sle.
 - 5. Vitro Architectural Glass (formerly PPG Glass); www.vitroglazings.com/#sle.

2.2 GLASS MATERIALS

- A. Float Glass: Provide float glass based glazing unless otherwise indicated.
 - 1. Kind FT - Fully Tempered Type: Complies with ASTM C1048.
 - 2. Fully Tempered Safety Glass: Complies with ANSI Z97.1 or 16 CFR 1201 criteria for safety glazing used in hazardous locations.

2.3 GLAZING UNITS

- A. Type G-2 - Monolithic Interior Vision Glazing:
 - 1. Applications: Interior glazing unless otherwise indicated.
 - 2. Glass Type: Fully tempered float glass.
 - 3. Tint: Clear.
 - 4. Thickness: 1/2 inch (12.8 mm), nominal.

2.4 ACCESSORIES

- A. Setting Blocks: Silicone, with 80 to 90 Shore A durometer hardness; ASTM C864 Option II. Length of 0.1 inch for each square foot (25 mm for each square meter) of glazing or minimum 4 inch (100 mm) by width of glazing rabbet space minus 1/16 inch (1.5 mm) by height to suit glazing method and pane weight and area.
- B. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness; ASTM C864 Option II. Minimum 3 inch (75 mm) long by one half the height of the glazing stop by thickness to suit application, self adhesive on one face.
- C. Glazing Tape, Back Bedding Mastic Type: Preformed, butyl-based, 100 percent solids compound with integral resilient spacer rod applicable to application indicated; 5 to 30 cured Shore A durometer hardness; coiled on release paper; black color.
 - 1. Width: As required for application.
 - 2. Thickness: As required for application.
 - 3. Spacer Rod Diameter: As required for application.
- D. Glazing Splines: Resilient silicone extruded shape to suit glazing channel retaining slot; ASTM C864 Option II; color black.

PART 3 EXECUTION

3.1 VERIFICATION OF CONDITIONS

- A. Verify that openings for glazing are correctly sized and within tolerances, including those for size, squareness, and offsets at corners.
- B. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and support framing is ready to receive glazing system.

3.2 PREPARATION

- A. Clean contact surfaces with appropriate solvent and wipe dry within maximum of 24 hours before glazing. Remove coatings that are not tightly bonded to substrates.
- B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.
- C. Prime surfaces scheduled to receive sealant where required for proper sealant adhesion.

3.3 INSTALLATION, GENERAL

- A. Install glazing in compliance with written instructions of glass, gaskets, and other glazing material manufacturers, unless more stringent requirements are indicated, including those in glazing referenced standards.
- B. Install glazing sealants in accordance with ASTM C1193, GANA (SM), and manufacturer's instructions.

3.4 INSTALLATION - DRY GLAZING METHOD (GASKET GLAZING)

- A. Application - Exterior and/or Interior Glazed: Set glazing infills from either the exterior or the interior of the building.
- B. Place setting blocks at 1/4 points with edge block no more than 6 inch (152 mm) from corners.
- C. Rest glazing on setting blocks and push against fixed stop with sufficient pressure on gasket to attain full contact.
- D. Install removable stops without displacing glazing gasket; exert pressure for full continuous contact.

3.5 FIELD QUALITY CONTROL

- A. Glass and Glazing product manufacturers to provide field surveillance of the installation of their products.
- B. Monitor and report installation procedures and unacceptable conditions.

3.6 CLEANING

- A. Remove excess glazing materials from finish surfaces immediately after application using solvents or cleaners recommended by manufacturers.
- B. Remove non-permanent labels immediately after glazing installation is complete.
- C. Clean glass and adjacent surfaces after sealants are fully cured.
- D. Clean glass on both exposed surfaces not more than 4 days prior to Date of Substantial Completion in accordance with glass manufacturer's written recommendations.

3.7 PROTECTION

- A. After installation, mark pane with an 'X' by using removable plastic tape or paste; do not mark heat absorbing or reflective glass units.
- B. Remove and replace glass that is damaged during construction period prior to Date of Substantial Completion.

END OF SECTION 08 80 00

SECTION 09 29 00 – GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes interior gypsum board.
- B. Related Requirements:
 - 1. Division 07 Section "Joints Sealants."
 - 2. Division 09 Section "Wall Coverings."

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawing: Location for control joints if recommended by product manufacturer.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency or as specified in accordance with UL in its "Fire Resistance Directory".

2.2 INTERIOR GYPSUM BOARD

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. American Gypsum.
 - 2. CertainTeed Corporation.
 - 3. Georgia-Pacific Building Products.
 - 4. Lafarge North America Inc.
 - 5. National Gypsum Company.
 - 6. PABCO Gypsum.
 - 7. Temple-Inland Building Product by Georgia-Pacific.
 - 8. USG Corporation.
- B. Gypsum Wallboard: ASTM C 1396/C 1396M.
 - 1. Thickness: 5/8 inch.
 - 2. Long Edges: Tapered and featured (rounded or beveled) for prefilling.
- C. Gypsum Board, Type X: ASTM C 1396/C 1396M.
 - 1. Thickness: 5/8 inch.
 - 2. Long Edges: Tapered and featured (rounded or beveled) for prefilling.
- D. Gypsum Ceiling Board: ASTM C 1396/C 1396M.
 - 1. Thickness: 5/8 inch.
 - 2. Long Edges: Tapered.

2.3 TRIM ACCESSORIES

- A. Interior Trim: ASTM C 1047.
 - 1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.

2.4 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475/C 475M.
- B. Joint Tape:
 - 1. Interior Gypsum Board: Paper.
- C. Joint Compound for Interior Gypsum Board: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

2.5 AUXILIARY MATERIALS

- A. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.

PART 3 - EXECUTION

3.1 APPLYING AND FINISHING PANELS

- A. Comply with ASTM C 840.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- D. Install trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
 - 1. Control Joints: Install control joints according to ASTM C 840, Contractor shall submit locations for control joints to Architect for approval.
- E. Install expansion joint cover of width required for existing joint. Install following manufacturers recommended procedures.
- F. Prefill open joints, rounded or beveled edges, and damaged surface areas.
- G. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- H. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
 - 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
 - 2. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.
 - 3. Level 5: At wall covering, refer to requirements of Division 09 Section "Wall Coverings."
- I. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- J. Remove and replace panels that are wet, moisture damaged, and/or mold damaged.

END OF SECTION 09 29 00

SECTION 09 51 00 - ACOUSTICAL CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Extent of acoustical ceilings is indicated on Drawings and schedules.
- B. Types of acoustical ceiling products include the following:
 - 1. Acoustical lay-in panels of the following types:
 - a. Standard acoustic panels.
 - 2. Suspended grid systems, specialty trim and accessories.

1.3 RELATED SECTIONS

- A. Refer to Division 02 Section "Selective Demolition" for requirements for recycling demolished acoustical ceiling products.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's literature, including certification by a recognized independent testing laboratory, indicating compliance with requirements.
- B. Affidavits of Compliance to be included in final inspection manual:
 - 1. Provide manufacturer's letter of certification showing compliance with finish testing and classification requirements referenced by current adopted NFPA 101 "Life Safety Code".
 - 2. Letter shall include project number, project name, and building name.

1.5 QUALITY ASSURANCE

- A. Standards: Comply with the following:
 - 1. Acoustical Materials: ASTM E 1264.
 - 2. Suspension Systems: ASTM C 635 for materials; ASTM C 636 for installation.
 - 3. Surface Burning Characteristics: Flame spread: 25 or less; smoke developed: 50 or less; per ASTM E 84. UL listed and marked.
 - 4. Seismic Standard: Comply with Ceilings and Interior Systems Contractors Association (CISCA) "Recommendations for Direct-Hung Acoustical Tile and Lay-in Panel Ceilings--Seismic Zones 0-2."
- B. Source Limitations: Obtain each type of acoustic panel and related grid system from one source and by a single manufacturer.

1.6 PROJECT CONDITIONS

- A. Do not install ceilings until ambient temperature and humidity conditions can be continuously maintained at values near those intended for final occupancy.
- B. Building areas to receive ceiling shall be free of construction dust and debris.

PART 2 - PRODUCTS

2.1 STANDARD ACOUSTIC PANELS

- A. Smooth surface, humidity-tolerant, mineral composition panels with washable surface; and as follows:
 - 1. Surface: Smooth.
 - 2. Edges: Square.
 - 3. Size: 24 inches by 24 inches by 3/4-inch thick to match existing – or as indicated on the Drawings.
 - 4. LR: Not less than 0.82.
 - 5. NRC: Not less than 0.55.
 - 6. CAC: Not less than 33.
 - 7. Color: White.
 - 8. Manufacturer/Style: Provide product as indicated on Finish Legend or comparable product from one of the following:
 - a. Armstrong World Industries, Inc. (Basis-of-Design)
 - b. CertainTeed Saint-Gobain.
 - c. U.S. Gypsum.
 - 9. Related Suspension Grid: Standard 15/16-inch Panel Suspension System in compliance with requirements of "Suspension Systems" Article of this Section.

2.2 SUSPENSION SYSTEMS

- A. Suspension Systems, General: As required to support acoustical units, electrical and mechanical fixtures and other components as indicated, including anchorages, hangers, runners, cross runners, splines, clips, moldings, fasteners and other members, devices and accessories. Comply with requirements of ASTM C 635.
 - 1. Hanger Wire: Not less than 12 gage (0.106 inch) galvanized steel.
 - 2. Type: Exposed Direct-Hung Steel Suspension System
 - 3. Structural Class: Medium-Duty System.
- B. Standard 15/16-inch Panel Suspension System: Suspension system with exposed faces painted.
 - 1. Face Width: 15/16-inch wide.
 - 2. Product/Manufacturer: Provide the following:
 - a. "Prelude XL 15/16": Armstrong World Industries, Inc.
 - b. "Classic Stab System"; CertainTeed Saint-Gobain.
 - c. "Donn DX"; U.S. Gypsum.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with ASTM C636 and seismic design requirements indicated, per manufacturer's written instructions and Cisca's "Ceiling Systems Handbook."
- B. Layout: Balance ceiling borders on opposite sides, using more-than-half width acoustical units, except where otherwise dimensioned or indicated.
 - 1. Tolerance: 1/8 inch in 12 feet level tolerance.
 - 2. Pattern Direction: One-way, align joints.
- C. Suspension System: Secure to building structure, free from contact with objects within the ceiling plenum, with hangers spaced 48 inches on center along supported members; provide hangers not more than 8 inches from ends of each member.
 - 1. Where interference with ducts or suspended equipment prevents direct connection of suspension elements to building structure, provide steel channel members (Unistrut or equivalent) hung from structural members with threaded rods with appropriate fasteners; and adequately sized for suspension system capacity. Secure suspension system to steel channels. Connection to ductwork or equipment is not permitted.
 - 2. Do not fasten ceiling suspension members to metal roof deck.

- D. Edge Moldings: Secure to substrate with screw anchors spaced 16 inch on center. Set with concealed bead of acoustical sealant. Miter corner joints. Cope exposed flanges of intersecting suspension members for flush intersections.

3.2 CLEANING AND REPAIR

- A. Clean suspension grid and panels. Remove and replace panels and grid that are defective, or that have been damaged.
- B. Touch-up paint field-cut edges of factory painted tile that are exposed to view in finished installation, including horizontal and vertical surfaces at perimeter of ceilings where panels are cut for rabbeted edge molding.

END OF SECTION 09 51 00

SECTION 09 65 13 – RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes:
 - 1. Resilient base.
 - 2. Resilient molding accessories.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified, not less than 12 inches long.

1.4 EXTRA MATERIALS

- A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Furnish quantity of full-size units equal to 5% of amount installed for each type, color, and size indicated.

PART 2 - PRODUCTS

2.1 THERMOSET-RUBBER BASE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Roppe Corporation, USA.
 - 2. Flexco.
 - 3. Burke Mercer Flooring Products, Division of Burke Industries Inc.
 - 4. Tarkett (Johnsonite). (Basis-of-Design)
- B. Product Standard: ASTM F 1861, Type TS (rubber, vulcanized thermoset), Group I (solid, homogeneous).
 - 1. Style and Location:
 - a. Style A, Straight: Provide in areas with carpet.
 - b. Style B, Cove: Provide in areas with resilient flooring.
- C. Thickness: 0.125 inch.
- D. Height: 4 inches.
- E. Lengths: Coils in manufacturer's standard length.
- F. Outside Corners: Job formed or preformed.
- G. Inside Corners: Job formed or preformed.
- H. Colors: As indicated by manufacturer's designations. Refer to Drawings.

2.2 RUBBER MOLDING ACCESSORY

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Roppe Corporation, USA.
 - 2. Flexco.
 - 3. VPI, LLC, Floor Products Division.
 - 4. Tarkett (Johnsonite).
- B. Description: Rubber reducer strip for resilient flooring and transition strips.
- C. Profile and Dimensions: As indicated.
- D. Locations: Provide rubber molding accessories as required at transition to existing corridor flooring.
- E. Colors and Patterns: Submit color and profiles to Architect for approval.

2.3 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- C. Do not install resilient products until they are the same temperature as the space where they are to be installed.
- D. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.2 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.

- G. Preformed Corners: Install preformed corners before installing straight pieces.
- H. Job-Formed Corners:
 - 1. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.
 - 2. Form without producing discoloration (whitening) at bends.
- I. Inside Corners:
 - 1. Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.
 - 2. Miter or cope corners to minimize open joints.

3.3 RESILIENT ACCESSORY INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient accessories.
- B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

3.4 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.
- B. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION 09 65 13

SECTION 09 65 19 - RESILIENT TILE FLOORING

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 luxury vinyl tile.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Verification: Full-size units of each color and pattern of resilient floor tile required.
- C. Maintenance Data: For resilient products to include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Single Source: Obtain each type of product required, including adhesives and accessories from one manufacturer throughout the Project.
- B. Installer Qualifications: Installation of resilient flooring shall be performed by specialists, with minimum 5 years of experience in work of type and scope similar to that of this Project that has resulted in construction with a record of successful in-service performance.
- C. Fire-Test-Response Characteristics: Provide products identical to those tested for fire-exposure behavior per test method indicated by a testing and inspecting agency acceptable to authorities having jurisdiction.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F. Store tiles on flat surfaces.

1.6 PROJECT CONDITIONS

- A. Maintain temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F in spaces to receive floor tile during the following time periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.
- B. After postinstallation period, maintain temperatures within range recommended by manufacturer, but not less than 65 deg F or more than 95 deg F.
- C. Conditioning: Do not install flooring until required temperature and relative humidity have been stabilized and will be maintained in installation areas through remainder of construction period. Allow flooring to acclimate to the above conditions for 72 hours prior to installation.
- D. Close spaces to traffic during floor covering installation.

- E. Close spaces to traffic for 48 hours after floor covering installation.
- F. Install resilient products after other finishing operations, including painting, have been completed.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Floor Tile: Furnish 2 boxes of each type, color, and pattern of floor tile installed.

1.8 WARRANTY

- A. 10 year limited conductivity warranty.

PART 2 - PRODUCTS

2.1 LUXURY VINYL TILE

- A. Products: Subject to compliance with requirements, provide products indicated on Finish Legend.
- B. Tile Standard: ASTM F 1700, Class III, Type B (Embossed) solid vinyl tile.
- C. Thickness: Refer to Finish Legend.
- D. Size: Refer to Finish Legend.
- E. Colors and Patterns: Match Architect's sample indicated on Finish Legend.

2.2 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic cement based formulation provided or approved by resilient product manufacturer for applications indicated.
- B. Primers: Non-staining type as recommended by manufacturer.
- C. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances, moisture content, and other conditions affecting performance.
 - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
 - 2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written recommendations to ensure adhesion of resilient products.

- B. Concrete Substrates: Prepare according to ASTM F 710.
 - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 - 2. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
 - 3. Moisture Testing:
 - a. Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
 - b. Subject to flooring manufacturer's approval, moisture content shall be checked by using the anhydrous calcium chloride test as recommended by the Resilient Floor Covering Institute. Perform test in accordance with ASTM F1869.
 - c. Determine weight of calcium chloride and container before test is started, and then reweigh at conclusion of test period to determine the amount of moisture present.
 - d. At a minimum, conduct one (1) test for every 1,000 square feet, or fraction thereof of flooring being placed each day; test around perimeter of room or area, at columns and where moisture may be evident.
 - e. After testing for a period of 24 hours, moisture emission must not exceed 3.0 pounds per 1,000 square feet, unless otherwise recommended by flooring manufacturer. If test results exceed limitation, do not proceed with flooring installation until corrective action has been completed.
 - 4. Apply concrete primer to concrete substrate prior to LVT installation.
- C. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
- D. Use trowelable leveling and patching compound to fill cracks, holes, and depressions in substrates. Remove bumps and ridges to product a uniform and smooth substrate.
- E. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
 - 1. Do not install resilient products until they are same temperature as space where they are to be installed.
- F. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, and dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 RESILIENT TILE INSTALLATION

- A. Comply with manufacturer's written instructions for installing floor tile.
- B. Dry-lay the flooring tiles without adhesive following the design layout. Do not layout more material than will be adhered that day. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter. Lay tiles square with room axis. Remove and neatly stack (in order for replacement later), a workable section of the area, but not too large, thus avoiding late placement into the adhesive. Clean the substrate again prior to applying the adhesive.
- C. Match tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
- D. Scribe, cut, and fit tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, edgings, door frames, thresholds, and nosings.
- E. Extend tiles into toe spaces, door reveals, closets, and similar openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent, nonstaining marking device.

- G. Install tiles on covers for telephone and electrical ducts and similar items in finished floor areas. Maintain overall continuity of color and pattern with pieces of tile installed on covers. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.
- H. Adhere tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.4 CLEANING AND PROTECTION

- A. Perform the following operations immediately after completing resilient product installation:
 - 1. Remove adhesive and other blemishes from exposed surfaces.
 - 2. Sweep and vacuum surfaces thoroughly.
 - 3. Damp-mop surfaces to remove marks and soil.
 - a. Do not wash surfaces until after time period recommended by manufacturer.
- B. Provide sealer approved by flooring manufacturer.
- C. Protect resilient products from marks, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended in writing by manufacturer.
 - 1. Do not move heavy and sharp objects directly over surfaces. Place hardboard or plywood panels over flooring and under objects while they are being moved. Slide or roll objects over panels without moving panels.

END OF SECTION 09 65 19

SECTION 09 72 00 - WALL COVERINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Wall covering.

1.2 RELATED REQUIREMENTS

- A. Section 09 91 00 - Painting: Preparation and priming of substrate surfaces.

1.3 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2017.
- B. ASTM F793/F793M - Standard Classification of Wall Coverings by Use Characteristics; 2015.

1.4 SUBMITTALS

- A. See Section 01 3300 - Submittal Procedures.
- B. Shop Drawings: Indicate wall elevations with seaming layout.
- C. Samples: Submit two samples of wall covering standard size from manufacture illustrating color, finish, and texture.
- D. Manufacturer's Installation Instructions: Indicate special procedures.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Inspect roll materials at arrival on site, to verify acceptability.
- B. Protect packaged adhesive from temperature cycling and cold temperatures.
- C. Do not store roll goods on end.

1.7 FIELD CONDITIONS

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the adhesive or wall covering product manufacturer.
- B. Maintain these conditions 24 hours before, during, and after installation of adhesive and wall covering.

PART 2 PRODUCTS

2.1 WALL COVERINGS

- A. Wall Covering - Type II: Vinyl Digital Wallcovering.
 - 1. Conform to ASTM F793/F793M, Category V, Type II.
 - 2. Color: Refer to Finish Legend.
 - 3. Pattern: Refer to Finish Legend.
 - 4. Manufacturers:
 - a. Surface Materials.
- B. Substrate Filler: As recommended by adhesive and wall covering manufacturers; compatible with substrate.
- C. Substrate Primer and Sealer: Alkyd enamel type.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that substrate surfaces are prime painted and ready to receive work, and conform to requirements of the wall covering manufacturer.
- B. Measure moisture content of surfaces using an electronic moisture meter. Do not apply wall coverings if moisture content of substrate exceeds level recommended by wall covering manufacturer.
- C. Verify flatness tolerance of surfaces does not vary more than 1/8 inch in 10 feet (3 mm in 3 m) nor vary at a rate greater than 1/16 inch/ft (1.5 mm/300 mm).

3.2 PREPARATION

- A. Fill cracks in substrate and smooth irregularities with filler; sand smooth.
- B. Wash impervious surfaces with tetra-sodium phosphate, rinse and neutralize; wipe dry.
- C. Surface Appurtenances: Remove or mask electrical plates, hardware, light fixture trim, escutcheons, and fittings prior to preparing surfaces or finishing.
- D. Surfaces: Correct defects and clean surfaces that affect work of this section. Remove existing coatings that exhibit loose surface defects.
- E. Marks: Seal with shellac those that may bleed through surface finishes.
- F. Apply one coat of primer sealer to substrate surfaces. Allow to dry. Lightly sand smooth.
- G. Vacuum clean surfaces free of loose particles.

3.3 INSTALLATION

- A. Apply adhesive and wall covering in accordance with manufacturer's instructions.
- B. Apply adhesive to wall surface immediately prior to application of wall covering.
- C. Use wall covering in roll number sequence.
- D. Razor trim edges on flat work table. Do not razor cut on gypsum board surfaces.

- E. Apply wall covering smooth, without wrinkles, gaps or overlaps. Eliminate air pockets and ensure full bond to substrate surface.
- F. Butt edges tightly.
- G. Overlap adjacent panels as recommended by manufacturer.
- H. Horizontal seams are not acceptable.
- I. Do not seam within 2 inches (50 mm) of internal corners or within 6 inches (150 mm) of external corners.
- J. Install wall covering before installation of bases and items attached to or spaced slightly from wall surface.
- K. Do not install wall covering more than 1/4 inch (6 mm) below top of resilient base.
- L. Cover spaces above and below windows, above doors, in pattern sequence from roll.
- M. Apply wall covering to electrical wall plates prior to replacing.
- N. Wall covering is required behind fin tube cabinets.
- O. Where wall covering tucks into reveals, or metal wallboard or plaster stops, apply with contact adhesive within 6 inches (150 mm) of wall covering termination. Ensure full contact bond.
- P. Remove excess adhesive while wet from seam before proceeding to next wall covering sheet. Wipe clean with dry cloth.

3.4 CLEANING

- A. Clean wall coverings of excess adhesive, dust, dirt, and other contaminants.
- B. Reinstall wall plates and accessories removed prior to work of this section.

3.5 PROTECTION

- A. Do not permit construction activities at or near finished wall covering areas.

END OF SECTION 09 72 00

SECTION 09 91 00 - PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes surface preparation and the application of paint systems on the following substrates:
 - 1. Exposed interior items and surfaces.
 - 2. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.
- B. All paints and coatings used on the interior of the building (defined as inside of the weatherproofing system and applied on-site), including sealants and adhesives used in mechanical, electrical, and plumbing work, shall comply with the following criteria:
 - 1. Architectural paints, coatings and primers applied to interior walls and ceilings must not exceed the VOC content limits established in Green Seal Standard GS-11, Paints, First Edition, May 20, 1993.
 - 2. Anti-corrosive and anti-rust paints applied to interior ferrous metal substrates must not exceed the VOC content limit of 250 g/L established in Green Seal Standard GC-03, Anti-Corrosive Paints, Second Edition, January 7, 1997.
 - 3. Clear wood finishes, floor coatings, stains, sealers, and shellacs applied to interior elements must not exceed the VOC content limits established in South Coast Air Quality Management District (SCQAMD) Rule 1113, Architectural Coatings, rules in effect January 1, 2004.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Verification: For each type of paint system and in each color and gloss of topcoat indicated.
 - 1. Submit Samples on rigid backing, 8 inches square.
 - 2. Step coats on Samples to show each coat required for system.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area.
 - 5. Submit VOC levels of each paint type.

1.4 QUALITY ASSURANCE

- A. MPI Standards:
 - 1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."
 - 2. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and paint systems indicated.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste from storage areas daily.

1.6 PROJECT CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.
 - 1. Quantity: Furnish an additional 5 percent, but not less than 1 gallon of each material and color applied.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide no-VOC products by The Sherwin-Williams Company or comparable products by one of the following:
 - 1. Benjamin Moore & Co.
 - 2. International Protective Coatings.
 - 3. O'Leary Paint Co.
 - 4. PPG Industries, Inc.
 - 5. Pratt & Lambert Paints.
 - 6. Sherwin-Williams Co.
 - 7. Tnemec.

2.2 PAINT, GENERAL

- A. Material Compatibility:
 - 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- B. VOC Content for Interior Paints: For interior paints and coatings applied at Project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 1. Flat Paints and Coatings: 50 g/L.
 - 2. Nonflat Paints and Coatings: 150 g/L.
 - 3. Dry-Fog Coatings: 400 g/L.
 - 4. Primers, Sealers, and Undercoaters: 200 g/L.
 - 5. Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.
 - 6. Zinc-Rich Industrial Maintenance Primers: 340 g/L.
 - 7. Pretreatment Wash Primers: 420 g/L.
 - 8. Floor Coatings: 100 g/L.
 - 9. Shellacs, Clear: 730 g/L.
 - 10. Shellacs, Pigmented: 550 g/L.
- C. Colors: As indicated on Drawings.

2.3 PRIMERS/SEALERS

- A. Interior Latex Primer/Sealer: MPI #50.

2.4 LATEX PAINTS AT GYPSUM BOARD

- A. Interior Latex (Flat): MPI #53 (Gloss Level 1).
- B. Interior Latex (Eggshell): MPI #52 (Gloss Level 3).
- C. Interior Latex (Satin): MPI #52 (Gloss Level 4).
- D. Interior Latex (Semigloss): MPI #54 (Gloss Level 5).

2.5 ACRYLIC PAINTS AT STEEL

- A. Steel Substrates:
 - 1. 1 Coat Pro Industrial Pro-Cryl Universal Water Based Primer.
 - 2. 2 Coats Pro Industrial Zero VOC Acrylic.
 - a. Gloss Level: Semi-gloss.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - 1. Gypsum Board: 12 percent.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.
- B. Remove plates, machined surfaces, and similar items already in place that are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
 - 2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
- C. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.
- D. Steel Substrates: Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer.
- E. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- F. Gypsum Board Substrates: Do not begin paint application until finishing compound is dry and sanded smooth.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions.
 - 1. Use applicators and techniques suited for paint and substrate indicated.
 - 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 - 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
- B. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

- C. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- D. Painting Mechanical and Electrical Work: Paint items exposed in equipment rooms and occupied spaces including, but not limited to, the following:
 - 1. Mechanical Work:
 - a. Uninsulated metal piping.
 - b. Uninsulated plastic piping.
 - c. Pipe hangers and supports.
 - d. Tanks that do not have factory-applied final finishes.
 - e. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
 - f. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
 - g. Mechanical equipment that is indicated to have a factory-primed finish for field painting.
 - 2. Electrical Work:
 - a. Switchgear.
 - b. Panelboards.
 - c. Electrical equipment that is indicated to have a factory-primed finish for field painting.

3.4 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.5 INTERIOR PAINTING SCHEDULE

- A. Gypsum Board: Provide the indicated "Professional" or "Industrial" coating systems over interior gypsum board and plaster surfaces:
 - 1. Low-Luster, Acrylic-Enamel Finish: Two finish coats over a primer.
 - a. Primer: Latex-based, interior primer; total dry film thickness of not less than 1.2 mils.
 - 1) Super Spec Latex Enamel Undercoater & Primer Sealer 253.
 - b. Finish Coats: Low-luster (eggshell), acrylic-latex, interior enamel; total dry film thickness of not less than 2.6 mils.
 - 1) Super Spec Latex Eggshell Enamel 274.
 - 2) Color: As scheduled.
- B. Ferrous Metal: Provide the indicated "Professional" or "Industrial" coating systems over factory-primed ferrous metal:
 - 1. Satin, Acrylic-Enamel Finish: Two finish coats over a factory-applied primer, or indicated primer as applicable.
 - a. Primer (for factory-unprimed work): Waterborne, rust-inhibitive, acrylic primer; total dry film thickness of not less than 2.0 mils.
 - 1) SuperSpec HP Acrylic Metal Primer P04.
 - b. Finish Coats: Semi-gloss, acrylic-latex, interior enamel; total dry film thickness of not less than 2.0 mils.
 - 1) Satin Impervo Acrylic-Latex N314.
 - 2) Color: As scheduled.

3.6 PIPE IDENTIFICATION COLOR SCHEDULE

- A. Identify exposed pipes with the following colors.
 1. Colors are from the Tnemec Colorbook color card.
 2. Equivalent colors of other Manufacturers indicated in Part 2 of this Section may be used.
- B. Where a facility has an existing identification system already in use, coordinate with the system in use.
- C. In situations where 2 colors do not have sufficient contrast to easily differentiate between them, paint a 6-inch band of contrasting color at 30-inch intervals.

Piping	Color Description	Tnemec Colorbook ID
Natural Gas	Orange/Red with Black Bands	International Orange 05SF with Black Bands
Potable Water	Blue	Safety Blue SC06
Nonpotable Water	Blue with Black Bands	Safety Blue SC06 with Black Bands
Heating Hot Water (Supply)	Blue	Safety Blue SC06
Heating Hot Water (Return)	Blue	Safety Blue SC06
Steam/Condensate	Orange	Safety Orange 04SF
Chilled Water Supply/Return	Blue	Safety Blue SC06
Condenser Water Supply/Return	Green	Safety Green 09SF
Fire Protection	Red	Safety Red 06SF
Sanitary/Sewage Lines	Dark Gray	Gray 33GR
Compressed Air	Green	Safety Green 09SF
Drain Lines, Vent Lines	Gray	Slate Gray 31GR
Other Lines	Gray	Slate Gray 31GR

END OF SECTION 09 91 00

SECTION 10 14 01 - INTERIOR SIGNAGE

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 SECTION INCLUDES

- A. Accessible room and door signs.
- B. Interior directional and informational signs.

1.3 REFERENCE STANDARDS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. ANSI/ICC A117.1 - American National Standard for Accessible and Usable Buildings and Facilities; International Code Council; 2009.

1.4 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Manufacturer's printed product literature for each type of sign, indicating sign styles, font, foreground and background colors, locations, overall dimensions of each sign.
- C. Signage Schedule: Provide information sufficient to completely define each sign for fabrication, including room number, room name, other text to be applied, sign and letter sizes, fonts, and colors.
 - 1. Submit for approval by Owner through Architect prior to fabrication.
- D. Samples: Submit two samples of each type of sign, of size similar to that required for project, illustrating sign style, font, and method of attachment.
- E. Selection Samples: Where colors are not specified, submit two sets of color selection charts or chips.
- F. Verification Samples: Submit samples showing colors specified.
- G. Manufacturer's Installation Instructions: Include installation templates and attachment devices.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Package signs as required to prevent damage before installation.
- B. Package room and door signs in sequential order of installation, labeled by floor or building.
- C. Store tape adhesive at normal room temperature.

1.7 FIELD CONDITIONS

- A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.

- B. Maintain this minimum temperature during and after installation signs.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Flat Signs:
 - 1. ASI Sign Systems: www.asisignage.com.
 - 2. Best Sign Systems, Inc: www.bestsigns.com.
 - 3. Innerface Architectural Signage: www.innerfacesign.com.
 - 4. Mohawk Sign Systems, Inc: www.mohawksign.com.
 - 5. Substitutions: Not permitted.

2.2 SIGNAGE APPLICATIONS

- A. Accessibility Compliance: Signs are required to comply with ADA Standards and ICC A117.1 and applicable building codes, unless otherwise indicated; in the event of conflicting requirements, comply with the most comprehensive and specific requirements.
 - 1. Where combinations of lines of text, pictograms, and/or braille will result in sign sizes larger than those scheduled, coordinate with the Architect to resolve one size for each signage type so affected.
- B. The following types of signs shall include a pictogram of the International Symbol of Accessibility: Accessible entrances where not all entrances are accessible.
- C. Accessible Room and Door Signs: Provide a sign for every doorway, whether it has a door or not, not including corridors, lobbies, and similar open areas.
 - 1. Sign Type: Flat signs with clear panel media with color applied to reverse side.
 - 2. Provide "tactile" signage, with letters raised minimum 1/32 inch and Grade II braille.
 - 3. Character Height: 1 inch.
 - 4. Sign Size: As scheduled.
 - 5. Room Doors: Identify with room names and numbers to be determined later, not those shown on the drawings.
 - 6. Raised Character and Braille Exit Signs: Identify with the text "EXIT" and braille.
 - a. Provide at the interior side of each doorway to an exit ramp or exit discharge.
- D. Interior Directional and Informational Signs:
 - 1. Sign Type: Same as room and door signs.
 - 2. Sizes: As indicated on the drawings.
 - 3. Wording of signs is scheduled on the drawings.
 - 4. Where signs are scheduled to provide direction to accessible elements, include a directional arrow.
 - 5. Where suspended, ceiling mounted, or projecting from wall signs are indicated, provide two-sided signs with same information on both sides.
 - 6. Accessible Means of Egress: Directional signage indicating the location of the other means of egress and which are accessible means of egress shall be provided at the following:
 - a. At Exits serving a required accessible space but are not providing accessible means of egress.
 - 7. Accessible Elements: Directional signage indicating route to nearest like accessible element shall be provided at the following locations:
 - a. Inaccessible building entrances.
 - b. At exits serving a required accessible space but not providing an approved accessible means of egress.
 - 8. Live Load Design: As scheduled, for each floor or portion thereof of a commercial or industrial building that is or has been designed to exceed 50 psf live load capacity, provide a sign identifying the live load design capacity.
 - 9. Fire-Resistance Ratings: Identification signs for fire walls, fire barriers, fire partitions, smoke barriers, and smoke partitions:
 - a. Refer to wall stenciling in Section 09 91 23 Interior Painting.

- E. Interior Space Signage:
 - 1. Type: As indicated on the drawings
 - 2. Size: As indicated on the drawings
 - 3. Location: As shown on the drawings.

2.3 SIGN TYPES

- A. Flat Signs: Signage media without frame.
 - 1. Edges: Square.
 - 2. Corners: Radiused.
 - 3. Wall Mounting of One-Sided Signs: Tape adhesive.
- B. Color and Font: Unless otherwise indicated:
 - 1. Character Font: Helvetica, Arial, or other sans serif font.
 - 2. Character Case: Upper case only.
 - 3. Background Color: As scheduled.
 - 4. Character Color: Contrasting color, as scheduled.

2.4 ACCESSORIES

- A. Tape Adhesive: Double sided tape, permanent adhesive.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install neatly, with horizontal edges level.
- C. Locate signs where indicated:
 - 1. If no location is indicated obtain Owner's instructions.
 - 2. All tactile signs shall be mounted with the tactile characters between 48 inches above the floor to the baseline of the lowest characters and a maximum of 60 inches above the floor to the baseline of the highest characters.
 - 3. All tactile signs shall be mounted with the braille characters between 48 inches and 60 inches above the floor to the baseline of the braille cells.
 - 4. All tactile signs shall be located with a clear floor area of a minimum 18 x 18, centered on the tactile characters, and clear of any door swing arc between the door closed position and a 45 degrees open position.
 - 5. Room and Door Signs: Locate on wall at latch side of door with centerline of sign at 60 inches above finished floor.
 - a. If no suitable wall surface is available as directed above, consult with Architect for relocation.
 - 6. Live Load Design: Locate in a conspicuous place in that part of each story in which they apply.
- D. Protect from damage until Substantial Completion; repair or replace damage items.

3.3 SCHEDULE

- A. Refer to Sign Schedule on the Drawings.

END OF SECTION 10 14 01

SECTION 12 36 41 - SOLID-SURFACE COUNTERTOPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes solid-surface-material for use as countertops and wall cap.

1.3 ACTION SUBMITTALS

- A. Product Data: For countertop materials.
- B. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, and methods of joining.
- C. Samples for Verification: For countertop material, 6 inches square.

1.4 PROJECT CONDITIONS

- A. Field Measurements: Verify dimensions of countertops by field measurements after base cabinets are installed but before countertop fabrication is complete.

1.5 COORDINATION

- A. Coordinate locations of utilities that will penetrate countertops or backsplashes.

PART 2 - PRODUCTS

2.1 COUNTERTOP MATERIALS

- A. Particleboard Subtop: ANSI A208.1, Grade M-2 Glue.
- B. Solid Surface Material: Homogeneous solid sheets of filled plastic resin complying with ANSI SS1.
 - 1. Manufacturers: As indicated on Drawings.
 - 2. Type: Provide Standard Type unless Special Purpose Type is indicated.
 - 3. Colors and Patterns: As indicated on Drawings.
 - 4. Profile Edge: Square profile with eased edge.
 - 5. Thickness: 1/2-inch thick, solid surface material with front edge built up to 1-inch thickness for wall cap and 1-1/2-inch thickness for countertops.
- C. Fabrication: Fabricate tops in one piece with shop-applied edges unless otherwise indicated. Comply with solid surface material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Fasten subtops to existing wall by screwing through subtops into existing wall blocking. Shim as needed to align subtops in a level plane.

- B. Secure countertops to subtops with adhesive according to solid surface material manufacturer's written instructions. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
- C. Install backsplashes and endsplashes to comply with manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.
- D. Seal edges of cutouts in particleboard subtops by saturating with varnish.
- E. Apply sealant to gaps at walls; comply with Division 07 Section "Joint Sealants."

END OF SECTION 12 36 41

SECTION 12 50 00 - FURNISHINGS (FOR REFERENCE ONLY)

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Furnishings.

1.2 RELATED SECTIONS

- A. Division 26 - Electrical.

1.3 SUBMITTALS

- A. Submit under provisions of Section 01 30 00 – Submittal Procedures
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
- C. Verification Samples: For each finish product specified, two samples, representing actual product and finish.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Minimum 5 year experience manufacturing similar products.
- B. Installer Qualifications: Minimum 2 year experience installing similar products.

1.5 PRE-INSTALLATION MEETINGS

- A. Convene minimum two weeks prior to starting work of this section.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store products in manufacturer's unopened packaging bearing the brand name and manufacturer's identification until ready for installation.
- B. Handling: Handle materials to avoid damage.

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.

1.8 SEQUENCING

- A. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Steelcase, Haworth, OFS Brands, Enwork; or approved equal.
- B. Requests for substitutions will be considered in accordance with provisions Section 01 25 13. Any substitution will need to be approved by the Owner, Owner's Representative, and Architect

- C. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00 - Product Requirements.

2.2 MATERIALS

- A. Furnishings: Refer to drawings for locations and coordination of architectural and engineering trades
- B. Bidding: Contractor shall provide unit prices for each of the items listed below.

C1

(Lounge)

Manufacturer: OFS Brands
Model Name: Tangent 8'x10' U Shape (See Plan for Layout) Sectional with Tall Back, Cushions W/ Tie downs
Model Number(s): (TN-2233B) (TN-2222B) (TN-1133WT) (TN-1122WT) (TN-22C) (TN-33C)
Fabric: Designtex Tiny Boucle Juniper - 3926-503 or \$50/Yard COM

Qty:	1	Unit \$	Total \$
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C2

(Lounge)

Manufacturer: OFS Brands
Model Name: COACT MID BACK SOFA 67.5"W
Model Number: F78043-M
Fabric Seat: Maharam Meld Crater 466387-014 or \$50/Yard COM
Fabric Back: Carnegie Collage #6 6546-6 or \$70/Yard COM
Leg Finish: Luster Gray

Qty:	2	Unit \$	Total \$
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C3

(Conference Stool)

Manufacturer: OFS Brands
Model Name: FLEXXY MID BACK STOOL
Model Number: 16055
Fabric Vinyl: Designtex Trove Lilypad 3839-501 or \$50/Yard COM
Mesh Back: OFS Flexxy Grey
Plastic Shell: OFS Grey
Base Finish: Standard Black
Glides: For LVT

Qty:	6	Unit \$	Total \$
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C4

(Ottoman)

Manufacturer: Turnstone
Model Name: Bouy
Model Number: TSBUOY
Fabric Seat: Designtex Billard Cloth Tangelo 3549-701 Or Grade 3 Fabric
Surround: Artic White

Qty:	4	Unit \$	Total \$
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C5

(Stool)

Manufacturer: Haworth
Model Name: Maari Wood Leg Stool, Low Back, Upholstered Seat, Bar Height
Model Number: S8WB-24-0K
Poly Shell: Cocoa TR-CF
Fabric Seat: Maharam Merit Kookaburra 466444-023 or \$50/Yard Com
Leg: White Oak
Glide: For LVT

Qty:	13	Unit \$	Total \$
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C6

(Chair)

Manufacturer: Haworth
Model Name: Maari 4 Leg Chair with Upholstered Seat and Back
Model Number: S7S-22-0K
Poly Shell: Cocoa TR-CF
Fabric Seat: Maharam Merit Kookaburra 466444-023 or \$50/Yard Com
Leg: Smooth Plaster TR-PLS
Glide: For LVT

Qty:	12	Unit \$	Total \$
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C7

(Conference Chair)

Manufacturer: OFS Brands
Model Name: FLEXXY MID BACK CHAIR
Model Number: 16015,
Fabric Seat: Designtex Trove Lilypad 3839-501 or \$50/Yard COM
Mesh Back: OFS Flexxy Grey
Plastic Shell: OFS Grey
Base Finish: Standard Black
Glides: For LVT

Qty:	4	Unit \$	Total \$
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T1

(Media Table)

Manufacturer: Steelcase
Model Name: Media:scape Rectangular Stool Height Table
Model Number: MT03SR7260
Power: Standard 6 outlets within Media Well of Table, Large 8x4 switcher, 6 Pucks: 3 VGA, 3 HDMI, and display Scaler
Dimension: 60" D x 72" W x 38" H
Laminate Top: Formica Neutral Twill 8826-58
Edge: 3mm
Base: Platinum Metallic
Glides: Levelers\glides for LVT

Qty:	1	Unit \$	Total \$
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T2

(Laptop Table)

Manufacturer: Turnstone
Model Name: Turnstone Campfire Personal Table
Model Number: TS4TWP
Laminate: Formica Neutral Twill 8826-58
Glides: For LVT

Qty:	2	Unit \$	Total \$
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T3

(Cafe Table)

Manufacturer: Coaless
Model Name: Enea Lottus Table
Model Number: COEL3036
Dimensions: 36" W x 30" H
Laminate: Formica Neutral Twill 8826-58
Base: Platinum Metallic

Qty:	3	Unit \$	Total \$
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T4

Manufacturer: Enwork
Model Name: Sawhorse Table
Dimensions: 36" x 60"
Laminate: Formica Neutral Twill 8826-58
Base: Silver Metallic

Qty:	1	Unit \$	Total \$
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T5

Manufacturer: Haworth
Model Name: Jive Table 36x36 x 20" H X Base Table on Glides
Laminate: Formica Neutral Twill 8826-58
Base: Metallic Silver

Qty:	1	Unit \$	Total \$
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PART 3 EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

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 in accordance with manufacturer's instructions and in proper relationship with adjacent construction.

3.4 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION 12 50 00

SECTION 23 01 00 – OPERATION AND MAINTENANCE OF HVAC 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.
- B. Refer to individual Division 23 sections for additional equipment specific Operations and Maintenance Manual requirements.

1.2 SUMMARY

- A. This Section includes preparing and furnishing an operating and maintenance manual for mechanical equipment.

1.3 DESCRIPTION

- A. Compile an Operating and Maintenance Manual:
 - 1. For all building mechanical systems and major equipment items.
 - 2. Including, but not necessarily limited to:
 - a. Installing company's name, address, telephone number and name of job supervisor.
 - b. Maintenance and operating booklets (as supplied by the equipment Manufacturer) for each item or representative type item installed.
 - c. Valve tag schedule.
 - d. A complete set of Shop Drawings.
 - e. Temperature control drawings.
 - f. Equipment information forms for each equipment piece.
 - 3. Each equipment information form include all applicable items of the following:
 - a. Type of unit.
 - b. Manufacturer's name.
 - c. Equipment service area.
 - d. Recommended cleaning procedures and intervals.
- B. Prepare Information Packets:
 - 1. Attach to each major piece of equipment in a string tie envelope labeled with the equipment's designation in large print.
 - 2. Information Required:
 - a. A copy of the equipment information form as defined above.
 - b. A temperature control written operation sequence.
 - c. A maintenance checklist form with equipment identification information and listing all relevant maintenance procedures in a column format to accommodate date entries.

1.4 SUBMITTALS

- A. Three copies of Operating and Maintenance Manual.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

Not used.

END OF SECTION 23 01 00

SECTION 23 05 00 – GENERAL HVAC PROVISIONS

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 specifying the general requirements for execution of that portion of the Work defined in Division 23 of these Specifications and as indicated on the Drawings:
 - 1. Major items include, but are not necessarily limited to:
 - a. Cutting and patching.
 - b. Concrete foundations and support steel.
 - c. Piping, fittings and valves.
 - d. Piping, ductwork and equipment insulation.
 - e. Temperature and pressure gages.
 - f. HVAC equipment, including drives.
 - g. Ductwork.
 - h. Temperature control systems.
 - i. Demolition of existing mechanical work.
 - j. Labor, materials, equipment, tools, supervision and start-up services.
 - k. Mechanical systems testing, adjusting and balancing.
 - l. Instructions to Owner regarding operation.
 - m. Incidental and related items necessary to a complete and functionally operational installation of the Work.
- B. Division of Work: In accordance with the General Conditions, Contractor is responsible for dividing the Work among the Subcontractors and Suppliers and for delineating the Work to be performed by specific trades. The following are suggestions as to how the Work may be divided. This is not a complete list of all the Work:
 - 1. General Contractor:
 - a. Install access doors.
 - b. Provide concrete isolation and housekeeping pads for mechanical equipment.
 - c. Refer to Division 01 Section "Cutting and Patching." Provide access doors in walls and ceilings for access to mechanical equipment.
 - 2. Mechanical Subcontractor:
 - a. Refer to Division 01 Section "Cutting and Patching."
 - b. Furnish location, size and quantity of openings to Contractor before construction of new walls, ceilings, and floors.
 - c. Furnish size and locations of concrete equipment isolation and housekeeping pads as required for this Work and as indicated on the Drawings to Contractor before slabs are poured.
 - d. Furnish size and location of access doors required for this work as indicated on the Drawings to Contractor.
 - e. Provide miscellaneous structural steel required in connection with support of the Work of Division 23.
 - f. Perform final cleaning of mechanical systems and equipment.

1.3 REFERENCES

- A. Except as herein specified or as indicated on the Drawings, the work of Division 23 shall comply with the following:
 - 1. ANSI: A13.1 - Standard for the Identification of Piping Systems.
 - 2. ASME - American Society of Mechanical Engineers:
 - a. B31.1 - Power Piping.
 - b. B31.9 - Building Services Piping.
 - 3. ASTM: A325 - Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.

4. Michigan Rehabilitation Code of 2015
5. Michigan Mechanical Code of 2015.

1.4 DESIGN AND PERFORMANCE REQUIREMENTS

- A. Construction details, components, accessories, sizes and model numbers indicated on the Drawings or in these specifications are used to indicate minimum levels of quality and coordination requirements.
- B. Equipment supplied, whether as scheduled or selected from list of acceptable Manufacturers, must meet minimum requirements listed in specifications or on Drawings, be compatible with facility and intended use, and meet requirements for a functional system.
- C. Drawings:
 1. Are diagrammatic and indicate general arrangement of systems and work included.
 2. Do not necessarily indicate every required valve, fitting, trap, thermometer, gage, duct, elbow, transition, turning vane, mounting support and access panel.
 3. Shall not be scaled for measurement or installation location.
 4. Shall not serve as Shop Drawings.
- D. Schedules and model numbers shall not be used to:
 1. Serve as final, definitive quantity requirements. Contractor shall make own count as indicated on Drawings.
 2. Determine proper type or model with arrangement, mounting and accessories applicable.
- E. Coordinate installation work of Division 23 with work of other trades to provide a complete and functional system. Generally, the location of ductwork, sanitary, storm and vent piping take precedence over fire protection and HVAC piping, electrical conduit and cable trays.

1.5 PRODUCT UNLOADING AND HANDLING

- A. Unload equipment and materials required for completion of the Work.
- B. Handle and store equipment and materials carefully to prevent damage. Method of rigging and handling shall be subject to the approval of an authorized representative of the equipment Manufacturer whose equipment is being handled.

1.6 TROUBLESHOOTING

- A. By Contractor: If, during the start-up or warranty period, mechanical systems operational problems occur for which the root cause is not readily apparent, Contractor shall promptly, through a Subcontractor or other resource designated by Subcontractor, provide diagnostic and investigative services to determine the cause or causes.
- B. By Engineer:
 1. At Contractor's request, Engineer will provide the services necessary to determine the cause or causes of the operational problems.
 2. Under the provisions of the General Conditions, Engineer will also provide these services if Contractor fails to respond satisfactorily to operational problems within a reasonable time after written notice from Engineer.
 3. If while working at Contractor's request or under the provisions of the General Conditions, Engineer determines that the problems are due to failure of the Work to comply with the requirements of the Contract Documents, Owner will compensate Engineer for additional services and deduct the amount paid from payment or payments to Contractor.

1.7 MAINTENANCE

- A. Special Tools: Where special tools are required for operation, furnish these to Owner.

- B. Loose and Detachable Parts:
 - 1. Retain loose and small detachable parts of the apparatus and equipment furnished until the completion of the Work.
 - 2. Turn over these parts to Owner.
- C. Start-up Filters:
 - 1. Do not run air handling equipment without filters.
 - 2. Use of installed permanent heating and cooling equipment ductwork systems shall be in accordance with Division 01 Section "Temporary Facilities and Controls."
 - 3. Provide filters as required to protect the air handling systems during construction phase work.
 - 4. Just prior to Substantial Completion, replace temporary construction filter elements with the owner required filter systems.
- D. Construction Strainers:
 - 1. Remove after flushing and cleaning and prior to commencement of TAB.
 - 2. Attach removed construction strainer to piping where removed as proof of removal.

PART 2 - PRODUCTS

2.1 FABRICATIONS

- A. Miscellaneous Structural Steel:
 - 1. Structural steel work shall be done in accordance with the AISC Specification for Design, Fabrication and Erection of Structural Steel for Buildings, except that allowable stresses shall be reduced 25%.
 - 2. Where required, high strength structural steel bolting conforming to ASTM Specification A325 and assembled to AISC "Specifications for Assembly of Structural Joints. Using High Strength Steel Bolts" or welding shall be used in place of rivets.
 - 3. Connections shall be properly designed for the type of connection and the loads to be carried, and shall be subject to Engineer's or Owner's approval.
 - 4. Welding shall be done by operators who have been previously qualified by tests as prescribed in the American Welding Society "Standard Qualification Procedure" to perform the type of work required.
 - 5. Welding techniques shall conform to the American Welding Society "Code for Arc and Gas Welding in Building Construction", Section 4, Workmanship.
 - 6. Finished members shall be true to line and free from twist, bends and open joints.
- B. Material installed in a ceiling plenum shall be either noncombustible or have a maximum flame spread of 25 and a maximum smoke developed rating of 50.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Character of Work: Installation shall be executed in a workmanlike manner and shall present a neat mechanical appearance when completed.
- B. Laying Out of Work:
 - 1. Layout piping, ductwork, equipment and components in accordance with the Contract Documents and the Manufacturer's recommended practice, including provision of adequate space for maintenance. Review layout with Engineer prior to installation.
 - 2. Check drawings of other trades to verify spaces in which work will be installed. Maintain maximum head room and space conditions at all points. Where head room or space conditions appear inadequate, notify Engineer before proceeding with installation.
 - 3. If directed by Engineer, Contractor shall make reasonable modifications in the layout as required to permit proper execution of the Work and to prevent conflict with work of other trades.
 - 4. Work shall be installed so as to be ready for operation, maintenance and repair. Minor deviations from Drawings may be made to accomplish this. Changes shall not be made without approval of Engineer.
 - 5. Unless indicated otherwise, install piping and ductwork concealed above ceilings or within walls.

3.2 MODIFICATIONS TO EXISTING FACILITIES

- A. Comply with the requirements of Division 02 Section "Selective Demolition" for removal of existing pipes, equipment, and other systems.
- B. Comply with the requirements of Division 02 Section "Selective Demolition," for all work related to the modification, alteration, conversion, renovation, and reuse of existing facilities.

3.3 PIPE FITTINGS

- A. Provide insulating couplings or unions where dissimilar materials are joined.
- B. Provide unions at valves and at equipment for making repairs.

3.4 PAINTING

- A. Paint exposed, non-insulated piping and exposed ductwork in accordance with the requirements of Division 09 – Finishes.
- B. Provide labels as specified below. Comply with OSHA "Safety Color Code for Marking Physical Hazards" and ANSI A13.1 for pipe labels and colors.
- C. Valves, Fittings, and Supports:
 - 1. Paint valves and fittings the same base color as the pipe they adjoin.
 - 2. Paint floor stands the same base color as the pipe they adjoin.
 - 3. Paint wall brackets and pipe hangers the same base color as the wall or ceiling they adjoin, or gray, if wall or ceiling is not painted.

3.5 CODING AND TAGGING

- A. Piping:
 - 1. Applied to new piping after installation, insulation, and final painting.
 - 2. Conform to Owner's existing standards or conventions.
 - 3. Markings:
 - a. Painted on, 1-inch high black letters.
 - b. Color coded band, conforming to ANSI A13.1.
 - c. Directional arrow.
 - 4. Place markers at 20-foot centers with at least 1 in each room.
 - 5. Plastic coated "Set Mark-Snap-Around" pipe markers manufactured by Seton Name Plate Corp., New Haven, Connecticut; or approved equal, may be used in lieu of painted markers and bands.
- B. Valves:
 - 1. Provide 19-gage brass tags indicating assigned valve number on valves. 1/4-inch high lettering. Tags to be 1-1/2-inch diameter.
 - 2. Furnish schedule(s) of tagged valves with number, location and purpose of each valve.
 - 3. Place a copy of each schedule:
 - a. In the Maintenance Instructions.
 - b. In a string tie envelope labeled "Valve Schedule" and mount in location as designed by the Owner.
- C. Where valves, dampers, fans, and terminal units are located above the ceilings, a cadmium plated screw or such marking as designed by Engineer shall be located in the ceiling tile directly below the device.
- D. Provide record documentation of all hydronic system air vent locations on record drawings (as-builts) or other method as approved by Engineer.

- E. Equipment:
 - 1. Provide for:
 - a. Each Terminal unit, with source air handling unit number.
 - b. Labeled with its tag name/number as given on the Drawings.
 - c. Use 2-inch high stenciled painted lettering.
 - 2. Similarly label control components associated with the above named equipment items.
 - 3. Labels to indicate system and spaces served.
- F. Dampers:
 - 1. Provide for each fire damper, combination fire/smoke damper, smoke damper, and balancing damper.
 - 2. Label shall bear the tag name and number as indicated on the Drawings.
 - 3. Use 2-inch high stenciled black lettering.
 - 4. Mark balancing damper location after final adjustment.

3.6 START-UP

- A. Preparation:
 - 1. Verify That System:
 - a. Has been inspected and put in service.
 - b. Is fully operational.
 - 2. Operation and Maintenance Manuals:
 - a. Completed.
 - b. Sufficient copies available for use in demonstrations and instructions.
 - 3. Air and hydronic system balancing shall have been completed prior to these performance tests.
- B. Demonstration and Instructions:
 - 1. Demonstration Of and Instruction On Operation and Maintenance of System:
 - a. To Owner's personnel.
 - b. Two weeks prior to final inspection.
 - 2. Equipment Requiring Seasonal Operation: Demonstration within 12 months.
 - 3. Instruction:
 - a. Operation and maintenance manual as basis.
 - b. Review contents of manual in detail.
 - c. Explain aspects of operation and maintenance.
 - 4. Demonstrate:
 - a. Start-up.
 - b. Operation.
 - c. Control.
 - d. Adjustment.
 - e. Troubleshooting.
 - f. Servicing.
 - g. Maintenance.
 - h. Shutdown.

3.7 ADJUSTING

- A. Adjust and align equipment for smooth operation:
 - 1. Plumb true and with parts in proper position and alignment.
 - 2. Rotating parts shall turn freely and in the correct direction.
 - 3. Flexible couplings shall be checked for alignment subject to Owner's approval.
 - 4. Follow Manufacturer's instructions.
- B. The work of installation shall be executed in conformity with the best practice, so as to contribute to efficiency of operation, minimum noise or vibration, minimum maintenance, accessibility and sightliness.

3.8 FIELD QUALITY CONTROL

- A. Manufacturer's Field Services:
 - 1. Provide when required by individual Section.
 - 2. Provide the following services except where indicated otherwise in individual Sections:
 - a. Inspect, check and approve system installation.
 - b. Supervise system start-up.
 - c. Provide written report indicating that system:
 - 1) Has been properly installed and lubricated.
 - 2) Is in accurate alignment.
 - 3) Is free from undue stress imposed by connecting lines or anchor bolts.
 - 4) Has been satisfactorily operated under full load conditions.
 - d. Demonstrate operation of system to Owner's personnel.
 - e. Instruct Owner's personnel on operation and maintenance of system.
- B. Performance Test:
 - 1. Test the entire Work, including all of its individual systems for 2 weeks before final payment will be made.
 - 2. Every phase of plumbing, air conditioning and heating and ventilating plant shall be operated separately, or in conjunction one with the other to demonstrate to Engineer the ability of the plant to meet capacity and performance requirements while maintaining design condition, in accordance with the true intent and purpose of these Specifications.
 - 3. Make final tests in the presence of Owner and Engineer.
 - 4. If a part of the Work or equipment does not meet Specifications:
 - a. Correct the situation.
 - b. Obtain approval of Engineer before final payment is made.
 - 5. Provide the personnel and bear costs for correcting malfunctions.
 - 6. Owner will provide operating personnel and utilities.
 - 7. Air and hydronic systems balancing shall be completed prior to performance testing.

3.9 CLEANING AND FINISHING

- A. Comply with the requirements of Division 01 Section "Cleaning and Waste Management."
- B. Entire installation shall be free from surface oil and grease before work will be considered for final payment.
- C. After tests have been made and the system pronounced tight:
 - 1. Clean piping and equipment.
 - 2. Lubricate bearings.
- D. Final cleaning includes but is not limited to the following:
 - 1. Equipment with Factory Finishes:
 - a. Wash factory-finished equipment with mild soap and water and leave in first-class condition, entirely free of stains or streaks.
 - b. Do not use abrasive materials. Touch up scratches or other violations of the factory finish paint with matching paint from the equipment Manufacturer prior to cleaning.

END OF SECTION 23 05 00

SECTION 23 05 09 – COPPER PIPE AND FITTINGS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the furnishing and installation of copper pipe and fittings.
- B. Division of Work: In accordance with the General Conditions, Contractor is responsible for dividing the Work among the Subcontractors and Suppliers and for delineating the work to be performed by specific trades. The following are suggestions as to how the Work may be divided. This is not a complete list of all the work:
 - 1. General Contractor: Coordinate work of this Section with other trades.
 - 2. Mechanical Subcontractor: All work of this Section except as listed under General Contractor.

1.3 REFERENCES

- A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
 - 1. ASTM Specifications:
 - a. B88 - Seamless Copper Water Tube.
 - b. B280 - Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
 - 2. ANSI Publications: A13.1 - Scheme for the Identification of Piping Systems.

1.4 SUBMITTALS

- A. Shop Drawings: For couplings, gasketing materials. Include dimensions, details of construction and installation, name of Manufacturer and model.

1.5 QUALITY ASSURANCE

- A. Fabrication and Installation Personnel Qualifications:
 - 1. Trained and experienced in the fabrication and installation of the materials and equipment.
 - 2. Knowledgeable of the design and the reviewed Shop Drawings.
- B. Testing of Copper Piping: In accordance with Division 23 Section "Testing and Cleaning of HVAC Systems."

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials in original, unbroken, brand marked containers or wrapping as applicable.
- B. Handle and store materials in a manner which will prevent deterioration and contamination with foreign matter.
- C. Reject damaged, deteriorated or contaminated material and immediately remove from the Site. Replace removed materials at no additional cost to Owner.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Seamless Copper Tubing:
 - 1. Factory coded and marked.
 - 2. Conform to the following schedule:
 - a. Aboveground: ASTM B88, Type L, hard drawn.
 - 3. Pipe Markings:
 - a. All piping longer than 2'-0" shall have a permanent marking in accordance with ASTM or ANSI specifications.
 - b. This identification shall include the following:
 - 1) Manufacturer's name.
 - 2) Pipe pressure rating.
 - 3) Pipe size.
- B. Solder type shall conform to the following schedule:
 - 1. Hydronic System Lines: 50% tin, bismuth, 50% lead.
 - a. IAPMO listed lead free.
 - 2. Drain Piping: 50% tin and 50% lead.
 - 3. Condensate Drain Piping: 50% tin and 50% lead.
- C. Fittings: General Service:
 - 1. Sweat type, wrought copper, long radius elbows.
 - 2. Cast fittings shall only be allowed with written permission from the Engineer.

2.2 GROOVED PIPING SYSTEMS (Use of Grooved Piping MUST be approved by Wayne State University)

- A. General:
 - 1. Comprised of mechanically cut or roll grooved or crimped pipe and fittings secured with compatible gasketed mechanical couplings.
 - 2. All grooved piping materials shall conform to the specifications governing the systems or application for which they are used.
 - 3. All couplings and fittings shall be copper.
- B. Manufacturers:
 - 1. Victaulic.
 - 2. Grinnell.
- C. Pipe and Tubing: Comply with the requirements above.
- D. Couplings:
 - 1. Housing: Copper Tubing: Ductile iron, ASTM A536.
 - 2. Style: Copper Tubing:
 - a. Rigid style.
 - b. Victaulic style 606; Grinnell style 672.
 - 3. Gasket:
 - a. Water Service: EDPM.
 - b. Air Surface: Nitrile.
 - 4. Bolts – Nuts:
 - a. Track bolts with 110,000 psi tensile strength.
 - b. Heavy hex nuts.
 - c. Zinc electroplated carbon steel.
- E. Fittings:
 - 1. Copper or bronze.
 - 2. Grooves or shoulders compatible with system couplings.
 - 3. Segmentally welded fittings not acceptable.
 - 4. Clamp-on mechanical tees not acceptable.

- F. Valves:
 - 1. Refer to Division 23 Section "General Duty Valves for HVAC," or specification section governing the system or application for which they are used.
 - 2. Compatible with grooved pipe coupling.

- G. Strainers: Compatible with grooved pipe coupling.

PART 3 - EXECUTION

3.1 PREPARATION

- A. During Freezing Weather:
 - 1. Protect all materials in such a manner that no harm can be done to:
 - a. Installations already made.
 - b. Materials and equipment on the Site.
 - 2. Furnish all necessary protection for such installations and equipment as may be required.

3.2 ERECTION

- A. General:
 - 1. All Piping: Follow approved paths as indicated on the Drawings.
 - 2. Connect to existing lines where required, or to equipment in an approved manner.
 - 3. Locate Pipes, Valves and Equipment to Provide:
 - a. Access for maintenance.
 - b. Minimum obstruction of passageways and working space.
 - 4. Normally, all pipe runs shall be plumb, parallel with the building and level, except for drain slope.
 - 5. Be responsible for establishing and maintaining drain slope of piping in order to ensure drainage.
 - 6. Expansion of Piping:
 - a. All pipe connections shall provide freedom of movement of the piping during expansion and contraction without springing of piping or injury to building steel or structure.
 - b. Any damage to building steel or structure as a result of work installed by Contractor shall be repaired at Contractor's expense.
 - 7. As Piping Material is Erected:
 - a. Thoroughly clean the inside of all piping.
 - b. Remove foreign material such as scale, sand, weld spatter, particles and cutting chips.
 - 8. Provide caps or plugs in all openings at the end of each day's work and as otherwise directed for the protection of the piping.
- B. Pipe Joints:
 - 1. Cut ends of copper tubing squarely using only sharp tube cutters.
 - 2. Ream pipe to full I.D. before preparing the joint.
 - 3. Soldering:
 - a. Solder or braze joints by cleaning outside ends of all copper tubings and inside of fittings immediately before joining and soldering.
 - b. Apply solder flux to both tube and fitting.
 - c. Insert tube full depth into fitting, apply heat and solder in such a manner as to draw solder into and completely around the joint.
 - 4. Joining Valves:
 - a. When joining copper lines to valves follow Manufacturer's instructions.
 - b. In general:
 - 1) Valve shall be in the fully open position.
 - 2) Solenoid and expansion valves shall be broken down.

3.3 GROOVED PIPING SYSTEMS

- A. Piping shall be prepared in accordance with the latest Manufacturer's specifications or other standards applicable.
- B. Copper tubing shall be roll grooved without metal removal.

- C. Couplings, fittings, valves and pipe shall be assembled in accordance with latest Manufacturer's instructions.
- D. Support piping according to Manufacturer's maximum span recommendations or Division 23 Section "Hangers and Supports for HVAC Piping and Equipment," whichever is more stringent.
- E. Raised face flanges shall have a metal flange washer installed.
- F. Cutting, Grooving and Crimping:
 - 1. All flexible pipe fittings including grooved, cut and plain end and all quick fit fittings shall be installed with a machine specifically designed for this purpose.
 - 2. All piping to be grooved, cut and crimped shall be prepared using this specifically designed machine.
- G. Mechanical joints are not allowed within walls.
- H. Submit written approval of installation.

3.4 FIELD QUALITY CONTROL

- A. Clean and test piping in accordance with Division 23 Section "Testing and Cleaning of HVAC Systems."

END OF SECTION 23 05 09

SECTION 23 05 23 – GENERAL DUTY VALVES FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the furnishing and installation of all valves.

1.3 REFERENCES

- A. Except as specified or as indicated on the Drawings, the work of this Section shall comply with the following:
 - 1. General: Provide valves with features indicated and, where not otherwise indicated, provide proper valve features as determined by Installer for installation requirements. Comply with ASME B31.9 for building services piping, and ASME B31.1 for power piping.
 - 2. Flanged: Valve flanges complying with ANSI B16.1 (cast iron), ANSI B16.5 (steel), or ANSI B16.24 (bronze).
 - 3. Threaded: Valve ends complying with ANSI B2.1.
 - 4. Solder-Joint: Valve ends complying with ANSI B16.18.
 - 5. Flangeless: Valve bodies manufactured to fit between flanges complying with ANSI B16.1 (cast iron), ANSI B16.5 (steel), or ANSI B16.24 (bronze).
 - 6. Welded Ends: Valve ends complying with ASME/ANSI B16.5.

1.4 DESIGN AND PERFORMANCE REQUIREMENTS

- A. General:
 - 1. This Section is provided as a guide in the application and specification of specific valves intended for use in this Project. This Section does not instruct where to install these valves unless specifically noted. Refer to other specific Mechanical Specification Sections and Drawing details for instruction for location and use.
 - 2. As indicated on the Drawings.
 - 3. As called out in the Piping Systems Schedules.
- B. Valves not specifically indicated on the Drawings:
 - 1. Size and class of valve and pipe schedule to agree with line in which installed.
- C. Valves shall have Manufacturer's name, trademark and working pressure rating cast into the valve body.

1.5 SUBMITTALS

- A. Shop Drawings for all valves.
- B. Manufacturer's Literature: For All Valves:
 - 1. Manufacturer's name.
 - 2. Details of construction.
 - 3. Performance characteristics.
 - 4. Pressure and temperature ratings.
 - 5. Close-off pressure.

1.6 QUALITY ASSURANCE

- A. Made in USA:
 - 1. Unless specifically noted otherwise, all valves shall comply with the Federal Trade Commission Made in USA standard.
 - 2. Supplier shall furnish documentation of USA content if requested by Engineer.
- B. Fabrication and Installation Personnel Qualifications:
 - 1. Trained and experienced in the fabrication and installation of the material and equipment.
 - 2. Knowledgeable of the design and the reviewed Shop Drawings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Valves shall be manufactured by one Manufacturer for each type of valve. Where valve Manufacturers are not specifically indicated, they shall be one of the following:
 - 1. Nibco.
 - 2. Kennedy.
 - 3. Grinnell.
 - 4. Stockham.
- B. Acceptable Manufacturers of valves, hose kits and hook-ups:
 - 1. Nexus.
 - 2. Armstrong.
 - 3. B&G.

2.2 MATERIALS

- A. Bronze Valves:
 - 1. All brass alloys used in valves shall contain no more than 15% zinc.
 - 2. Alloys must comply with ASTM B61, B62 or B584.

2.3 HAND VALVES

- A. General:
 - 1. Provide extended stem handles and necks with a minimum clearance of 1-1/2-inch on insulated service.
 - 2. All valves used for throttling/balancing shall have adjustable memory stops.
 - 3. Pressure ratings are at service indicated by application.
- B. Globe Valves:
 - 1. Threaded end 2-inch and smaller (125 psig and less): 125 pounds wsp, bronze body, rising stem, screwed bonnet, Teflon disc, Grinnell No. 3210, Crane No. 7.
 - 2. Threaded end 2-inch and smaller (above 125 psig): 300 pounds wsp, bronze body, rising stem, union bonnet, renewable Teflon disc, Grinnell No. 3251, Crane No. 362-E.
 - 3. Solder joint end 2-inch and smaller: 125 pounds wsp, bronze body, rising stem, screwed bonnet, Teflon disc, Grinnell No. 3210SJ, Crane No. 1310.
- C. Ball Valves:
 - 1. Ball valves used in connection with piping 2 inches in size and smaller shall have screwed or sweat ends, 2 piece bronze body, standard port with stainless steel ball or cad plated ball and a like stem. VA rated for 150 pound SWP and 600 WOG. Seats and seals shall be virgin teflon for standard duty cycle. Provide reinforced teflon for applications identified for extended duty cycle.
 - 2. 3 inches and larger shall be flanged or butt welded.
- D. Drain Valves: Furnish at each low point 3/4-inch gate or ball valves as specified above. Install nipple with cap at valve outlet.

- E. Plug Valves:
 - 1. Plug valves shall be nonlubricated eccentric plug type rated for 175 pound WOG with semi-steel body neoprene coated plug and epoxy coated seat; equal to DeZurik Series 100 or Homestead Ballcentric. Furnish with compatible wrench. All valves used for throttling/balancing to have adjustable memory stop.
 - 2. Plug valves (gas cock) for natural gas shutoff applications shall be lubricated type equal to Homestead Figure 611 or 612 or Rockwell Figure 114 or 115.

2.4 CHECK VALVES

- A. Silent Check Valve:
 - 1. Install silent check valves in all pump discharge.
 - 2. Piping less than 2-inch: 300 pounds, bronze body, renewable bronze disc screwed or sweat ends, bronze trim, Mueller, #203 BP; or equal.
- B. Swing Check Valve:
 - 1. 2-Inch and Smaller: 150 psi valves for heating hot water.
 - a. MSS SP-80; Class 125, cast-bronze body and cap conforming to ASTM B62; with horizontal swing, Y-pattern, and bronze disc; and having threaded or solder ends.
 - b. Provide valves capable of being reground while the valve remains in the line.
 - c. Provide Class 150 valves meeting the above specifications, with threaded end connections, where system pressure requires or where Class 125 valves are not available.

2.5 AUTOMATIC CONTROL VALVES - MODULATING SERVICE

- A. Manufacturers:
 - 1. Fisher.
 - 2. Leslie.
 - 3. Siemens.
 - 4. Honeywell.
- B. Hydronic Control Valves:
 - 1. Provide globe type or characterized port ball valve, modulating device with equal percentage relationship between valve lift and fluid flow unless noted otherwise.
 - 2. Body:
 - a. Flanged cast iron for sizes 2-1/2 inches and larger.
 - b. Screwed bronze for sizes 2 inches and smaller.
 - 3. Trim:
 - a. Stainless steel stem.
 - b. Brass plug with renewable composition disc.
 - c. Replaceable seat.
- C. Sizing: 3 psi maximum pressure drop at design flow where Cv is not indicated for hydronic applications.
- D. Operating Pressure: Provide valve and operator designed for tight shutoff at 125% of design pressure:
- E. Operators:
 - 1. Electric:
 - a. Serviceable and rebuildable.
 - b. Alternate Manufacturers:
 - 1) Belimo.
 - 2) Honeywell.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install valves in conformance with:
 - 1. The Shop Drawings reviewed by Engineer.
 - 2. The Manufacturer's recommendations.
- B. Install Valves:
 - 1. At all branch piping connection to mains.
 - 2. At all connections to equipment.
 - 3. As required for complete control or isolation of any piece of equipment or service to branch lines.
 - 4. In accessible locations.
 - 5. Equal in flow area to connecting piping, unless otherwise indicated.
- C. No valve shall be installed with its stem below the horizontal.
- D. Furnish chain operated hand wheels, including rust-proof chain and chain guide for inaccessible overhead valves.
- E. Install flanged valves at equipment in a manner which allows equipment side of valve to be opened up without draining piping system.

END OF SECTION 23 05 23

SECTION 23 05 29 – HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the furnishing and installation of all pipe hanging and support systems.

1.3 REFERENCES

- A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
 - 1. ASME - American Society of Mechanical Engineers:
 - a. B31.1 - Power Piping.
 - b. B31.8 - Gas Transmission and Distribution Piping Systems.
 - c. B31.9 – Building Services Piping.
 - 2. MSS - Manufacturers Standardization Society:
 - a. SP-58 - Pipe Hangers and Supports - Materials, Design and Manufacture.
 - b. SP-69 - Pipe Hangers and Supports - Selection and Application - 1996.
 - c. SP-89 – Pipe Hangers and Supports – Fabrication and Installation Practices.
 - d. SP-90 - Guidelines on Terminology for Pipe Hangers and Supports.

1.4 DESIGN AND PERFORMANCE REQUIREMENTS

- A. Unless otherwise indicated on Drawings or in these Specifications, this Contractor shall be responsible to design and provide all pipe hangers, supports, restraints, braces, framing, etc., as required to comply with all applicable building codes, ASME B31 and MSS SP-69.
- B. Comply with the requirements of Division 23 Section “Sound and Vibration Control for HVAC” for vibration isolation of piping.
- C. Comply with the requirements of ASME B31.8 for pipe hangers and support of natural gas piping systems.
- D. The Work in this Section includes responsibility for all hangers, supports, restraints, braces, framing, etc. as required to comply with the requirements of the International Building Code of 2006.

1.5 SUBMITTALS

- A. Manufacturer's Literature: For structural steel attachment devices, hangers and rollers. Include name of Manufacturer; model number and MSS Type, if applicable; and piping systems to be used with.
- B. Submit Shop Drawings for all engineered hanger, restraints and support assemblies.
 - 1. For Metal Framing Pipe Supports: Include locations, dimensions, lengths, Manufacturer, material, cross-section number or type, finish, pipe sizes, and pipe locations.
- C. Upon request by Engineer, submit calculations for all engineered hanger, restraints and support assemblies.
 - 1. Calculations: For metal framing pipe supports upon request by Engineer. Include support locations, pipe sizes, pipe weights, allowable stresses, and actual stresses.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. The materials of all pipe hanging and supporting elements shall be in accordance with the latest requirements of the ASME Code for Pressure Piping B31.1 and MSS Standard Practice MSS SP-58 and MSS SP-69 except as supplemented or modified by the requirements of these Specifications.
- B. The material in contact with the pipe shall be compatible with the piping material so that neither shall have a deteriorating action on the other.
- C. Special Finishes and Materials: All ferrous hangers and supports used in the following areas shall be hot dip galvanized unless piping or equipment has factory has a field-applied finish.

2.2 MANUFACTURERS

- A. Elcon.
- B. Michigan Hanger.
- C. Anvil.
- D. Bergen.
- E. Hilti.
- F. Lindapter.

2.3 PIPE HANGERS AND SUPPORTS

- A. Horizontal Piping Hangers: Unless otherwise indicated and except as specified in piping system Specification sections, install the following types:
 - 1. Adjustable Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30 (DN15 to DN750).
 - 2. Yoke Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 degrees F (49 to 232 degrees C) pipes, NPS 4 to NPS 16 (DN100 to DN400), requiring up to 4 inches (100 mm) of insulation.
 - 3. Carbon or Alloy Steel, Double Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24 (DN20 to DN600), requiring clamp flexibility and up to 4 inches (100 mm) of insulation.
 - 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24 (DN15 to DN600), if little or no insulation is required.
 - 5. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4 (DN15 to DN100), to allow off-center closure for hanger installation before pipe erection.
 - 6. Adjustable Swivel Split or Solid Ring Hangers (MSS Type 6): For suspension of noninsulated stationary pipes, NPS 3/4 to NPS 8 (DN20 to DN200).
 - 7. Adjustable Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8 (DN 15 to DN200).
 - 8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8 (DN15 to DN200).
 - 9. Adjustable Swivel Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2 (DN15 to DN50).
 - 10. Split Pipe Ring With or Without Turnbuckle Adjustment Hangers (MSS Type 11): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8 (DN10 to DN200).
 - 11. Extension Hinged or 2 Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 3 (DN10 to DN80).
 - 12. U-Bolts (MSS Type 24): For support of heavy pipe, NPS 1/2 to NPS 30 (DN15 to DN750).
 - 13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.

- B. Supports and Rollers:
1. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36 (DN100 to DN900), with steel pipe base stanchion support and cast iron floor flange.
 2. Pipe Stanchion Saddles (MSS Type 37): For support of pipes, NPS 4 to NPS 36 (DN100 to DN900), with steel pipe base stanchion support and cast iron floor flange with U-bolt to retain pipe.
 3. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion type support for pipes, NPS 2-1/2 to NPS 36 (DN65 to DN900), if vertical adjustment is required, with steel pipe base stanchion support and cast iron floor flange.
 4. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30 (DN25 to DN750), from 2 rods if longitudinal movement caused by expansion and contraction might occur.
 5. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 20 (DN65 to DN500), from single rod if horizontal movement caused by expansion and contraction might occur.
 6. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42 (DN50 to DN1050), if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
 7. Pipe Roll and Plate Units (MSS Type 45): For support of pipes, NPS 2 to NPS 24 (DN50 to DN600), if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
 8. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes, NPS 2 to NPS 30 (DN50 to DN750), if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- C. Hanger Rod Attachments: Unless otherwise indicated and except as specified in piping system specification sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches (150 mm) for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 degree F (49 to 232 degree C) piping installations.
 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type II, split pipe rings.
 4. Malleable Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 degree F (49 to 232 degree C) piping installations.
- D. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Specification sections, install the following types:
1. Restraint Control Devices (MSS Type 47): Where indicated to control piping movement.
 2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches (32 mm).
 3. Spring Cushion Roll Hangers (MSS Type 49): For equipping Type 42 roll hanger with springs.
 4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
 5. Variable Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25% to absorb expansion and contraction of piping system from hanger.
 6. Variable Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25% to absorb expansion and contraction of piping system from base support.
 7. Variable Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25% to absorb expansion and contraction of piping system from trapeze support.
 8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load adjustment capability. These supports include the following types:
 - a. Horizontal (MSS Type 54): Mounted horizontally.
 - b. Vertical (MSS Type 55): Mounted vertically.
 - c. Trapeze (MSS Type 56): Two vertical type supports and 1 trapeze member.

2.4 HANGER RODS

- A. Minimum rod diameters for rigid rod hangers shall be as shown in MSS SP-69 Table 4 (Minimum Rod Diameter for Single Rigid Rod Hangers) and as indicated in Part 3 of these Specifications.

- B. Hanger rods shall be subject to tensile loading only. At hanger locations where lateral or axial movement is anticipated, suitable linkage shall be provided to permit swing.
- C. Rod material must be compatible with hanger and comply with above. Do not field cut thread on galvanized rod.
- D. Do not use perforated strap.
- E. Multiple Supports:
 - 1. Horizontal banks of pipe may be supported on a common base member without regard to the pipe centerline elevation.
 - 2. In the supporting of multiple pipe runs, provisions shall be made to keep the lines in their relative lateral positions, using clamps or clips as required. Lines subject to thermal expansion shall be free to roll axially or slide.

2.5 SADDLES AND SHIELDS

- A. All Piping:
 - 1. Saddle: MSS Type 39 (Grinnell #160-164), or Anvil Figure 162 or 165.
 - 2. Shield: MSS Type 40 (Grinnell #167), provide and install in accordance with Manufacturer's shield size selection tables.
 - 3. The contour of the saddle shall match the radius of the pipe insulation.

2.6 FABRICATED STEEL SUPPORTS AND RESTRAINTS

- A. Provide as required:
 - 1. Steel shapes and plates.
 - 2. Bolts.
 - 3. Welds.
- B. Materials and fabrication in accordance with:
 - 1. AISC Specification for the Design, Fabrication and Erection of Structural Steel for Buildings.
 - 2. AISC Code of Standard Practice for Steel Buildings and Bridges (except Section 4.2.1.).
- C. Design: Responsibility of Subcontractor, except as specifically indicated on Drawings.
- D. Paint all finished fabrications:
 - 1. As specified in Division 09 - Finishes.
 - 2. Color as directed by Engineer.

2.7 MANUFACTURED PIPE SUPPORT SYSTEM

- A. Acceptable Manufacturers:
 - 1. B-Line.
 - 2. Elcen.
 - 3. Super Strut, Inc.
 - 4. Unistrut Building Systems.
- B. Provide products from one Manufacturer.
- C. Channel (Standard Applications):
 - 1. Mild strip steel.
 - 2. 12 gage minimum material.
 - 3. Factory painted equal to Unistrut Perma-Green.
 - 4. Equal to Unistrut Part No. P1000.

- D. Clamps and Supports:
 - 1. Beam clamp equal to Unistrut Part No. P2785.
 - 2. Pipe strap equal to Unistrut Part No. P2558.
 - 3. Pipe roller equal to Unistrut Part No. P2474.
 - 4. All items fabricated in material equal to channel specifications.
- E. Clamp Nuts:
 - 1. Electro-galvanized stainless steel for use with stainless steel and fiberglass parts.
 - 2. Mild bar steel for standard applications.
 - 3. Class 2 American Standard threads.
 - 4. Equal to Unistrut Part No. P1012.

2.8 BUILDING ATTACHMENTS

- A. As indicated on the Drawings or in the Specifications.
- B. Concrete Attachments:
 - 1. Provide galvanized finish for all attachments used in wet or potentially wet areas.
 - 2. Provide stainless steel bolts and nuts in wet and potentially wet areas.
 - 3. Poured Concrete:
 - a. Use cast-in-place inserts or bolted surface mounted attachments, at Contractor's option.
 - b. Expansion style anchors are not permitted on piping systems subject to vibration.
 - 4. Precast Concrete Tees:
 - a. Use fittings specifically designed for attachment to stems of precast tees.
 - b. Drilling is not permitted except where specifically approved by Engineer and coordinated with precast Manufacturer to miss embedded, prestressed steel strands.
 - 5. Precast Concrete Plank:
 - a. Use toggle bolt attachment as indicated on Drawings.
 - b. Alternatively, provide adhesive anchor, Hilti HY-20; or as approved.
 - c. Drilling is not permitted except where specifically approved by Engineer and coordinated with precast Manufacturer to miss embedded, prestressed steel strands.
- C. Horizontal Piping:
 - 1. Steel W, I, or S shapes: MSS Type 23 clamp with retaining clip, (Grinnell Fig. 87) up to 2-inch; MSS Type 28 (Grinnell Fig. 292) or MSS Type 21 (Grinnell Fig. 133, 134) above 2-inch.
 - 2. Steel Channel: MSS Type 20 universal channel clamp.
 - 3. Bar Joists: Steel washer plate (Grinnell Fig. 60).
 - 4. Concrete: See "B" above.
 - 5. Timber: Angle bracket and lag screws or as detailed on Drawings.
 - 6. Steel Z Shapes: Custom attachment required. Submit details of welded or bolted attachment to Engineer.
- D. In the absence of a Specification for a particular type of attachment, furnish attachments comparable in type and quality to that specified above for a similar situation.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

- A. General Requirements:
 - 1. The selection of pipe hangers and supports shall be based on the overall design concept of the piping system and any special requirements which may be called for in these Specifications or as indicated on the Drawings. The support systems shall provide for, and control, the free or intended movement of the piping including its movement in relation to that of the connected equipment. They shall prevent excess stress resulting from the transfer of weight being introduced into the pipe or connected equipment.
 - 2. The selection of hangers and supports shall be made to provide the piping system with the degree of control that its operating characteristics require.
 - 3. The selection of hangers or supports will take into consideration the combined weight of the supported systems, including system contents and test water.

4. Select and install hangers and supports to allow controlled thermal movement of piping system, to permit freedom of movement between pipe anchors, and facilitate action of expansion joints, expansion loops, expansion bends and similar units.
 5. The spans in MSS SP-69 Table 3 do not apply where concentrated weights, such as valves or heavy fittings, or where changes in direction of the piping occur between hangers.
 6. Select all hangers and supports rated for the maximum potential loading with pipe full.
 7. Select hangers for cold (less than 50 degrees F) piping service for installation over the insulation.
 8. Where significant, vertical movement of pipe occurs at the hanger location a resilient support shall be used:
 - a. Selection of resilient supports shall be based on permissible load variations and effects on adjacent equipment. Support selection for typical load variations are shown on MSS SP-69 Table 2 (Spring Support Selection). Load and movement calculations shall be made for the proper selection of spring hangers.
 - b. Vertical movement and load transfer from riser expansion to horizontal runs shall be given consideration when applying spring hangers.
 - c. Spring cushion hangers may be used where vertical movement does not exceed 1/4-inch and where formal load and movement calculations are not required.
 - d. Variable spring hangers shall be used for all other resilient support requirements except as noted in the following paragraph.
 - e. Constant support hangers shall be used on piping systems where the deviation in supporting force must be limited to 6% and which cannot be accommodated by a variable spring hanger.
- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Specification sections.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Pipe Hanger and Support Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. General:
1. Adjust all components as required for proper operation and required pipe slope.
 2. Double nut all support rods at hangers.
 3. Location and Routing:
 - a. Install Piping as Indicated:
 - 1) On the Drawings.
 - 2) On the reviewed Shop Drawings.
 - b. Secure Engineer's approval for all pipe routing changes.
 4. Coordinate with other trades for placement of concrete attachments prior to concrete pouring.
 5. Install all items in accordance with Manufacturer's instructions.
- C. Support at Valves: Provide additional supports at all valves in piping 4-inch and larger.
- D. Horizontal Runs:
1. General:
 - a. Provide adequate supports for the loads with a factor of safety of at least 5 (400 pounds minimum).
 - b. Provide protective shield at all hangers and rollers supporting plastic pipe and coated pipe.
 - c. Support spacing not to exceed MSS SP-69 Table 3.
 - d. Hanger rod diameter shall not be less than the requirements of MSS SP-69 Table 4.
 2. Rollers: All piping systems designed to accommodate thermal expansion movement shall be mounted on rollers.
 3. Bar Joists: Attachments to bar joists shall be made to top member and at panel points.

3.3 VIBRATION ELIMINATORS

- A. Provide as indicated on the Drawings and in accordance with the requirements of Division 23 Section "Sound and Vibration Control for HVAC."
- B. Install so as to cause minimum restraint to normal thermal movements.

3.4 INSULATION PROTECTION

- A. Provide Protection Saddle:
 - 1. Equal to insulation thickness.
 - 2. At each hanger.
 - 3. For all insulated piping systems where longitudinal expansion exceeds 1-inch per 100 feet.
 - 4. Installed as follows:
 - a. Surround lower covering.
 - b. Straddle equidistant on hanger.
 - c. Flared at both ends as required to avoid damage to pipe covering, jacket and vapor barrier.

3.5 PAINTING

- A. Touchup: Cleaning and touchup of painting of field welds, bolted connections and abraded areas of shop paint on miscellaneous metal are specified in Division 09 – Finishes for Painting.
- B. Galvanized Surfaces: Clean welds, bolted connections and abraded areas. Apply galvanizing repair paint to comply with ASTM A780.

END OF SECTION 23 05 29

SECTION 23 05 31 – PENETRATIONS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the furnishing and installation of the major items listed below:
 - 1. Duct and pipe sleeves.
 - 2. Sealing and finishing of all mechanical openings.
 - 3. Provide UL rated firestopping and sealing at all new and existing pipe penetrations of fire rated walls.
- B. Division of Work: In accordance with the General Conditions, Contractor is responsible for dividing the Work among the Subcontractors and Suppliers and for delineating the work to be performed by specific trades. The following are suggestions as to how the Work may be divided. This is not a complete list of all the work:
 - 1. General Contractor:
 - a. Locate and place all sleeved and framed openings as part of constructing the wall surfaces in which the openings occur.
 - b. Provide all lintels and required stiffening members for wall openings.
 - 2. Mechanical Subcontractor:
 - a. Advise General Contractor of quantity, location and size of all required openings.
 - b. Arrange and pay for all openings required after wall is complete.

1.3 REFERENCES

- A. Except as herein specified or as indicated on the Drawings, the Work of this Section shall comply with ASTM D2202 - Test Method for Slump of Sealants.

1.4 SUBMITTALS

- A. Manufacturer's Literature: For all sealing assemblies.
 - 1. Manufacturer's name.
 - 2. Model number.
 - 3. Details of construction and installation.
- B. Delegated-Design Submittal:
 - 1. Structural calculations for anchorage systems, sealed by the Professional Engineer responsible for the design.
 - 2. Clearly indicating design criteria and loadings used.
 - 3. For each vibration isolation device.
 - a. Include design calculations and details for selecting vibration isolators complying with performance requirements, design criteria, and analysis data signed and sealed by the qualified Professional Engineer responsible for their preparation.

1.5 PERFORMANCE REQUIREMENTS

- A. Design Responsibilities:
 - 1. Minimum Requirements:
 - a. Details, if any, indicated on the Drawings and Specifications contained herein are minimum requirements.
 - b. Generally comply with layouts and configurations as indicated on the Drawings.

2. Structural Performance:
 - a. Design shall be performed by a professional engineer.
 - b. Design shall comply with the building code plus amendments and local ordinances, if any, legally adopted for the location in which the Project is located.
 - c. Design anchorage systems capable of withstanding design loads within limits and under conditions indicated.
 - 1) The term "withstand" means that the unit will remain in place without separation of any parts from the device when subjected to the wind forces specified.
3. Design Loads:
 - a. Dead Loads: Actual weights of materials and fixed equipment, as calculated by designer.

1.6 QUALITY ASSURANCE

- A. Fabrication and Installation Personnel Qualifications:
 1. Trained and experienced in the fabrication and installation of the materials and equipment.
 2. Knowledgeable of the design and the reviewed submittals.
- B. Codes and Standards: "Architectural Sheet Metal Manual" as published by SMACNA.
- C. Openings in Fire-Rated Surfaces: As specified in Division 07 Section "Penetration Firestopping."
- D. Delegated Designer Qualifications:
 1. Professional Engineer licensed in the state in which the Project is located.
 2. Having experience in a minimum of 5 projects in the last 10 years of comparable or greater complexity

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Pipe Seals and Boots:
 1. The Pate Company.
 2. Portals Plus, Inc.
 3. Roof Products and Systems Corporation.
 4. Thunderline Corporation.
 5. Thycurb Corporation.
- B. Modular Mechanical Seals:
 1. Thunderline/Link-Seal.
 2. As approved.
- C. Backer Rod: Industrial Thermo Polymers, "Standard Backer Rod".
- D. Acoustical Sealant: Pecora, "BA-98".
- E. Expanding Resilient Foam: General Electric, "RTF762."

2.2 MATERIALS

- A. Backer Rod:
 1. Extruded round, closed cell, polyethylene foam.
 2. Resilient, non-exuding.
 3. Density: 2.0 pounds per cubic foot.
 4. Tensile Strength: 50 psi.
 5. Nonabsorbent to water and gasoline.
 6. Suitable for use as a backing for acoustical sealant.
 7. Compatible with sealant and approved by sealant Manufacturer.

- B. Acoustical Sealant: Nonfire-Rated Penetrations:
 - 1. Non-drying, non-hardening and non-bleeding.
 - 2. Laboratory tested sealant which effectively reduces airborne sound transmission through wall systems.
 - 3. Viscosity: 350,000 to 400,000 (Brookfield No. 65, 10 RPM).
 - 4. Aging: Firm but rubbery, good tack after 50 days conditioned at 160 degrees F.
 - 5. Slump: 0.1 to 0.2-inch in accordance with ASTM D2202.
 - 6. Color: Gray.
- C. Packing Material for Penetrations:
 - 1. Glass Fiber or Mineral Fiber:
 - a. Noncombustible.
 - b. Resistant to water, mildew, and vermin.
 - 2. Expanding Resilient Foams:
 - a. Acceptable alternative if manufactured for this purpose.
 - b. Minimum material density: 60 pounds per cubic foot.
 - 3. Fire-Rated Penetrations: Permanently flexible, approved firestop putty. Refer to Division 07 Section "Penetration Firestopping."

2.3 SLEEVES

- A. Materials:
 - 1. 18-Gage Galvanized Steel:
 - a. For ductwork openings.
 - b. For pipe penetrations in non-bearings walls.
 - 2. Schedule 40 Steel Pipe:
 - a. For all bearing walls.
 - b. For all concrete or masonry walls.
- B. Size All Sleeves:
 - 1. To allow for movement due to expansion, without contact to pipe or insulation.
 - 2. To provide for continuous insulation, except as required by Division 07 Section "Penetration Firestopping."
 - 3. As indicated on the Drawings.

2.4 MANUFACTURED UNITS

- A. Modular Mechanical Seals:
 - 1. Provide modular, mechanical type, consisting of inter-locking synthetic rubber links shaped to continuously fill the annular space between the pipe and the wall opening.
 - 2. The elastomeric element shall be sized and selected in accordance with Manufacturer's recommendations and have the following properties as designated by ASTM:
 - a. For Standard Service Applications:
 - 1) -40 to +250 degrees F (-40 to +121 degrees C).
 - 2) EPDM = ASTM D2000 M3 BA510.

PART 3 - EXECUTION

3.1 INTERIOR WALL

- A. Seal airtight all openings around pipes and ducts in the structure at:
 - 1. Mechanical equipment rooms.
 - 2. Penetrations of all drywall ceilings and concrete slabs suspended on isolators.
 - 3. All enclosed shaft penetrations.
- B. Duct Penetrations:
 - 1. Where each duct passes through a wall, floor, or ceiling, there shall be a clear annular space of 1-inch (25 mm) between the duct and structure.
 - 2. Frame, sleeve, or grout all voids in opening perimeter to contain packing material.

3. After all of the ductwork is installed, check the clearance, and pack the voids full depth with packing material. In noise-critical walls and floors, caulk both ends with acoustical sealant backed by a backer rod or permanently flexible firestop material.
4. Where there is not sufficient access space to pack around all sides of a duct (for example, at the underside of a slab), first place a short stub duct in the wall, pack and caulk around it, and then attach the inlet and outlet ducts to each end.
5. Where ducts enter or leave a shaft or pass through a wall or slab in sufficient numbers and density that individual pack-and-caulk details are not possible, special isolation details shall be developed:
 - a. Before the shaft is fully enclosed, seal the penetration with a heavy membrane surrounding the ducts on each side of the wall or slab being penetrated.
 - b. Each membrane may be 2 layers drywall, 1-inch (25 mm) plaster or 14-gage lead sheet.
 - c. Other materials may be acceptable.
 - d. Pack the void between the 2 membranes with packing material or pump full of resilient closed cell firestop foam.
 - e. Caulk all edges airtight.
 - f. In all cases, the proposed detail shall be approved by Engineer.

C. Pipe Penetrations:

1. HVAC Piping:
 - a. Where a pipe passes through a wall, ceiling, or floor, place cast or grout a sleeve into the structure.
 - b. Internal diameter of the sleeve: 2 inches (50 mm) larger than the external diameter of the bare pipe or pipe insulation O.D. passing through it.
 - c. After all of the piping is installed in a specific area, check the clearance and correct it, if necessary, to within 1/2-inch (12 mm).
 - d. Pack the void full depth with packing material and seal at both ends, with minimum 1-inch (25 mm) deep sealant.
 - e. In noise-critical walls and floors, pack with acoustical sealant backed by foam rod.
 - f. Where pipes pass through a masonry wall in sufficient numbers and density that individual pack-and-caulk details are not possible, a special isolation detail shall be developed:
 - 1) Cast pipe sleeves in a block of concrete with the sleeves located a minimum of 2 inches (50 mm) apart.
 - 2) Block thickness: At least as thick as the surrounding wall construction.
 - 3) Each sleeve diameter: 2 inches (50 mm) larger than the external diameter of the pipe passing through it.
 - 4) Build the sleeved block into the wall.
 - 5) After the pipes are installed, pack and caulk voids as indicated above.

3.2 ESCUTCHEONS AND CLOSURE COLLARS

- A. Includes penetrations of ceilings, partitions, and walls.
- B. Provide Escutcheons for All Piping Exposed to View:
 1. As indicated on the Drawings.
 2. Sized to fit over coverings.
 3. In All Potentially Wet Areas: Stainless steel.
 4. In All Dry Finished Areas: Chrome plated.
 5. Do not use escutcheons in acoustic isolation walls unless otherwise indicated.
- C. Provide Sheet Metal Closure Collar for all Ductwork:
 1. Fit snugly around duct or covering, and surface penetrated without contact.
 2. Attach with approved fasteners 6-inch centers maximum spacing.
 3. Fabricate with minimum 4-inch face.

END OF SECTION 23 05 31

SECTION 23 05 73 – TESTING AND CLEANING OF HVAC 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 providing testing and cleaning services and the major items listed below:
 - 1. Provide all pumps, gages, valves and other equipment and material necessary to properly conduct tests and perform cleaning.
 - 2. Provide all equipment, material, labor and testing required to properly pacify hydronic system piping so that it may be integrated into the existing hydronic system with no adverse effects or contamination.
 - 3. Arrange and pay for all costs of utilities and chemicals required for the Work.
 - 4. Repair and Restore All Work Damaged:
 - a. By tests.
 - b. By cutting required in connection with the tests.

1.3 REFERENCES

- A. American National Standards Institute/Institute of Inspection Cleaning and Restoration Certification (ANSI/IICRC).
 - 1. ANSI/IICRC S520 - Standard for Professional Mold Remediation.
- B. National Air Duct Cleaners Association (NADCA):
 - 1. ACR, The NADCA Standard - Assessment, Cleaning & Restoration of HVAC Systems (Current Version).
- C. National Fire Protection Association (NFPA):
 - 1. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems.
 - 2. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
- D. North American Insulation Manufacturers Association (NAIMA):
 - 1. Cleaning Fibrous Glass Insulated Air Duct Systems.
- E. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):
 - 1. HVAC Duct Construction Standards - Metal and Flexible.
- F. Underwriters' Laboratories (UL):
 - 1. UL Standard 181 - UL Standard for Safety Factory-Made Air Ducts and Connectors.
 - 2. UL Standard 181A - UL Standard for Safety Closure Systems for Use with Rigid Air Ducts.

1.4 SUBMITTALS

- A. Flushing and Cleaning:
 - 1. Submit certificates for all code-required inspections.
 - 2. Submit all water Sample analysis reports as required in Part 3 of these Specifications.
- B. Pressure Test Reports:
 - 1. Submit within 1 week after each system pressure test.
 - 2. List time, date and persons present for the following for each system:
 - a. Initial tests.
 - b. Final test.

3. Include report indicating:
 - a. Test type and duration.
 - b. Initial pressure.
 - c. Final pressure.
4. Indicate that necessary repairs and final tests were satisfactorily completed.

1.5 QUALITY ASSURANCE

- A. Comply with all applicable codes.
- B. Secure State Health Department approval for potable water systems.

PART 2 - PRODUCTS

2.1 CLEANING AGENT MANUFACTURERS

- A. Aqua-Chem.
- B. Aquatrol.
- C. Enerco.
- D. Nalco.

2.2 MATERIALS

- A. Detergents, solvents, and other cleaning agents shall be compatible with materials of fabrication of systems where they are used. No cleaning agent shall adversely affect materials or mechanisms in systems and cleaning agents shall be acceptable to equipment manufacturers and the Owner's environmental coordinator.
- B. Detergents, solvents, and other cleaning agents shall be compatible with process streams to be handled by systems in which the cleaning agents are used.
- C. Owner will provide water for cleaning and flushing. Other cleaning fluids, agents, and equipment shall be provided by Contractor.
- D. Hydronic systems shall use the following products or an equal substitute and shall be approved by the Engineer prior to flush.
 1. Use a nitrite based solution, as recommended by Manufacturer, prior to any other for the removal of iron oxides from the metal surfaces, and passivation of the base metal.
 2. The solution shall be circulated until a steady iron concentration is reached in the circulating water. As the solution dissolves iron oxide deposits, ferric hydroxide is formed and the pH rises it is necessary to maintain a pH range of 9 to 9.5. Therefore, supplemental feeding of the solution may be required in extremely dirty systems.
 3. A sodium nitrite based corrosion protection shall be placed in the pacified pipe after the system has been cleaned and flushed.
- E. Provide all necessary temporary equipment required for cleaning and flushing operations.
- F. Pipe Cleaning:
 1. Provide permanent hose connections for supply, discharge and recirculating lines for the new piping system.
 2. Provide piping at the ends of the main and branch lines of the piping system as required to accomplish flush of the piping.
 3. Provide a temporary pump of sufficient head and GPM required to achieve a flushing velocity of at least 10 feet per second.
 4. Provide temporary chemical skids with tote tanks as required for mixing chemicals and serving as a source reservoir and/or collection point for cleaning and flushing solutions.

5. Provide temporary bag filters (with filter bags) as required for removal of contaminants from flushing process.
6. Provide all hose, electrical leads and supply connections for completion of system required to fill, drain and refill of the lines utilizing plant supplied water and power.

PART 3 - EXECUTION

3.1 PIPING SYSTEM PRESSURE TEST

- A. General:
 1. Perform all tests before piping is painted, covered, concealed or backfilled.
 2. Before testing, remove or otherwise protect from damage, control devices, air vents, fixtures, meters, or other parts which are not designated to withstand test pressures.
- B. Test Procedures:
 1. Air Test:
 - a. Charge with air to the test pressure specified.
 - b. When possible, perform test when ambient air temperature is constant.
 2. Soap Test:
 - a. Charge with air, water or carbon dioxide to pressure specified.
 - b. Examine all joints for leaks with a soap suds solution.
 3. Water Test:
 - a. Charge with water to the pressure specified.
 - b. Exterior Surface of Pipe and Fittings:
 - 1) Show no cracks or other form of leaks.
 - 2) Completely drip dry.
- C. Pressure Test Criteria:
 1. Test criteria below are minimum requirements. In addition, the requirements of State and Local Codes having jurisdiction shall be met:

Piping System	Type Test	Pressure	Allowable Pressure Drop	Minimum Test Duration
Water (Fire Protection)	Water	200 psig	0 psi	2 Hours
Water (Domestic)	Water	100 psig	0 psi	4 Hours
Hydronic	Water	100 psig	2 psi	8 Hours

3.2 PIPE FLUSHING AND CLEANING PROCEDURES

- A. Prior to Flushing:
 1. Remove orifice plates, traps, strainer elements, flow control valves, etc. prior to or during process of cleaning. Remove instruments which might be damaged by cleaning procedures. Replace such items with spool pieces, plugs, or blind flanges. A "blind list" shall be prepared listing where blinds have been installed for cleaning and shall be provided to Owner after cleaning is complete to verify that all blinds have been removed.
 2. Items removed from piping system shall be cleaned separately.
 3. Lock valves in open position.
 4. Use new gaskets and thread lubricants when removed items are reinstalled after cleaning.
 5. Temporary Bypass Piping: Provide full size bypass piping and valves at coils and heat exchangers such that the coils and heat exchangers can be isolated.
 6. Temporary Strainers: Disconnect piping to be flushed from equipment or install temporary strainers immediately upstream of such equipment.
- B. System Protection:
 1. Protect piping and equipment against overpressure, collapse from vacuum, and hydraulic shock during flushing and draining procedures.

2. Exercise special care with polyvinyl chloride (PVC) and fiberglass-reinforced plastic (FRP) piping and upon initial filling of long pipe runs to determine that pipe is in contact with hangers and supports before filling. Piping bowed out of hangers or supports will settle or lengthen during filling and resulting forces may be damaging at changes in direction.
 3. Install high point vents and low point drains required to remove trapped air and to drain flushing liquid.
- C. Hydronic Piping Systems Flushing and Cleaning:
1. Thoroughly flush with water to remove pipe dope, slushing compounds, oils, welding slag, loose mill scale and other extraneous materials. Open all valves to ensure cleaning of entire system.
 2. Apply detergent and operate system in accordance with water treatment service organizations recommendations, circulating for a minimum of 8 hours:
 - a. Use only equipment and chemicals furnished by a qualified water treatment service organization.
 - b. Determine loop capacity by metering fill with all air bled out.
 - c. Isolate alkaline cleaners from cooling towers and aluminum and galvanized surfaces.
 - d. Place all control valves in open position for filling and venting.
 3. Flush through the piping mains from the extreme end to extreme end of the system until solution is well mixed and stable. Recirculate the water through the piping system until the desired cleanliness has been achieved. If the water is very dirty and the tote tank does not provide enough settling time to remove the debris prior to being suctioned out by the Contractor provided recirculation pumps, install a temporary bag housing with a filter or wire mesh strainer in the flowpath.
 4. After the mains have been flushed, flush the branch lines starting with the branch closest to the supply point and progress toward the extreme end of the piping that is furthest from the source. Repeat the flushing through each branch until the desired cleanliness has been achieved.
 5. Collect water samples and label them with a location and time/date, for analysis of cleanliness. Continue to sample the new piping system piping until it is completely flushed clean of all contaminants and matches the influent source for cleanliness.
 6. When desired cleanliness has been achieved, drain all flushing water from the system and then refilled, circulated throughout the mains and branches to rinse out the flushing chemicals, and dumped again.
 7. Restore all piping to its design state (remove all temporary piping and close all valves), and refill the system with water and the proper amount of pacifying chemical as directed by the chemical supplier. Recirculate the chemicals throughout the system for a sufficient amount of time as the chemical supplier requires for proper mixing and metal exposure.
 8. Drain the system, refill with water and coordinate with the Owner to open the new piping to the existing hydronic system for final mixing of Owner's chemical into the newly refilled piping via the existing system pumps and chemical injection system.
 9. In the event that the new piping is not to be integrated into the existing hydronic system for more than a month, coordinate with the Owner as to whether the system is to remain in "wet layup" with the pacifying chemicals in place or "dry layup" in which case the piping is to be drained and a nitrogen purge applied.
 10. Drain the system, refill with water and Owner furnished chemicals as directed by the Owner.
 11. Process Fluids piping shall be placed in "dry layup" as specified.
 12. After the system has been cleaned:
 - a. Test water Sample and submit analysis to Engineer.
 - b. Water Sample shall exhibit neutral pH and no turbidity.

3.3 CLEANING AND FINISHING

- A. After tests have been made and the system pronounced tight:
1. Clean piping and equipment.
 2. Lubricate bearings.
- B. Final cleaning includes but is not limited to the following:
1. Equipment with Factory Finishes:
 - a. Wash factory-finished equipment with mild soap and water and leave in first-class condition, entirely free of stains or streaks.
 - b. Do not use abrasive materials.
 - c. Touch up scratches or other violations of the factory finish paint with matching paint from the equipment Manufacturer.

C. Disposal of Job Site Duct Cleaning Waste:

1. Seal HVAC system debris and removed contaminated materials in containers before removal from work area.
2. Handle materials classified as hazardous by governmental agencies in accordance with applicable federal, state, and local regulations and codes.

END OF SECTION 23 05 73

SECTION 23 05 93 – TESTING, ADJUSTING AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes a description of the mechanical system testing, adjusting and balancing (TAB) scope of services. The following systems shall be included in the testing, adjusting, and balancing process:
 - 1. Air handling/air distribution systems.
- B. Test and Balance Contractor will be contracted through Wayne State University.
- C. Division of Work:
 - 1. In accordance with the General Conditions, Contractor shall be responsible for dividing the Work among the Subcontractors and Suppliers and for delineating the work to be performed by specific trades.
 - 2. The following are suggestions as to how the Work may be divided. This is not a complete list of all the work:
 - a. Mechanical Subcontractor:
 - 1) Provide related work as specified herein to support the mechanical systems TAB work being performed by TAB engineer.
 - 2) Provide access to all balancing devices.
 - 3) Provide replacement fan sheaves and impellers:
 - a) At no additional cost to Owner.
 - b) As required to achieve design performance for mechanical equipment.
 - 4) Perform system start-up functions including, but not necessarily limited to:
 - a) Venting air from all hydronic system piping and components.
 - b) Setting all manually operated dampers and valves in the full open position.
 - c) Complete and submit pre-test and balance checklist to Engineer and TAB engineer prior to start of TAB work.
 - 5) Correct all mechanical system deficiencies identified by TAB engineer.
 - b. TAB Engineer:
 - 1) Provide timely notice to mechanical Subcontractor and TCS Subcontractor of all incomplete work and deficiencies which prevent proper performance of test and balance work.
 - 2) Test, adjust and balance all air and hydronic systems and prepare final report.
 - c. Temperature Control System (TCS) Subcontractor:
 - 1) Provide related work as specified herein to support the mechanical systems TAB work being performed by TAB engineer.
 - 2) Operate all temperature control devices to support TAB work that is dependent on various control operating modes.
 - 3) Correct all TCS system deficiencies identified by TAB engineer.

1.3 REFERENCES

- A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
 - 1. Sheet Metal and Air Conditioning Contractor's Association (SMACNA) publications:
 - a. Procedural Standards for Testing, Adjusting, and Balancing of environmental systems.
 - b. Procedural Standards for Measuring Sound of Vibration.
 - c. Testing, Adjusting, Balancing Manual for Technicians.
 - 2. Associated Air Balance Council (AABC): National Standards for Total System Balance, 2002 Edition.
 - 3. National Environmental Balancing Bureau (NEBB): Procedural standards for testing, adjusting, and balancing of environmental systems.

1.4 DEFINITIONS

- A. Proper Performance Characteristics:
 - 1. In accordance with design intent, acceptable energy efficiency and Manufacturer's recommendations.
 - 2. Providing acceptable thermal and acoustical performance in all service areas.
 - 3. As directed by Engineer.
- B. TAB Engineer: An individual, firm or corporation whose primary work is testing, adjusting and balancing environmental systems working under a direct contract to the Owner.

1.5 SUBMITTALS

- A. Submit Pre Test and Balance Checklist and mechanical systems TAB report in accordance with Division 01 Section "Submittal Procedures."
- B. Submit Pre Test and Balance Checklist at least 2 weeks prior to scheduled start of TAB work as scheduled by Contractor and approved by Owner.
- C. Preliminary TAB Submittal:
 - 1. Prior to final inspection.
 - 2. 3 copies to Engineer.
- D. Final Submittal: 5 copies to Engineer.
- E. The TAB report shall include, but not necessarily be limited to, the following general items:
 - 1. Summary remarks regarding problems.
 - 2. Initial, interim and final performance test data.
 - 3. Description of test procedures and equipment used.
 - 4. Systems' Drawings and/or schematics clearly marked to identify location of equipment tested, duct traverse location(s), location of system static pressure sensor, etc.
 - 5. Systems performance data sheets shall include design conditions, installed equipment information, and field test data for:
 - a. Air Systems:
 - 1) Design Conditions:
 - a) Air capacity.
 - b) System total static pressure drops and profiles of all air handling systems, including filters, coils, etc.
 - c) Motor horsepower and design brake horsepower.
 - d) Fan speeds.
 - e) Fan curves or fan rating tables showing design conditions.
 - 2) Installed Equipment:
 - a) Equipment Manufacturer.
 - b) Equipment model numbers, sizes, types, etc.
 - c) Motor types, sizes and characteristics.
 - d) Heater and starter types, sizes and characteristics.
 - e) Drive types, sizes and speed range.
 - f) Equipment ratings if different from design.
 - g) Identification of all terminal devices, including outlets.
 - h) Location of all smoke control devices.
 - 3) Field Test Data - Initial and Final Test Readings For:
 - a) Air capacities.
 - b) Static pressures through units and unit components.
 - c) Equipment speeds.
 - d) Motor operating voltages and amperages.
 - e) Brake horsepower.
 - f) Operating performance plotted on fan curves or fan rating tables.
 - g) System schematic and notes including measured static pressure values, system static pressure sensor values, etc.

- h) Airflow and static pressure data for all duct mains as balanced under typical total system operation. Report will not be accepted without airflow and static pressure profile (refer to Paragraph 3.3).
- i) Identify each outlet or inlet as to location, area, size and fan system.
- j) Required and field measured cfm for each outlet or inlet.

1.6 QUALITY ASSURANCE

A. Qualifications:

- 1. TAB Field Technician Personnel:
 - a. Trained and experienced in the operation of the test and balance equipment.
 - b. Knowledgeable of the design of all systems scheduled for testing and balancing.
- 2. TAB Engineer:
 - a. A certified member of either the following organizations or trained in the practices thereof:
 - 1) AABC.
 - 2) NEBB.
 - b. Acceptable firms providing testing, adjusting, and balancing services include:
 - 1) Absolut Balancing Company, South Lyon, Michigan.
 - 2) International Test & Balance, Southfield, Michigan.
 - 3) Total Balance Company, St. Claire Shores, Michigan.
 - 4) As approved (approval required prior to bid submittal).

B. Report Forms:

- 1. The report forms included in the appendix of the AABC Standard are incorporated in the work of this Section for the purpose of identifying the level of detail required for testing and reporting.
- 2. TAB engineer may use the AABC forms or other similar forms which present equivalent information in a logical format.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Patching Materials:

- 1. Comply with requirements as specified in other Sections where applicable to provide materials essentially and functionally identical to original installation before testing and balancing work.
- 2. Maintain the integrity of systems for air tightness, water tightness, and durability of finish.

2.2 INSTRUMENTS

A. Instruments used for TAB work shall be as indicated in the referenced standards.

B. Calibration:

- 1. Instruments to have been calibrated within one year of start of TAB work.
- 2. Appropriate documentation shall be made available to the Engineer on request.

PART 3 - EXECUTION

3.1 PROCEDURES

A. General:

- 1. Determine what actual performance characteristics are deemed proper during system tests.
- 2. If the design supply, return or exhaust air quantities for a space create a space pressure other than neutral, or if a space is indicated to be a certain pressure, provide balancing to the extent required to achieve this designed pressure.
- 3. During heating (and cooling) season of the first year of operation, at times when directed, make final adjustments until all occupants are reasonably satisfied and all equipment is operating at peak efficiency.
- 4. Confirmation of proper equipment operation must be through actual observation. Computer simulation and sensor readouts are not acceptable proof.

B. Air Systems:

1. General:
 - a. Adjust and set all dampers, deflecting vanes, discharge vanes and accessory items to achieve proper air distribution and patterns in all parts of the air supply, return and exhaust systems:
 - 1) Determine air flow and static pressure in all branch ducts by velocity traverse and balance out all branches by means of branch duct manual dampers.
 - 2) Balance terminal outlets on each branch duct using volume dampers in run-out duct to the outlet, not the terminal outlet dampers.
 - b. Mark final balance position for all dampers which are not left 100% open with an indelible pen.
 - c. Adjust and set all belted fan speeds as required to attain proper total air flow.
 - d. Measure supply fan total air flow at both the full return air and full outdoor air damper positions.
 - e. Make smoke gun tests, if necessary, to check for drafts and make final adjustments and settings for optimum comfort conditions.
2. Methods: Acceptable procedures for obtaining performance measurements are listed below:
 - a. CFM Airflow for Duct Sections:
 - 1) Duct traverse as specified in SMACNA Manual "HVAC Systems - Testing, Adjusting and Balancing," Chapter V, Section 4-B, using a pitot tube and inclined manometer.
 - 2) Acceptable Methods:
 - a) Pitot tube array with reading by inclined manometer.
 - b) Electronic manometer.
 - c) Hot-wire anemometer.
 - b. CFM airflow, for room supply, return and exhaust, at diffusers, registers and grilles: Use airflow hood.
 - c. Fan TSP: Use inclined manometer.
 - d. Equipment Pressure Drops: Use inclined manometer.
 - e. Air Temperatures: Use thermometer.
 - f. Smoke Testing: Use titanium tetrachloride.
 - g. CFM Differential Airflow Reading:
 - 1) Block door entrance leaving 1 or 2 square foot measured opening.
 - 2) Read opening with thermal anemometer.
 - h. Differential Pressure: In cases where sensors for differential pressure are permanently installed, differential pressure may be read directly using an Electronic Digital Manometer.
3. TAB Procedures for Air Systems:
 - a. Check all motorized, balancing and gravity relief dampers for proper position.
 - b. Inspect coils, filters and fans for cleanliness.
 - c. "Bump" motor to check for proper fan rotation.
 - d. Check unit performance including:
 - 1) Fan speed.
 - 2) Amperage and voltage.
 - 3) Suction, discharge and total static pressures at fan.
 - 4) Supply air volume of fan by taking duct traverse in discharge duct or zone ducts.
 - e. Note: Check unit performance in both 100% outside air and 100% return air positions, including static pressures across individual equipment components.
 - f. Set outside air motorized damper at proper minimum position.
 - g. See that necessary adjustments or changes are made to achieve design airflow capacities or consult Engineer if change(s) required are beyond the scope of the TAB contract.
 - h. Balance Medium and High Velocity Ductwork:
 - 1) Measure inlet static pressure and airflow at all terminal unit inlets through actual transverse. Flow sensor readings are not acceptable.
 - 2) If terminal unit has constant volume regulator or manual adjustment damper, make certain the correct maximum amount of air is being delivered.
 - 3) All measurements should be taken only when system is operating under normal operating conditions.
 - 4) If system is variable volume, set up diversity conditions where applicable and record static pressure at sensor(s).
 - 5) Set terminal unit minimum airflow capacities where applicable.
 - i. Balance Low Velocity Ductwork:
 - 1) Take traverse and static pressure readings in main branch ducts and set balancing dampers for approximate correct distribution of air.
 - 2) Proportionately balance all branch ducts.
 - 3) Proportionately balance all outlets and inlets.

- 4) Make smoke gun tests to check for drafts and make final settings for optimum comfort conditions in occupied space.
- 5) Recheck supply air unit performance and make any necessary final adjustments. Include allowances for wet coil, dirty filters, and other normal operating conditions which may reduce air flow.
- 6) Record final measurements as required.

3.2 FIELD QUALITY CONTROL

- A. Preliminary Review and Analysis:
 1. If after standard balancing procedures have been carried out and readjustments attempted, the system does not perform as specified, Engineer shall be notified at once.
 2. All "as is" field data shall be submitted in a preliminary report for review and analysis.
 3. Manipulation of system to achieve air flow and balance without meeting intended and specified total system air flow will not be accepted in a balance report. Should this occur, rebalance shall be at the Contractor's expense.
- B. Final Inspection: Prior to final acceptance, all systems shall be operated to test performance as directed to the satisfaction of the Engineer:
 1. Steam and water shall circulate throughout entire system without noise, evidence of leaks and trapping or air-binding.
 2. Air in ducts shall circulate without excessive noise.
 3. Motors, fans and other equipment shall operate without excessive noise or vibration.
 4. Systems shall be balanced to operate within stated tolerances. If any heating unit, chilled water cooling coil, or air outlet does not operate within the stated tolerances, then the entire system shall be considered out of balance and shall be readjusted until all units are within the stated tolerances.
 5. Heating, ventilating and air-conditioning systems shall maintain uniform temperatures without drafts.
 6. Burners shall be tested and set for high efficiency and smokeless combustion.
- C. Testing: TAB engineer will repeat system testing, adjusting, and balancing until Owner or Engineer verifies accuracy of data.

3.3 STATIC PRESSURE AND AIR FLOW PROFILE

- A. Provide a static pressure and air flow profile diagram:
 1. Air flow readings shall be based on a duct traverse.
 2. Data shall reflect actual coincident system performance established at total system balance:
 - a. Throttling of one branch below design to obtain design performance in another is not acceptable. Refer to Paragraph 3.2.A.
 - b. Diversity in variable air volume systems shall be reflected on profile diagram.
 3. Provide data for each duct main and a minimum of one set of readings for each floor for multiple floor systems.

3.4 PRE TEST AND BALANCE CHECKLIST

- A. Contractor shall copy the following Pre Test and Balance Checklist (Exhibit B, attached) and submit one completed checklist for rooftop unit.
- B. TAB engineer may be entitled to be compensated for additional time required due to failure of other Subcontractors to properly complete their work.

EXHIBIT B PRE TEST AND BALANCE CHECKLIST

Equipment Tag No. _____ Date: _____

As an aid to properly interface work between trades and prevent unnecessary return visits for everyone concerned, the TAB engineer requires that the following list of items be completed by the Mechanical Subcontractor prior to any testing and balancing of air and hydronic systems.

Work required is as follows:

<input checked="" type="checkbox"/>	Item No.	Description
	1.	Static pressure control sensors shall be installed in locations indicated on contract documents.
	2.	Variable frequency controllers installed on fan drives shall be properly set up for minimum to maximum speed positions.
	3.	Fan rotation is correct.
	4.	Fan RPM is to be set after fan performance test by Test and Balance Contractor, however, initial installed RPM shall be within 10 percent of what was intended per equipment submittal.
	5.	Verify that fan is running within motor nameplate amp draw at initial installed RPM.
	6.	Balancing dampers shall be installed in locations shown on Contract Documents.
	7.	Damper operators shall be installed with provisions for access and not covered with insulation.
	8.	All (normal operational) dampers shall be set and locked in the 100 percent open position.
	9.	All fire dampers shall be open with fuse links installed and any props removed. Any motor operated fire and smoke dampers are operating correctly.
	10.	All filters shall be in place, including clean construction filters installed upstream.
	11.	Terminal units shall be functioning with thermostat.
	12.	Terminal units shall be sequencing properly with radiation valve (i.e., normally closed T.U. with normally open valve, etc.).
	13.	Reverse acting (R.A.) thermostat shall be with N.O. terminal boxes and direct acting (D.A.) thermostat shall be with N.C. terminal boxes.
	14.	All air shall be bled from hot or chilled water system.
	15.	All (normal operational) valves shall be set in 100 percent open position
	16.	Memory devices shall be installed on all specified balancing valves
	17.	Installation of all temperature wells and gage cocks.
	18.	Pressure taps shall be installed across body of pump and inlet and outlet of coils. Location of pressure taps shall be between isolation and check valves, etc., associated with coils.
	19.	Hydronic systems shall have been cleaned and flushed and construction strainers removed from equipment.
	20.	Pump rotation shall be correct.
	21.	Verify that pump is running within motor nameplate amp draw at initial installed impeller size.
	22.	All exhaust fans shall be wired, operable and in correct rotation.
	23.	All multiple exhaust duct system balance dampers shall be installed and set 100 percent open.
	24.	All relief air or backdraft dampers shall be set for proper operation, i.e., just closing.

END OF SECTION 23 05 93

SECTION 23 07 13 – DUCT INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the furnishing and installation of thermal insulation applied to external surfaces of ductwork and air handling devices.

1.3 REFERENCES

- A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
 - 1. ASTM Specifications:
 - a. C411 – Standard Test Method for Hot Surface Performance of High Temperature Thermal Insulation.
 - b. C553 – Mineral Fiber Blanket and Thermal Insulation for Commercial and Industrial Applications.
 - c. C612 – Mineral Fiber Block and Board Thermal Insulation.
 - d. E84 – Standard Test Method for Surface Burning Characteristics of Building Materials.
 - e. E119 – Standard Test Methods for Fire Tests of Building Construction and Materials.
 - f. E814 – Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
 - 2. NFPA Standard:
 - a. 90A - Installation of Air Conditioning and Ventilating Systems.
 - b. 255 - Surface Burning Characteristics of Building Materials.
 - 3. SMACNA: MF-1 - Mechanical Fastener Standard.
 - 4. ASHRAE Standard: 90.1 - 1989 Energy Efficient Design of New Buildings Except Low-rise Residential Buildings.
 - 5. Underwriter's Laboratories: UL-181 – Factory-Made Air Ducts and Air Connectors.

1.4 SUBMITTALS

- A. Manufacturer's Literature: For all thermal materials.
 - 1. Manufacturer product data brochure.
 - 2. Thermal performance characteristics - "K" Values.
 - 3. Details of construction and installation.
 - 4. Compliance with standards and UL listing.
- B. Samples:
 - 1. Proposed substitutions for products other than those herein specified.
 - 2. Engineer's approval prior to installation.
 - 3. Fire barrier shall have the following ratings:
 - a. Flame Spread Maximum: 0.
 - b. Smoke Developed Maximum: 0.
 - c. In accordance with ASTM E84.

1.5 QUALITY ASSURANCE

- A. Fabrication and Installation Personnel Qualifications:
 - 1. Trained and experienced in the fabrication and installation of the materials and equipment.
 - 2. Knowledgeable of the design and the reviewed Shop Drawings.

- B. Regulatory Agencies Requirements:
 - 1. State and local codes and ordinances.
 - 2. Insulation, facing and adhesive shall have a composite rating:
 - a. 25 flame spread maximum.
 - b. 50 smoke developed maximum.
 - c. In accordance with NFPA 255.
 - 3. Fire barrier shall have the following ratings:
 - a. 0 flame spread maximum.
 - b. 0 smoke developed maximum.
 - c. In accordance with ASTM E84.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Materials shall be delivered in original, unbroken, brand marked containers.
- B. Handle and store materials in a dry place in a manner which will prevent deterioration and contamination with foreign matter.
- C. Reject damaged, deteriorated, contaminated material, or showing evidence of moisture, and immediately remove from the Site. Replace removed materials with new materials at no additional cost to Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Thermal Insulation:
 - 1. Owens-Corning.
 - 2. Johns Manville.
 - 3. Armacell.
 - 4. Certainteed.
 - 5. Rubatex.
 - 6. Knauf.
- B. Adhesives:
 - 1. Benjamin-Foster.
 - 2. Baldwin-Ehret-Hill.
 - 3. Armstrong.
 - 4. Goodloe E. Moore.

2.2 MATERIALS

- A. Flexible Duct Wrap (F):
 - 1. Glass fiber blanket, factory-laminated to vapor barrier facing.
 - 2. Density: 1.0 lbs/cu ft.
 - 3. Thickness: As scheduled.
 - 4. Thermal Conductivity (k): 0.30 at 75 degrees mean.
 - 5. Facing: FSK.
 - 6. Owens-Corning, Type 75; or equal.

2.3 MECHANICAL FASTENERS

- A. Impale Anchor:
 - 1. 12-gage galvanized steel.
 - 2. With self-adhesive pad.
 - 3. 2-inch speed washer.

2.4 ADHESIVES

- A. Insulation-Adhesive and Tape: As recommended by Manufacturer of insulation.
- B. Mastic: Benjamin-Foster, #60-15 C.I. Asphaltic coating or #3035 and #3800 General Purpose Vinyl-Acrylic coating; or equal.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean ductwork surfaces prior to applying insulation.

3.2 INSTALLATION

- A. Follow insulation Manufacturer's recommended procedures.
- B. Install in areas in pedestrian traffic areas where the bottom of piping is at an elevation less than 6'-8" above finished floor.
- C. Thermal Insulation:
 - 1. Flexible wrap insulation shall be attached with 4-inch wide strips of insulation bonding adhesive spaced at 8 inches center-to-center. Adhesive shall be applied over entire surface of ductwork conveying or subjected to unconditioned outside air.
 - 2. Mechanical fasteners shall also be used on the underside of rectangular ductwork runs wider than 24 inches. Fastener spacing in accordance with A. above.
 - 3. Allow maximum fullness at corners when using flexible wrap.
 - 4. Provide removable section of insulation with a protected edge over access doors and around damper operators to allow operation without damage to insulation.
- D. Joints and Sealants:
 - 1. Joints shall be tightly butted and sealed with 3-inch (minimum) foil reinforced kraft tape. Fastener penetrations and any other punctures in the vapor barrier facing shall also be taped and sealed with vapor barrier adhesive.
 - 2. Flexible wrap insulation joints shall be made with a 2-inch overlap of the vapor barrier secured with 9/16-inch outward clinching staples spaced 6 inches center-to-center.
 - 3. Taped joints at patches on rigid insulation shall be burnished or ironed on to ensure a tight seal.
 - 4. Use double tape strips when joining faced with unfaced insulation.
- E. Damper Handles:
 - 1. Seal all exposed edges of insulation around handles.
 - 2. Tie a 2-foot long piece of bright orange ribbon on handle so it hangs down allowing easier visual locating of dampers.

3.3 APPLICATION SCHEDULE

- A. Insulation Material Type:
 - R = Rigid fiberglass board
 - S = Semi-rigid fiberglass board
 - F = Flexible duct wrap
 - F-HD = High density flexible duct wrap
 - E = Flexible elastomeric sheet
 - L = Internal liner – Refer to Division 23 Section "Sound and Vibration Control for HVAC" for requirements
 - FB = Fire barrier

B. Covering (Refer to Part 2, Paragraph 2.3, of this Specification Section):

- A = Aluminum jacket
- P = Paint in accordance with Division 09 Section "Painting"
- PVC = Polyvinyl chloride jacket

C. Flanged Ductwork: Insulation thickness indicated in following tables shall be increased to be at least a 1/2-inch thicker than the flange depth.

D. Coordination of Insulation:

1. Requirements for internal liner for sound control are in addition to other requirements above. However, thickness requirements for external insulation may be reduced by up to 1-1/2-inch when duct liner is used.
2. Refer to Division 23 Section "Sound and Vibration Control for HVAC" for acoustic duct liner requirements.

E. Coordination of Insulation:

1. Requirements for internal liner for sound control are in addition to other requirements above. However, thickness requirements for external insulation may be reduced by up to 1-1/2-inch when duct liner is used.
2. Refer to Division 23 Section "Sound and Vibration Control for HVAC" for acoustic duct liner requirements.

F. Definitions:

1. Concealed: A space concealed from view or otherwise accessible only through the removal of ceiling tiles, access panels, or building construction components.
2. Exposed: Not concealed.
3. Plenum: A ceiling plenum or other concealed space used to transport air.
4. Heated Space: A space with a direct supply of heating.
5. Warm Space: A space within the building thermal barrier and also within the building vapor barrier but not having a direct supply of heating.
6. Unheated Space: A space within the building but outside of either the building thermal barrier or the building vapor barrier.
7. Cooled Space: A space with a direct supply of cooling.
8. Outside Air and Mixed Air: Unconditioned outside air, partial outside air, or relief or exhaust air downstream of last damper and subjected to unconditioned outside air.

G. Supply and Return Air:

1. Concealed:
 - a. In Air Plenum: Type F, 2-inch: Not required for return air in a return air plenum.
 - b. In Heated or Warm Space:
 - 1) Heating and Cooling Supply Air: Type F, 2-inch.
 - 2) Return Air and Heating Only Supply Air: Type F, 2-inch.
 - c. In Unheated Space: Type F, 2-inch.

END OF SECTION 23 07 13

SECTION 23 07 19 – HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the furnishing and installation of piping insulation.

1.3 REFERENCES

- A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
 - 1. ASTM Specifications: C534 - Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
 - 2. ASTM Standard Test Methods: E84 - Surface Burning Characteristics of Building Materials.
 - 3. National Fire Protection Association (NFPA) publications: NFPA 255 - Surface Burning Characteristics of Building Materials: 25, 50, 50 flame spread, fuel, smoke.
 - 4. ASHRAE: 90A - Energy Conservation in New Building Design, current edition.

1.4 SUBMITTALS

- A. Manufacturer's Literature: For piping insulation.
 - 1. For Each Type Used:
 - a. Name of Manufacturer.
 - b. Details of construction and installation.
 - c. Manufacturer's data (density, K-factor).
 - 2. For Each Application:
 - a. Thickness.
 - b. Total "R" value.
 - c. Jacket material.

1.5 QUALITY ASSURANCE

- A. Fabrication and Installation Personnel Qualifications:
 - 1. Trained and experienced in the fabrication and installation of the materials and equipment.
 - 2. Knowledgeable of the design and the reviewed Shop Drawings.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials in original, unbroken, brand marked containers or wrapping as applicable. Handle and store materials in a manner which will prevent deterioration and contamination with foreign matter.
- B. Reject damaged, deteriorated, or contaminated material and immediately remove from the Site. Replace removed materials at no additional cost to Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Insulation:
 - 1. Pittsburgh-Corning.
 - 2. Owens-Corning.
 - 3. Certainteed.
 - 4. Armacell.
 - 5. Rubatex.
 - 6. Knauf.
 - 7. Johns Manville.
- B. Jacketing (Aluminum or PVC):
 - 1. Ceel-Co.
 - 2. O'Brien.
 - 3. Zeston.
 - 4. Childers.
 - 5. Pabco.
- C. Adhesives:
 - 1. Benjamin Foster.
 - 2. Childers.
 - 3. Vimasco.
 - 4. B.E.H.
 - 5. Or equal.

2.2 TYPES OF INSULATION MATERIALS

- A. Rigid Molded Glass Fiber – General (FG):
 - 1. All-service jacket (ASJ) type factory applied jacketing.
 - 2. 3 lbs/cu ft minimum density.
 - 3. k factor of 0.23 at 75 degrees F mean.
 - 4. 50 degree F service temperature.
 - 5. Owens-Corning Type ASJ Max Pipe Insulation with SSL Max closure system; or equal.
 - 6. Typical for application on pipes 16 inches and up.
- B. Mineral-Fiber Insulation (MF):
 - 1. Preformed Pipe Insulation:
 - a. Type I, 850 Degrees F (454 Degrees C) Materials:
 - 1) Mineral or glass fibers bonded with a thermosetting resin.
 - 2) Comply with ASTM C547, Type I, Grade A, without factory applied jacket.
 - b. Johns Manville "Micro-Lok;" or equal.
 - 2. Pipe and Tank Insulation:
 - a. Mineral or glass fibers bonded with a thermosetting resin.
 - b. Semirigid board material complying with ASTM C1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C612, Type IB.
 - c. Nominal density is 2.5 lb./cu. ft. (40 kg/cu. M) or more.
 - d. Thermal conductivity (k-value) at 100 degrees F (55 degrees C) is 0.29 BTU x in./h x sq. ft. x degrees F (0.042 W/m x K) or less.
 - e. Johns Manville; MicroFlex; or equal.

2.3 INSULATION INSERTS

- A. Insulation inserts shall be made of calcium silicate treated with water repellant.
- B. Inserts shall be preformed for the pipe size, same thickness as adjoining pipe insulation, same length as shield, and 180 degree-minimum segments.

- C. Insulation inserts shall not be less than the following lengths:
 - 1. 2-1/2-Inch Pipe Size and Less: 10 inches long.

2.4 ACCESSORIES

- A. Adhesives.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General:
 - 1. Install piping insulation:
 - a. In conformance with the Drawings, these Specifications, and the Manufacturer's recommendations.
 - b. Over clean, dry piping system.
 - c. To the following thickness:
 - 1) As specified herein or as indicated on the Drawings.
 - 2) If not specified herein or indicated on the Drawings, in accordance with Manufacturer's recommendations for the specific application.
 - d. Continuous through walls, ceilings and sleeves except at fire stops.
 - e. In areas in pedestrian traffic areas where the bottom of piping is at an elevation less than 6'-8" above finished floor.
 - 2. Fill all cracks and voids with insulating cement carefully troweled to leave a smooth finish.
 - 3. Repair or replace insulation damaged by:
 - a. Demolition.
 - b. Making connections to piping or equipment.
 - c. Water or mildew.
 - 4. Insulate bundles of pipes out-of-doors with complete wrap of insulation 1-1/2 inches thick and of suitable diameter to contain bundle, with outer wrap.
 - 5. Verify that piping has been tested and cycled before applying insulation materials.
 - 6. All sectional pipe covering shall be neatly and tightly applied with unbroken lengths and with the ends of the sections firmly butted together. Longitudinal joints shall be on the least conspicuous side of the pipe and slightly staggered. Fiberglass cloth or other coating shall be lapped over all joints and well pasted or cemented down in a neat and inconspicuous manner.
 - 7. The insulation on piping shall be extended through all sleeves, anchor points and supports in order to produce a continuous application, and same shall be installed to conform to a uniform diameter.
 - 8. All fittings, flanges, end caps, etc. on all lines, except where otherwise noted, shall be covered with insulated fitting covers. Thickness of insulation, jackets and finishes shall also match adjacent piping.
 - 9. Secure calcium silicate pipe insulation with stainless steel bands.
 - 10. Insulation for piping shall be continuous through hangers and supports.
 - 11. Provide insulation inserts and insulation protection shields at hanger or support locations.
 - 12. Valve bodies to the bonnet flange or union, drip legs, and pipes at anchor points shall be insulated. Terminate insulation into a finished end.
 - 13. Terminate insulation into a finished end.
 - 14. Provide aluminum jacketing on all insulated piping for steam utility distribution.
- B. Joints and Fittings:
 - 1. Block insulate valves and flanges with reusable insulation system.
 - 2. Insulate elbows, tube turns, sweeps and bends with mitered sections or premolded fittings. Match pipe covering material where used.
 - 3. Fit joints tightly together.
 - 4. Seal joints with sealing compound and preformed aluminum bands.

3.2 JACKETS AND FINISH

- A. General:
1. Provide moisture barrier between the insulation and the jacketing in a continuous, unbroken seal.
 2. Hold jacketing in place by a continuous sealed joint, providing a positive weatherproof seal along the entire length of the jacket.
 3. Cap off ends with caps.
 4. On cold lines, cut caps to the exact size of the pipe and seal with a recommended silicone calking.
 5. Provide slip joints a minimum of every 25 feet or as needed for expansion.
 6. Locate longitudinal jacket seams on indoor exposed piping out of view.
- B. Attachment:
1. For systems operating at 50 degrees F and above: May be stapled using outward clinch staples spaced 3 inches apart at least 1/4-inch from the lap edge.
- C. Taper and seal insulation ends regardless of service.
- D. Fitting and pipe jackets to have matching finishes ready for painting.
- E. For Insulation Without Factory Applied Jacket:
1. Finish with 8-ounce glass mesh and mastic.
 2. Use breather mastic on piping operating at temperatures greater than 50 degrees F.

3.3 PIPING INSULATION APPLICATION SCHEDULE

- A. Basis of Thickness Chart:
1. Thicknesses shown are based on products having a maximum "k" factor of 0.26 at a mean temperature of 75 degrees F.
 2. These Thicknesses:
 - a. Can be reduced for products having significantly lower "k" values.
 - b. Shall be increased for products having higher "k" values in order to produce equivalent or greater thermal resistance.
- B. Flame/Smoke Ratings: Local requirements for flame and smoke ratings must be met and may exclude some options listed herein.
- C. Thickness Chart (In Inches):
1. Key: Insulation Type (Refer to Paragraph 2.2 of this Section):
 - a. FG = Rigid Fiberglass.
 - b. MF = Mineral Fiber.

PIPE SIZE								
	Piping Systems Type	Temp (F) Range	Less Than 1"	1" to 1-1/4"	1-1/2" to 3"	4" to 6"	8" & Up	Type of Insulation *
1.	Heating Water	180-250	1.5	1.5	2.0	2.0	2.0	FG, MF
* See PART 2 – PRODUCTS Article 2.2 TYPES for types of insulation.								

END OF SECTION 23 07 19

SECTION 23 09 00 – INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the design, furnishing and installation of HVAC instrumentation and controls (HI&C) systems:
 - 1. The Work of this Section also includes the integration of the Work of other trades as necessary to provide a complete operational control system as defined in the Contract Documents.
 - 2. The work of this section shall be performed by Siemens, of whom, is the University's preferred vendor.
- B. Major items unique to the work of this Section:
 - 1. Direct digital control (DDC) hardware.
 - 2. DDC software.
 - 3. All remote sensing devices and interconnecting wiring or tubing.
 - 4. All secondary control devices including, but not necessarily limited to, the following:
 - a. Room temperature sensors.
 - b. Primary and secondary controllers.
 - c. Automatic valves and dampers.
 - d. Damper and valve operators.
 - e. Relays.
 - f. Miscellaneous sensors.
 - 5. Electric power supply source.
 - 6. Conductor and conduit.
 - 7. Necessary appurtenances to make a complete and functional system to satisfy the functional intent.
 - 8. Final and complete operational demonstration.
 - 9. Mechanical testing, adjusting and balancing.
 - 10. BMS interface, integration devices and programming.
- C. Mechanical systems included in the Work of this Section:
 - 1. Except as specifically described below, it is the work of this Section to provide, install and integrate complete control of the HVAC systems, including, but not limited to the following:
 - a. Terminal unit controls.
- D. Integration:
 - 1. Provide communication interface and network integration for the following packaged control systems furnished under the Work of other Sections:
 - a. Variable air volume boxes as specified in Division 23 Section "Air Terminal Units."
 - 2. Existing Control Equipment:
 - a. Provide for interface between new controls installation and Owner's existing control and building management systems:
 - 1) As indicated on the Drawings.
 - 2) As required to satisfy the functional intent description of this Section.
 - b. All existing equipment is assumed to be fully functional and in proper working order as it relates to the work of this Section for Base Bid.

1.3 DIVISION OF WORK

- A. In accordance with the General Conditions, Contractor is responsible for dividing the Work among the Subcontractors and Suppliers and for delineating the work to be performed by specific trades.

B. This is not intended to be a complete list of all the Work:

1. Mechanical Subcontractor:
 - a. Install automatic valves and separable wells that are specified to be supplied by HI&C Subcontractor.
 - b. Provide all necessary valved pressure taps, steam, water drain and overflow connections and piping.
 - c. Provide all necessary piping connections required for flow devices, valve position indicators, flow switches, etc.
 - d. Install all automatic dampers unless furnished as a factory mounted item with HVAC equipment.
 - e. Provide all necessary blank-off plates (safing) required to install dampers that are smaller than duct size.
 - f. Assemble multiple section dampers with the required interconnecting linkages and extend required number of shafts through ductwork for external mounting of damper motors.
 - g. Provide necessary sheet metal baffle plates to eliminate stratification and provide air volumes specified. Locate baffles by experimentation and seal permanently in place only after all stratification problems have been eliminated.
 - h. Provide access doors or other approved means of access through ducts for service to control equipment.
 - i. Mount duct smoke detectors.
2. Electrical Subcontractor:
 - a. Provide conduit, conductors, and wire for all 120 volt or higher devices which interlock equipment provided under Division 23 with equipment and devices provided under other Divisions of the Specifications as indicated on Electrical Drawings and Division 26 Specifications.
 - b. Termination by HI&C Subcontractor.
 - c. Provide devices, conduit and wiring as indicated on Electrical Drawings.
3. HI&C Subcontractor:
 - a. Furnish all automatic dampers, valves, operators and linkages.
 - b. Provide a detailed schedule for the Mechanical Subcontractor of all automatic dampers and valves requiring their assembly or installation as suggested above.
 - c. Provide 120 volt and low voltage power to all valve/damper motors requiring same.
 - d. Wire all 120 volt flow, pressure and temperature sensing devices.
 - e. Coordinate with Electrical Subcontractor for smoke detector interface compatibility and functional intent.
 - f. Make final terminations to controlled components, including terminations from smoke detectors.
 - g. Provide conductors and conduit, including low voltage and 120 volt, as required to provide functional intent, except as specifically indicated otherwise on Drawings or in the specifications.
 - h. Provide all interface devices necessary for required communication to other systems.
 - i. Provide for power supply for all DDC panels that are required that are in addition to those indicated on the Drawings.
 - j. Operate all temperature control devices to confirm sequence of operations.

1.4 REFERENCES

- A. Except as herein specified or as indicated on the Drawings, the Work of this Section shall comply with the following:
1. ANSI - American National Standards Institute:
 - a. ANSI/ISA S5.1 - 1984 - Instrumentation Symbols and Identification (Joint Standard with ISA - Instrument Society of America).
 - b. ANSI X3.4 (ASCII).
 - c. ANSI/ASHRAE Standard 135 - BACNet.
 - d. ANSI/EIA Standard 709 - Control Network Protocol Specification (LONWorks).
 2. EIA - Electronic Industry Association: EIA Standard RS-232-C.
 3. NFPA – National Fire Protection Association:
 - a. 70 – National Electrical Code.
 - b. 90A – Standard for the Installation of Air-Conditioning and Ventilation Systems.

1.5 DEFINITIONS

- A. Where applicable, the terminology used herein uses the definitions listed in ASHRAE Standard 13.

B. Other definitions used include:

1. Low Voltage:
 - a. Voltage less than 120V single phase, typically 24V AC.
 - b. Low voltage is used primarily for communication and control of devices.
2. Large Valves: Valves for piping greater than 2 inches in diameter.
3. Large Dampers: Greater than 133-inch/pound torque required or 30 square feet.
4. DDC: Direct digital controls.
5. IP: Internet protocol.
6. LAN: Local area network.
7. HVAC: Heating, ventilating and air conditioning systems. Generally, the work of Division 23.
8. Primary Controller: A device that includes IP to field bus router, automatic time scheduling, trend logging, alarm handling, and supervisory logic control functionality. Sometimes referred to as a Building Controller.
9. Secondary Controller:
 - a. Advanced Application Controller: A controller with provisions and the control logic for all of the physical inputs and physical outputs associated with a single mechanical component such as a terminal unit, air-handling unit, chiller or boiler. An Advanced Application Controller may or may not have data management features such as time schedules, trend data storage and alarm message generation capabilities. These features may be provided by the Building Controller.
 - b. Application Specific Device or Controller: A sensor, controller, or end device that is pre-programmed by the vendor. It may have physical inputs and physical outputs. The control logic, while not programmable, may be configurable through the use of configuration parameters. The application may require input network variables and may send output network variables onto the network.
10. Control Logic Diagram: A graphical representation of control logic for the multiple processes that make up a system. Logic symbols are used to represent:
 - a. Input/Output (I/O) data.
 - b. Control functions such as PID, two-position control, switches, etc.
 - c. Math functions such as addition, subtraction, multiplication, division, etc.
 - d. Boolean functions such as greater than, less than, equal to, etc.
 - e. Limit functions such as maximum, minimum, ramps, etc.
11. Enterprise Level Data Manager (ELDM): A logic only device (controller without I/O) that is installed on the building LAN as the first node beneath the IP router. This device shall be programmable and be from the same Manufacturer that provides the enterprise level server and operator workstation software. The enterprise level data manager may be multiple identical devices installed on the building LAN in series in order to have sufficient capacity to support the building level controls. The enterprise level data manager may be combined in a single device with the IP router. The enterprise data manager serves 3 functions:
 - a. Time Schedules: Time schedule algorithms shall reside in the enterprise level data manager. Occupancy/energize commands shall be broadcast to the building level controllers in the number required by the sequence of control.
 - b. Trend Data Storage: The enterprise level data manager shall collect data from the building level controls at specified intervals and store the data for periodic uploading to the server. Polling communication techniques are acceptable for data collection by the data manager.
 - c. Alarm Generation: The enterprise level data manager shall receive binary alarm variables from the building level controllers and transmit this data to the alarm handling software module within the server and operator work stations. Receipt of alarm data from the building level controls shall be based on broadcasting from the building level controls and not based on polling by the enterprise level data manager.
12. JACE: Java Control Engine. A term used within the Niagara Framework to describe a enterprise level data manager:
13. Managed Communication: The transmission of data from a controller to a data manager, which in turn rebroadcasts the data to a second controller. The data manager may be referred to a network controller
14. Peer to Peer Communication: Data is broadcast from its origin and is received by the final device requiring the data without being received and retransmitted by a third device.
15. Standalone Controller: A standalone controller has provisions for all of the physical inputs and physical outputs associated with a single mechanical component such as a terminal unit, air handling unit, chiller or boiler. The controller shall also have embedded in it all of the control logic that associated the physical inputs to the physical outputs. A standalone controller will also have data management features such as time schedules, trend data storage and alarm message generation capabilities.

16. TCP/IP: Transmission Control Protocol/Internet Protocol. A basic communications protocol in a private network, either an intranet or an extranet.
17. Web Server: A software package installed on a primary/secondary controller or ELDM that provides for operation access to the Enterprise Level system from a computer on the LAN, using only a browser.

1.6 DESIGN AND PERFORMANCE REQUIREMENTS

- A. System layout and design responsibility are included as Work of this Section:
 1. Details of construction, quantities, components and accessories indicated on the Drawings and in the Specifications are minimum requirements.
 2. Increases in system component requirements beyond these minimums that are determined by the system designer to be necessary to provide the functional intent and for a complete system shall not be a basis for an increase in cost to Owner.
- B. Comply with the following performance requirements:
 1. Graphic Display: Display graphic with minimum 20 dynamic points or as required to display required data.
 2. Graphic Refresh: Update graphic with display with current data within 8 seconds.
 3. Object Command: Reaction time of less than 2 seconds between operator command of a binary object and device reaction.
 4. Object Scan: Transmit change of state and change of analog values to control units or workstation within 6 seconds.
 5. Alarm Response Time: Annunciate alarm at workstation within 45 seconds. Multiple workstations must receive alarms within 5 seconds of each other.
 6. Program Execution Frequency: Run capability of applications as often as 5 seconds, but selected consistent with mechanical process under control.
 7. Performance: Programmable controllers shall execute DDC/PID control loops, and scan and update process values and outputs at least once per second.
 8. Reporting Accuracy and Stability of Control: Report values and maintain measured variables within tolerances as follows:
 - a. Water Temperature: ± 1 degree F (0.5 degree C).
 - b. Water Flow: $\pm 5\%$ of full scale.
 - c. Water Pressure: $\pm 2\%$ of full scale.
 - d. Space Temperature: ± 1 degree F (0.5 degree C).
 - e. Ducted Air Temperature: ± 1 degree F (0.5 degree C).
 - f. Temperature Differential: Plus or minus 0.25 degree F (0.15 degree C).
 - g. Airflow (Terminal): $\pm 10\%$ of full scale.
 - h. Air Pressure (Space): ± 0.01 -inch wg (2.5 Pa).
 - i. Air Pressure (Ducts): ± 0.1 -inch wg (25 Pa).
 - j. Carbon Dioxide: ± 50 ppm.
 - k. Electrical: $\pm 5\%$ of reading.

1.7 SUBMITTALS

- A. Submit the following in accordance with Division 01 Section "Submittal Procedures."
- B. Submittals Prior to Construction:
 1. A description of the complete system, including a schematic diagram showing system architecture and all major components, cabinets, panels, sensors, controllers, hubs and operated devices, and required cabling between each.
 - a. Include any environmental and space requirements for equipment.
 - b. Anticipated deviations from performance and response time specified.
 - c. A layout drawing indicating locations of controllers and major devices.
 2. Sensors, Controllers, Actuators and Related Devices:
 - a. Complete system wiring diagrams and/or piping schematic including motor starters.
 - b. Specification sheets on all individual control system components, including rated accuracy of sensors.
 - c. Schedule of valves and dampers including size and performance characteristics.

3. Complete Descriptions of Operation:
 - a. Written sequences for software and hard-wired controls.
 - b. A sequence of control for each system being controlled. Include the following as a minimum.
 - 1) Process control sequence for each end device.
 - 2) Supervisory logic sequence of control for each system.
 - 3) The impact of each global application program on the sequence of control (Example: Demand Control).
 - 4) A list of all physical inputs and outputs associated with each sequence.
 - 5) Within the sequence of control, all application parameters that are to be user adjustable from an operator work station (OWS) shall be annotated with (adj) after the name of the parameter. This shall include setpoints, reset schedule parameters, calibration offsets, timer settings, control loop parameters such as gain, integral time constant, sample rates, differentials, etc.
 - 6) Within the sequence of control, all calculated values that are to be viewable at the OWS shall be annotated with (rpt) after the name.
 - 7) All points that shall be subject to manual control from an operator workstation.
 - 8) A list of all alarm points, a description of the alarm and a description of the alarm criteria.
 - 9) A list of all variables for which historical trending will be applied, the sample rates and any criteria used to start and stop the historical trending.
 4. Wiring diagrams.
 5. System Schematics: Include systems furnished by others that are integrated into the DDC system.
 6. Logic Schematics:
 - a. Provide for each system and subsystem a complete logic schematic indicating all inputs, outputs, decisions, etc.
 - b. Provide schematic format which includes all of the elements defined above.
 - c. Provide a legend for all symbols used.
 7. Information of a general, non-project specific nature is not acceptable.
 8. Start-up Testing Plan: Submit a start-up testing plan for each unique system.
 - a. The purpose of a start-up test is to demonstrate the "completeness" of the physical tasks associated with installation and the physical performance of the components.
- C. Submittals After Construction:
1. Start-up Testing Report.
 - a. Start-up testing reports shall be submitted on a per system basis.
 - b. Start-up testing reports shall be the documented results of the executed start-up testing plans.
 2. Operating and Maintenance Instructions: For all system components requiring maintenance include all maintenance information as required in Division 1 Section "Submittal Procedures" in addition to the following:
 - a. Descriptive System Information: Include system logic schematics, input/output functions and Sequences of Operation.
 - b. Operating Instructions: Include schedules and procedures for starting, stopping, cleaning, protection, testing, adjustments, calibration and replacement of components.
 3. As-Built Documentation:
 - a. Upon completion of the installation, and prior to acceptance by the Owner's representative, HI&C Contractor shall furnish as-built documentation and should include, but is not limited to the following:
 - 1) Points list in accordance with processor.
 - 2) Process flow diagram.
 - 3) Location plans.
 - 4) Operating sequences.
 - b. All changes to the above submitted drawings, equipment descriptions and operation manuals shall be clearly identified on the as-built documentation.
 4. Software:
 - a. Submit a copy of all software installed on the servers and workstations.
 - b. Submit all licensing information for all software installed on the servers and workstations.
 - c. Submit a copy of all software used to execute the project even if the software was not installed on the servers and workstations.
 - d. Submit all licensing information for all of the software used to execute the project.
 - e. All software revisions shall be as installed at the time of the system acceptance.

5. Firmware Files:
 - a. Submit a copy of all firmware files that were downloaded to or pre-installed on any devices installed as part of this project.
 - 1) This does not apply to firmware that is permanently burned on a chip at the factory and can only be replaced by replacing the chip.
 - b. Submit a copy of all application files that were created during the execution of the project.
 - c. Submit a copy of all graphic page files created during the execution of the project.
 - d. Submit a copy of all secondary graphic files such as bitmaps, jpegs, etc. that were used in the creation of the graphic pages.

1.8 QUALITY ASSURANCE

- A. Fabrication, Programming and Installation Personnel Qualifications:
 1. Trained and experienced in the fabrication and installation of the materials and equipment.
 2. Knowledgeable of the design and the reviewed Shop Drawings.
 3. 3 years minimum experience in the design and installation of HI&C work similar to that specified herein.
- B. Pre-Approved Installers: The following organizations are acceptable and are considered to meet the qualification requirements of this project:
 1. Siemens Building Technologies, Inc., Grand Rapids, Michigan.
- C. Regulatory Agencies Requirements:
 1. All temperature control wiring shall comply with NEC.
 2. All smoke detectors shall bear the UL label and be FM approved.
 3. All components used for smoke control shall comply with UL864.
 4. All DDC I/O Devices (Specified and Future):
 - a. ASCII (American Standard Code for Information Interchange) coded.
 - b. Furnished with EIA (Electronic Industries Association) interface hardware.
 5. All instrumentation hardware shall be ISA (Instrument Society of America) compatible.
 6. All primary components of DDC hardware shall be UL listed (UL916).
 7. Installation shall comply with FCC (Federal Communications Commission) rules for Class A and Class B computing devices pursuant to Subpart J of Part 15.
 8. ASHRAE Standard 135, BACnet/IP.
 9. Network wiring shall comply with EIA/TIA Standards.

1.9 WARRANTY

- A. In addition to the warranty provisions defined in the General Conditions, provide an extended warranty of a minimum 1 additional year (2 years total).

1.10 SERVICE AGREEMENT

- A. Provide 12-month service and maintenance contract paid in full:
 1. Within 30 days after Substantial Completion.
 2. Signed by Manufacturer's authorized representative.
- B. Programming and Setpoint Adjustments:
 1. In addition to service and maintenance, include 20 hours for adjustments in setpoints, reset schedules, and sequence revisions as directed by the Owner to "fine tune" control systems to building and occupant characteristics through 1 year of seasonal changes under full operation.
 2. Documentation:
 - a. Submit documentation of actual time spent for programming and setpoint adjustments within 30 days after completion of the work for approval by Owner or Engineer.
 - b. Time spent for service and maintenance as included above is not part of this allotment and is to be documented separately.

1.11 OWNERSHIP OF PROPRIETARY MATERIAL

- A. The Owner shall retain all rights to software for this project.
- B. The Owner shall sign a copy of the Manufacturer's standard software and firmware licensing agreement as a condition of this Contract. Such license shall grant use of all programs and application software to the Owner as defined by the Manufacturer's license agreement, but shall protect the Manufacturer's rights to disclosure of trade secrets contained within such software.
- C. The licensing agreement shall not preclude the use of the software by individuals under contract to the Owner for servicing or altering the system in the future. Use of the software by individuals under contract to the Owner shall be restricted to use only for the purpose of servicing or altering the installed system.
- D. All project developed software, files and documentation shall become the property of the Owner. These include but are not limited to:
 - 1. Server and workstation software.
 - 2. Application programming tools.
 - 3. Configuration tools.
 - 4. Addressing tools.
 - 5. Application files.
 - 6. Configuration files.
 - 7. Graphic files.
 - 8. Report files.
 - 9. Graphic symbol libraries.
 - 10. All documentation.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. General:
 - 1. Provide a micro-processor based logic system using low voltage electricity as a communication medium with an open architecture and distributed intelligence.
 - 2. All controlled components, sensors and controllers shall be addressable except:
 - a. Terminal heating units such as unit heaters, cabinet heaters, convectors, finned tube.
 - b. Ventilation fan and damper systems serving a single room and moving 1,000 cfm or less.
 - c. Variable air volume (VAV) boxes.
 - 3. Provide completely computerized system using low voltage electricity as the operating medium.
 - 4. System Functions:
 - a. Digital operation in accordance with preprogrammed strategies to control temperatures, energy use and selected electrical/mechanical equipment.
 - b. Capable of mathematical computation and logical/relational functions as required to achieve specified control strategies.
 - c. Capable of off-loading programs and accumulated data to magnetic media and a web browser.
 - d. Provide battery-powered RAM devices for program storage.
 - e. Continuous self-checking capability.
 - f. English language message display for all alarm and fault conditions.
- B. Interoperability:
 - 1. The system specified herein is a peer-to-peer addressable, standalone distributed control system integrating ANSI/ASHRAE Standard 135 (BACnet) technology and communication protocols in a common interoperable system. The system shall allow future expansion and modifications to the system with complete addressability without the use of proprietary components or software.
 - 2. All software and intelligent devices shall comply with BACnet standards to provide complete interoperability between all system components.
 - a. Each BACnet device shall be furnished with a protocol information conformance statement (PICS) certifying compliance to a minimum of Level 3.
 - 3. System shall provide complete password-protected accessibility to all devices, controllers and data using Java enabled web browsers without the requirement for proprietary software.

- C. System Architecture:
1. The system architecture shall consist of 2 layers, the LAN layer and the field bus layer.
 2. The TCP/IP layer connects all of the buildings on a single-wide area network (WAN) isolated behind the Owner's firewall. Fixed IP addresses for connections to the Owner's WAN shall be used for each device that connects to the WAN.
 3. The IP architecture shall operate over multiple IT subnets.
 4. Where multiple IT subnets are involved, a BACnet Broadcast Management Device (BBMD) shall be part of the system architecture within each IP subnet. The BBMD functionality shall be in a stand alone device or integral with a BACnet Building Controller.
 5. The system architecture shall include a BACnet Building Controller (B-BC) to connect each field bus to the WAN.
 6. Each field bus shall consist of multiple segments with no more than 125 total connected devices. Each segment shall be isolated from the other segments by a repeater. Each segment shall have no more than 30 connected devices.
- D. Networking:
1. All devices that connect to the LAN/WAN shall be capable of operating at 10 megabits per second or 100 megabits per second.
 2. LAN/WAN To Field Bus Routing Devices:
 - a. A BACnet Building Controller shall be used to provide this functionality.
 - b. These devices shall be configurable locally with RS232 or IP crossover cable and configurable via the LAN/WAN.
 - c. The routing configuration shall be such that only data packets from the field bus devices that need to travel over the LAN/WAN level of the architecture are to be forwarded.

2.2 MANUFACTURERS

- A. Subject to compliance with interoperability requirements and these Specifications, hardware, software, and components shall be supplied by and bear the name of 1 or more of Manufacturers listed below. Alternate Manufacturers are also listed in this Specification for individual components.
- B. Acceptable Manufacturers in accordance with University's Preferred Vendor Agreement:
1. Siemens Building Technologies, Inc.
- C. Stocking Requirements: All valves, operators, standard electrical components, and other replaceable parts shall be normally stocked within a 100 mile radius of the job Site.
- D. Electrical Components: Provide electrical components as specified in Division 26 and as manufactured by the acceptable Manufacturers listed therein.

2.3 HARDWARE SYSTEM REQUIREMENTS

- A. System Architecture:
1. Provide hardware comprised of a local building level primary controller and local control modules.
 2. User programmable.
 3. Provide Communication Networks:
 - a. Local links for distributed programming, data interchange and control at all system levels.
 - b. Internal modem or Web server for remote access through Internet lines to all system functions and levels with firewall and VPN hardware device.
 4. Standalone capability for local control modules.
 5. Analog Input:
 - a. Analog sensing elements for remote indication to be independent of local sensors used for local control loops.
 - b. The A/D conversion resolution shall not exceed 0.01 volts per count.
 6. Binary Input: Air flow status for each fan shall be indicated by means of a differential pressure sensing device which opens an electrical contact as the differential pressure falls below an adjustable pressure range setting.

7. Output Control:
 - a. Provide the necessary relays and wiring required to start and stop points, specified on the point list, through their respective existing control circuit.
 - b. Wiring required to complement the following control functions:
 - 1) Auto: In the auto control, the existing control sequence is not changed.
 - 2) Close: In the close control, the controlled device is maintained in the fully closed position.
- B. System Features:
 1. Modular construction and interoperable protocol to ensure future expansion capability with interconnection of system modules.
 2. Software configurable input and output points.
 3. Expandable Point Capacity:
 - a. At any point along the network without hardwiring points back to a central control panel.
 - b. Provide a minimum of 6% spare outputs user configurable for digital or analog.
 - c. System shall be modularly expandable to at least twice the installed capacity using additional hardware.
- C. System Communication:
 1. High Speed LAN and/or WAN Based, Arcnet or Ethernet Compatible: Capacity for a minimum of 2 operator stations, allowing concurrent multiuser, multitasking access to DDC network and control units.
 2. Provide transparent peer-to-peer communication between all control panels.
 3. Support an Internet communication link utilizing standard Internet protocol.
 4. Provide Internet browser capabilities allowing transparent interfacing with all the functionality of the head end user station, using Java enabled web browsers without the use of proprietary software.
- D. Operator Interface:
 1. Provide fully programmable remote web based access capabilities allowing alarm management and setpoint and schedule adjustments.
 - a. User interface shall be graphical in accordance with requirements below.
 2. Building Level Processor:
 - a. Run and print reports on specific equipment including AHUs, pumps, terminal units, boilers, etc.
 - b. Monitor and edit equipment scheduling parameters.
 - c. Receive and monitor alarms.
 - d. Exchange data (read and edit) between all the various control panels.
 - e. Receive and send data such that, from an off Site work station, all the functions listed under Items a, b, c, and d above, can be performed without the addition of new hardware or software.
 3. At Local Control Modules:
 - a. Peer-to-Peer Communications:
 - 1) Through an operator interface device, such as a laptop, hand held computer or touch pad screen, transparent interfacing to all other control panels shall be achieved such that it shall be as if being connected to the other control panel itself, without having to set up any separate communication services.
 - 2) Data, status information, reports, system software, custom programs, sensor data, etc., for all controllers shall be available for viewing and editing purposes.
 - b. Any Manufacturer's HVAC equipment using BACNet control and communication protocol provided with it, could be installed and connected at any time to the control panel system and transparently provide all sequence of operation controlling points and alarms, as if it came with the central control system's brand name controls on it, without having to add additional equipment.
 - c. Additional input and output points can be conveniently added via adding expansion modules.
 4. Application Software (latest versions reside on microcomputer):
 - a. Input/output capability from operator station.
 - b. System access level via software password.
 - c. Database creation and support.
 - d. Dynamic color graphic displays.
 - e. Alarm processing.
 - f. Event processing.
 - g. Data collection.
 - h. Full building graphics development.
 - i. Maintenance management.
 - j. Control software.

- k. Report writing.
 - l. Trending applications.
 - m. Control Manufacturer's internet website server link.
- E. Primary Controller:
- 1. Features:
 - a. Building-level control system, with on-board storage of programs and data, and with monitoring capabilities over all points in the building system.
 - b. Capable of standalone operation, supervising local control modules without a host computer.
 - c. Built-in, password-protected, multi-function keypad/display providing complete access to building-level monitoring and control.
 - d. RS-232-C port for connecting an optional ASCII terminal and/or printer to supplement the built-in keypad/display terminal.
 - e. Equipped with multiple processors, battery backup of RAM, and a battery backed-up real time clock.
 - 2. Functions:
 - a. Supervise all necessary building and energy management functions programs, including global data distribution (phase/power loss, outdoor temperature, external alarm status), time-of-day scheduling, holiday scheduling, optimized start/stop, duty cycle control, demand control, run time logging, equipment and system alarm monitoring, and self-diagnostics.
 - b. Network of local control modules (up to 256 input/output control points).
- F. Secondary Controller:
- 1. General:
 - a. Provide input/output, electronic thermostat, and terminal box controller modules as indicated on the Drawings and as required to satisfy the functional intent description of this Section.
 - b. Microprocessor-based with on-board program storage.
 - c. Capable of functioning as the input/output interface between the system and the building/equipment environment, providing control and management functions as programmed.
 - d. Capable of built-in bi-directional communication capability, over 2-wire cable or Ethernet, with the Primary Processor for programming and reporting functions and for supervision of all control and energy management operations.
 - e. Standalone capability to maintain programmed local control functions and operations including direct digital control in the event communications with the Primary Processor are lost.
 - f. Equipped with timed override switches to allow programmed off-hours operation.
 - g. Provide with LED indicators or LCD display to show schedule status, output status and communication status.
 - 2. Input/Output Modules:
 - a. Capable of the following local control capabilities:
 - 1) Supervisory and closed loop control.
 - 2) Setpoint and setback control.
 - 3) Positioning control.
 - 4) Proportional reset.
 - 5) Status monitoring.
 - 6) Equipment alarms.
 - 7) Sequencing (staging).
 - b. Local parameters and settings shall be monitorable and modifiable through the Primary Processor keypad/display terminal.
 - c. Perform energy and building management functions under supervisory control from the Primary Processor.
 - d. After initial communication with the Primary Processor, standalone programmed capabilities shall be stored on-board, in memory with 2,000 hour battery backup.
 - e. Equipped with 8 inputs and 8 outputs which shall be software configurable as either analog, digital or pulsed digital.
 - f. Configuration:
 - 1) Inputs and outputs shall be surge and spike protected.
 - 2) Inputs shall employ noise immunity circuits.
 - 3) Outputs shall employ noise suppression circuits.
 - 4) Outputs shall be equipped with internal manual/auto selection capability for local maintenance and troubleshooting use.

- 5) Provide suitable intermediate devices where the load being controlled exceeds the rating of the output, or uses a different operating medium.
- 3. Electronic Thermostat Modules:
 - a. Provide modules capable of the following:
 - 1) All necessary programmed functions.
 - 2) Energy and building management.
 - 3) Local control and monitoring.
 - b. Features Required:
 - 1) Automatic downloading by Primary Processor.
 - 2) Standalone operation after initial Primary Processor communication.
 - 3) RAM memory storage for failsafe, fixed setpoint program items.
 - 4) Permanent ROM memory storage for failsafe, fixed setpoint program items.
 - c. Local control functions include, but are not necessarily limited to:
 - 1) Cooling sequencing.
 - 2) Heating sequencing.
 - 3) Scheduling.
 - 4) Fan on/off.
 - 5) Mixed air damper modulation.
 - 6) Temperature setback.
 - 7) Optimized start and stop.
 - 8) Timed override.
 - d. Provide for input device signal interface:
 - 1) Temperature Sensor: 4-20 mA.
 - 2) Air flow switch.
 - 3) Override pushbutton.
- 4. Terminal Box Controller Modules:
 - a. Provide modules capable of the following:
 - 1) All necessary programmed functions.
 - 2) Energy and building management.
 - 3) Local control and monitoring.
 - 4) Integrating Primary Processor functions into local programs.
 - b. Features Required:
 - 1) Automatic downloading by Primary Processor.
 - 2) Standalone operation after initial Primary Processor communication.
 - 3) RAM memory storage for failsafe, fixed setpoint program items.
 - 4) Permanent ROM memory storage for failsafe, fixed setpoint program items.
 - c. Local control functions include, but are not necessarily limited to:
 - 1) Damper positioning.
 - 2) Fan start/stop.
 - 3) Reheat coil valve modulation.
 - 4) Temperature setback.
 - 5) Timed override.
 - d. Provide for input device signal interface:
 - 1) Temperature Sensor: 4-20 mA.
 - 2) Air flow switch.
 - 3) Override pushbutton.

2.4 SOFTWARE SYSTEM FEATURES

- A. The programmable energy and building management functions include, but are not necessarily limited to:
 - 1. User Setpoint Control:
 - a. Time of Day Scheduling:
 - 1) Capable of optimally starting based on individual unit recovery ramps.
 - 2) Time of day scheduling shall be continuous, such that if power is lost, on power up, the panel will look back for each device to see whether it should be on/off or in occupied/unoccupied temperature setpoints.
 - b. Holiday and weekend schedules.
 - c. Space temperature setpoint control.
 - d. Space humidity setpoint control.
 - e. Space ventilation setpoint control.

- f. Timed Override:
 - 1) Each scheduled device shall be able to be overridden at the operator work station and space sensor to the occupied mode for up to 4 hours.
 - 2) The override shall also be cancelable from the operator work station at any time during the override.
 - 2. System Controller Features:
 - a. Temperature reset.
 - b. Economizer control (free cooling).
 - c. Temperature control.
 - d. Humidity control.
 - e. Terminal box grouping.
 - f. Power fail restart sequencing.
 - g. PID loop control.
 - h. Data logging.
 - i. Duty cycling.
 - j. Optimized start/stop.
 - k. Demand limit control.
 - l. Control to greatest demand, with the ability to ignore specific demand inputs.
 - m. Event Log: The last 100 events shall be maintained for review at the OWS and remotely.
 - n. Daylight Savings Time:
 - 1) The system panel software shall automatically update time according to daylight savings at the legislated time and date, and reset time at the end of the daylight savings period.
 - 2) This function shall be able to be disabled.
 - 3. Control programs include, but are not necessarily limited to:
 - a. Setpoint (closed loop).
 - b. Proportional reset.
 - c. Sequencing by time and/or temperature.
 - d. Limit and status monitoring.
 - e. Local emergency overrides.
 - f. Local timed schedule overrides.
 - g. Outdoor temperature operating limits.
 - 4. Capable of combining functions as required for specific user requirements.
- B. User and Programmer Access:
 - 1. User password protected.
 - 2. Programmer password protected.
- C. Custom Programming:
 - 1. Provide a user-friendly, interactive, "on-line" programming language for the purpose of creating custom programs for specific, unique applications.
 - 2. All custom programming must be performed in English language commands, and all inputs, outputs, variables and flags shall be addressable by user specific English names without requiring alphanumeric addresses or point numbers.
 - 3. The system shall be programmable to allow or secure each of the above setpoint controls at each level.
 - 4. Provide software graphic package, including graphical representations for all major systems.
- D. Logs/Alarms:
 - 1. Provide automatic logging of control alarms, critical alarms, kW demand history and kWh consumption.
 - 2. Additional logging shall be programmable including, but not limited to:
 - a. Equipment run time.
 - b. Historic trends and logs.
 - c. User defined meters.
 - d. User access logs and point scans.
 - 3. Provide alarm monitoring and reporting capabilities for all input points, including phase loss alarms, external alarms, load control alarms, critical alarms with auto-dial-up feature, alarm summary on printer, including time and date of alarm, and programmable power-failure restart sequence.
 - 4. Audible Alarms:
 - a. Provide audible alarm at building level processor for each alarm condition.
 - b. Provide operator silencing. Reset daily.

5. At Control Panel Systems:
 - a. Peer-To-Peer Communications:
 - 1) Through an operator interface device, such as a laptop, hand held computer or touch pad screen, transparent interfacing to all other control panels shall be achieved such that it shall be as if being connected to the other control panel itself, without having to set up any separate communication services.
 - 2) Data, status information, reports, system software, custom programs, sensor data, etc., for all controllers shall be available for viewing and editing purposes.
 - b. Any Manufacturer's HVAC equipment using BACNet control and communication protocol provided with it, could be installed and connected at any time to the control panel system and transparently provide all sequence of operation controlling points and alarms, as if it came with the central control system's brand name controls on it, without having to add additional equipment.
 - c. Additional input and output points can be conveniently added via adding expansion modules.
 - d. Run and print trends of selected equipment performance characteristics in table and graph forms.
 - e. Run and print reports on specific equipment including AHUs, pumps, terminal units, chillers, boilers, towers, etc.
 - f. Monitor and edit equipment scheduling parameters.
 - g. Receive and monitor alarms.
 - h. Manage the network including monitoring of the loss of communication and clock setting functions.
 - i. Exchange data (read and edit) between all the various control panels.
 - j. Receive and send data such that from another control Manufacturer's PC work station off Site from the primary head end, all the functions listed under Items a, b, c, d, e and f, above, can be performed without the addition of new hardware or software.

E. Program Descriptions:

1. Time-Of-Day Scheduling:
 - a. Decrease energy consumption by turning off loads during unoccupied hours or unoccupied days.
 - b. Programmable in 1 minute increments.
 - c. Up to 64 discrete schedules in accordance with Primary Processor system.
 - d. Up to 16 groups of loads (consisting of up to 16 loads each) for concurrent scheduling.
 - e. Ability to assign loads to existing alternate schedules by linking.
 - f. Timed overrides and temporary "today" and "tomorrow" schedules, for each schedule.
2. Setpoint/Setback Control:
 - a. Decrease energy consumption by modifying space temperature setpoints during scheduled unoccupied hours, thereby reducing use of mechanical heating or cooling.
 - b. Timed override off hours setpoint operation.
3. Optimized Start/Stop:
 - a. Decrease energy consumption by learning building response to changing weather and automatically turning on HVAC as late as possible in the morning and off as early as possible in the evening, while meeting ambient temperature requirements during occupied hours.
 - b. Optimized start and stop times updated daily.
4. Holiday Scheduling:
 - a. Allow up to 16 holiday periods to be programmed.
 - b. Each holiday period programmable for a maximum of 99 consecutive days.
5. Temperature Reset:
 - a. Capable of user-defined linear proportional reset functions.
 - b. Programmable reset parameters, variables and limits.
 - c. Variables programmable as the highest, lowest or average of multiple inputs.
6. Direct Digital Temperature Control:
 - a. Maintain automatic temperature control directly by the local control module microprocessor.
 - b. Local module capable of performing all necessary local control functions.

2.5 ELECTRICAL DEVICES AND WIRING

- A. Comply with all local codes and applicable Sections in Division 26 of these Specifications.

- B. Low Voltage Wiring (24V or Less):
 - 1. Installed in a ceiling plenum used for return air shall be plenum rated wire securely fastened in accordance with the requirements of Division 26.
 - 2. Exposed wiring shall be installed in accordance with the requirements of Division 26.
- C. Approved Manufacturers:
 - 1. Honeywell.
 - 2. Siemens.
 - 3. Allen-Bradley.
 - 4. GE.
 - 5. Square D.
- D. Limit Switches: Limit switches shall be oil tight type with appropriate operator to provide required function. Limit switches used on dampers should be set at approximately 75% of full stroke.
- E. Control Relays and Contactors:
 - 1. Relays shall be a minimum DPDT, of proper coil voltage, with indicator light, and of sufficient rating for specified purpose. Relay base shall be of the screwed terminal type.
 - 2. Contactors shall be definite purpose type, have adequate number of poles, of proper coil voltage, and of sufficient rating for specified purpose.
- F. Selector Switches:
 - 1. Switches shall be multiple position type, oil-tight, watertight, dust-tight, have the adequate number of contact blocks, capable of additional contact blocks, and of sufficient rating for specified purpose.
 - 2. Nomenclature plate shall be provided with appropriate wording, units, etc.
- G. Push Buttons and Pilot Lights
 - 1. Push button switches and pilot lights shall be, oil-tight, watertight, dust-tight, have the adequate number of contact blocks, capable of additional contact blocks, and of sufficient rating for specified purpose.
 - 2. Nomenclature plate shall be provided with appropriate wording, units, etc.
 - 3. Pilot lights shall be LED, push-to-test type with replaceable lamps and lens. Lens shall be of the appropriate color for application served.
- H. Environment:
 - 1. All devices shall be of the correct NEMA rating for the environment in which it is installed.
 - 2. Refer to Electrical Drawings for area classifications.

2.6 ELECTRIC INSTRUMENTS

- A. Thermistor Temperature Sensors and Transmitters:
 - 1. Accuracy: ± 0.5 degrees F (0.3 degrees C) at calibration point.
 - 2. Wire: Twisted, shielded pair cable.
 - 3. Insertion Elements in Ducts: Single point, [8 inches (200 mm) long; use where not affected by temperature stratification or where ducts are smaller than 9 sf (0.84 sq. m).
 - 4. Averaging Elements in Ducts: 36 inches (915 mm) long, flexible; use where prone to temperature stratification or where ducts are larger than 10 sq. ft. (1 sq. m).
 - 5. Insertion Elements for Liquids: Brass or stainless-steel socket with minimum insertion length of 2-1/2 inches (64 mm).
 - 6. Room Sensor Cover Construction: Manufacturer's standard locking covers.
 - a. Setpoint Adjustment: Exposed.
 - b. Setpoint Indication: Exposed.
 - c. Thermometer: Exposed.
 - 7. Outside Air Sensors: Watertight inlet fitting, shielded from direct sunlight. Provide vandal resistant enclosures where accessible to the public.

2.7 AUTOMATIC CONTROL VALVES AND ACTUATORS

- A. Furnish valves in accordance with the requirements of Division 23 Section "General Duty Valves for HVAC."
- B. Control Valve Actuators:
 - 1. Size to operate with sufficient reserve power to provide smooth modulating action or 2-position action.
 - 2. Close-off (differential) pressure rating.
 - 3. Hydronic Systems: Combination of actuator and trim shall provide minimum close-off pressure rating of 150% of total system (pump) head for 2-way valves and 100% of pressure differential across valve or 100% of total system (pump) head.
 - 4. Electric Actuators and Motors:
 - a. Manufacturers: Subject to compliance with the requirements, provide products by one of the following:
 - 1) Johnson.
 - 2) Honeywell.
 - 3) Belimo Aircontrols (USA), Inc.
 - 4) Siemens.
 - b. Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.
 - c. Serviceable and rebuildable.
 - d. Coupling: V-bolt and V-shaped, toothed cradle.
 - e. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
 - f. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on nonspring-return actuators.

2.8 INSTRUMENT TEST HOLES

- A. Provide surface mounted, flanged test holes with removable caps and of sufficient length to extend beyond external duct insulation.
- B. Install at all control points in ductwork, including, but not necessarily limited to:
 - 1. Discharge air controllers.
 - 2. Return air controllers.
 - 3. Mixed air controllers.
 - 4. Pressure sensors.
 - 5. Limit thermostats.
 - 6. Temperature sensors.
- C. As manufactured by Ventfabrics, Inc.; Ventlock, Model 699; or equal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Electrical Wiring:
 - 1. Limit Interlocks:
 - a. Wiring of limit interlocks and dampers shall include on-off-auto switch on speed controllers.
 - b. Wiring of all limit interlocks shall be such that the equipment will be de-energized in all operating positions of the starter.
 - 2. Provide separate branch circuits for all 120 VAC power serving DDC equipment and related components.

3.2 FIELD QUALITY CONTROL

- A. Demonstration and Acceptance Test:
 - 1. Operate each and every phase of the control system separately, or in conjunction one with the other:
 - a. For a sufficient period of time to demonstrate the ability of the system to meet performance requirements in accordance with the true intent and purpose of these Specifications.
 - b. Provide for notification and approval of Engineer as required by Division 01 Section "Starting and Adjusting."
 - 2. The HI&C Subcontractor is responsible for verifying and demonstrating that each Sequence of Operation is being performed and design conditions stably maintained under operating conditions.
 - 3. Acceptance of performance will be provided by the Owner.
 - 4. Provide 8 hours of field service time for demonstration and acceptance test. Additional costs required due to retesting due to failure of system to perform satisfactorily shall be the responsibility of HI&C Subcontractor.
- B. Operator Instruction:
 - 1. When acceptable performance of the system hardware and software has been established, provide onsite operator instruction to Owner's operating personnel.
 - 2. Operator instruction during normal working hours shall be performed by competent Manufacturer's representative familiar with the software, hardware and accessories.
 - 3. At a time mutually agreed upon as stated above, provide 8 hours of instruction to Owner's designated personnel on the operation of all equipment within the system and describe its intended use with respect to the programmed functions specified.
 - 4. Includes, but is not necessarily limited to:
 - a. The overall operational program, equipment functions (both individually and a part of the total integrated system).
 - b. Commands.
 - c. Advisories.
 - d. The appropriate operator's intervention required in responding to the system's operation.
 - e. A description of the chronological information flow from field sensors, contacts and devices to the centrally located control console.
 - f. The overview of the system's communication network to acquaint the operator of the interplay between initiating devices, remote processing units, loop communications and their importance within the operating system.
 - 5. Provide additional information time, as deemed necessary by Owner's authorized representative, on a negotiated basis with Owner.
- C. Troubleshooting: Comply with the requirements of Division 23 Section "General HVAC Provisions," Article 1.7, for troubleshooting.

3.3 ADJUSTMENTS AND CALIBRATION

- A. Upon completion of this Project, adjust and validate all thermostats, controllers, valves, damper operators, relays, and other components provided as part of the temperature control system.
- B. Calibration:
 - 1. After completion of installation, the pneumatic piping shall be tested for leaks.
 - 2. Provide calibration documentation to Engineer, which shall include:
 - a. Airflow transmitter calibration curves to relate the transmitter output signal to the actual airflow as well as to the pressure drop across the primary flow measuring element.
 - b. For pressure, differential pressure, flow, and other transmitter's provide calibration curves using the zero, span and 3 other points between 10% and 90% of span. These curves shall relate the output signal of the transmitter to the primary measured value.
 - c. Indicating instruments shall read true conditions and be checked with test instruments.
 - d. Calibration of temperature and humidity sensors.

- C. Adjustments, Tuning and Start-up:
1. After the completion of calibration, adjust and tune the controls.
 2. Provide documentation, which is to include:
 - a. Input/output relationship of all controllers, positioners, and final drive units.
 - b. Gains and time constants established in all controllers.
 - c. Loop setpoints.
 - d. Limits on control actions.
 - e. Alarm limits.
 - f. Control dead bands.
 3. Provide seasonal adjustments as required under Article 1.10 - Service Agreement.

END OF SECTION 23 09 00

SECTION 23 21 13 – HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the furnishing and installation of a hydronic piping and circulation system for heating hot water.

1.3 REFERENCES

- A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
 - 1. American Society of Mechanical Engineering (ASME):
 - a. B31.1 - Code for Pressure Piping.
 - b. B31.5 - Code for Building Services Piping.
 - 2. National Electrical Manufacturers Association.

1.4 SUBMITTALS

- A. Manufacturer's Literature: For all products listed in Part 2.
 - 1. General:
 - a. Dimensions.
 - b. Details of construction and installation.
 - c. Name of Manufacturer.
 - d. Model number.
 - 2. Flow Measurement Devices:
 - a. Flow and pressure drop curves.
 - b. List each application with flow and size clearly indicated.
- B. Operation and Maintenance Manuals: For all flow measurement devices.
 - 1. Equipment function, normal operating characteristics and limiting conditions.
 - 2. Assembly, installation, adjustment and checking instructions.
 - 3. Maintenance instructions.
 - 4. Guide to "troubleshooting".
 - 5. Parts lists and predicted life of parts subject to wear.

1.5 QUALITY ASSURANCE

- A. Fabrication and Installation Personnel Qualifications:
 - 1. Trained and experienced in the fabrication and installation of the materials and equipment.
 - 2. Knowledgeable of the design and the reviewed Shop Drawings.

1.6 MAINTENANCE

- A. Valve Schedule:
 - 1. Provide the following schedules:
 - a. Valves: Indicate valve number, location and function of all valves.
 - 2. Mount schedules under plexiglass as directed by the Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Except as otherwise indicated on the Drawings or specified herein, the manufactured units and flow measurement devices shall be supplied by one of the following:
1. Bell & Gossett.
 2. Armstrong Pumps, Inc.
 3. Taco, Inc.
 4. Flow Design, Inc. (Circuit Setter).
 5. Deiterich Standard Corp. (Flow Indicators).
 6. Amtrol (Expansion Tank).
 7. Nexus.
 8. Apollo.

2.2 MATERIALS

- A. Piping: Comply with the requirements of Division 23 Section "Copper Pipe and Fittings for HVAC."

2.3 MANUFACTURED UNITS

- A. Strainer:
1. ASME, 125 psi, 375 degrees F.
 2. Strainer Material: Galvanized.
 3. Diameter Holes: 3/16-inch.
 4. Free Area: 5 times pipe area.
 5. Blow Down Connection: Yes.
 6. Size: As indicated on the Drawings.
- B. Shutoff Valves:
1. 125 psi at 250 degrees F.
 2. Furnish with adjustable memory stop on all throttling applications.
 3. Comply with the requirements of Division 23 Section "General Duty Valves for HVAC."
 4. 2-1/2-Inch and Larger:
 - a. Butterfly unless indicated otherwise on the Drawings.
 - b. Iron body.
 - c. Bronze disc.
 - d. Stainless steel shaft.
 - e. Resilient seat material designed for temperatures up to 250 degrees F.
 - f. Equal to Dezurik Fig. No. 632-L-D-RS66-1 with adjustable memory stop for all throttling applications.
 5. 2-Inch and Smaller:
 - a. All bronze construction.
 - b. Ball or Butterfly unless indicated otherwise on the Drawings.
 - c. Characterized port ball valves for throttling valve applications.
 - d. Equal to Milwaukee Model BB2FS or Conbraco Apollo 70-100 with adjustable stop lever for all throttling applications.

2.4 FLOW MEASUREMENT DEVICES

- A. Size:
1. Select size to provide design flow at mid-range of scale.
 2. Do not use pipe size as basis of selection.

- B. Circuit Setter (Flow Rates 2 gpm and Above):
1. Manufacturer and Model:
 - a. Bell & Gossett Model CB calibrated balancing valve.
 - b. Armstrong Model CBV circuit balancing valve.
 - c. Taco Model CS circuit setter.
 2. Bronze body construction with integral brass ball or globe valve, differential pressure readout ports and threaded drain connection.
 3. Rated for 300 psig/250 degree F operating conditions.
 4. Readout ports include caps and internal check valves.
 5. Furnish with calibrated name plate and memory stop.
 6. Furnish 1 Model RO-2 readout kit.
 7. Not acceptable for use as shutoff/isolation valve.
- C. Circuit Setter (Flow Rates Less Than 2 gpm):
1. Manufacturer and Model: Armstrong Model APV Venturi with a throttling ball valve.
 2. Bronze body construction with integral brass ball valve, venturi flow element, and differential pressure readout ports.
 3. Rated for 300 psig/250 degree F operating conditions.
 4. Readout ports include caps and internal check valves.
 5. Furnish with memory stop.
 6. Furnish 1 readout kit.
 7. Not acceptable for use as shutoff/isolation valve.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General:
1. Install piping and circulation system in accordance with:
 - a. The Drawing.
 - b. These Specifications.
 - c. The Shop Drawings reviewed by Engineer.
 - d. The Manufacturer's recommendations.
 2. System shall not interfere with passage, head room or openings of doors and windows.
 3. Pipe: Straight, without rust or other defects.
 4. Joints:
 - a. Welded: Required for pipes 2-1/2 inches and larger, unless using grooved piping system.
 - b. Screwed:
 - 1) Reamed after cutting and before threading.
 - 2) Sharp, clean threads.
 - 3) Use pipe compound on male threads only.
- B. Mains and Branches:
1. Install above the ceiling and in bar joists, above bottom chord, as indicated on the Drawings.
 2. Sizes as indicated on the Drawings.
 3. Install Tops of Mains Level:
 - a. Use eccentric fittings at changes in pipe size.
 - b. Provide adequate supports to prevent air pockets.
 4. Branches:
 - a. Take off bottom of main.
 - b. Provide swing connection before vertical riser to a heating unit or convector.

- C. Fittings:
 - 1. Provide Air Vents:
 - a. As indicated on the Drawings.
 - b. At all high points on the system.
 - 2. Provide Drain Valves:
 - a. At the bottom of all risers.
 - b. At boiler.
 - c. At all low points.
 - 3. Provide insulating couplings or unions where copper and steel pipes are joined.
 - 4. Provide unions at all valves and at all equipment for making repairs.
- D. Valves:
 - 1. Provide Shutoff Valves:
 - a. On both sides of all pumps where necessary to ensure proper operation of the system.
 - b. On all branches at the main.
 - c. So that equipment can be serviced without shutting down the system.
 - 2. Provide unions at all valves and at all equipment for making repairs.

3.2 SCHEDULES

SCHEDULE FOR
HYDRONIC PIPING
125 PSI MAXIMUM PRESSURE - 200 DEGREES F MAXIMUM TEMPERATURE

PIPE SIZE	SCHEDULE	MATERIAL	ASTM	GRADE	REMARKS
2	40	CW Steel	A53	B	Threaded and Coupled
2-1/2 - 12	40	ERW Steel	A53	B	Beveled End
14 - 24	375" Wall	Seamless Steel	A53	B	Beveled End
1/2 - 2	Type L	Seamless Copper	1388	--	50/50 Solder

FITTINGS	SIZE (IN)	DESCRIPTION	ANSI	ASTM
Ells	1/2 - 2	150# Malleable Iron Screwed	B16.3	A197
	2-1/2 - 18	Standard Weight Steel L.R. Butt Weld	B16.9	A234 WPA
	1/2 - 2	Wrought Copper (Long Radius)		
Tees	1/2 - 2	150# Malleable Iron Screwed	B16.3	A197
	2-1/2 - 18	Miter Branch & Weld into Run or Butt Weld Tees	B16.9	A 234 WPA
	1/2 - 2	Wrought Copper		
Reducers	1/2 - 2	150# Malleable Iron Screwed	B16.3	A197
	2-1/2 - 18	Standard Weight Steel Butt Weld	B16.9	A234 WPA
	1/2 - 2	Wrought Copper		
Bushings	1/2 - 2	Outside Hex. Head Malleable Iron	B16.3	A197
Couplings	1/2 - 2	150# Malleable Iron Screwed	B16.3	A197
	2-1/2 - 18	Butt Weld		
Unions	1/2 - 2	150# Malleable Iron Screwed	B16.3	A197
Plugs	1/2 - 2	Malleable Iron Square Head Solid		
Caps	1/2 - 2	Malleable Iron Screwed	B16.3	A197
	2-1/2 - 18	Standard Weight Steel Butt Weld	B16.9	A234 WPA
Flanges	2-1/2 - 18	150# F.S. Slip-on Welding	B16.9	A181-I
Gaskets		Non-Asbestos Compressed Material	B16.21	
Bolts		Regular "Unfinished" Square Head Machine		A307 Gr.B
Nuts		American Standard "Heavy Series"		
		Semi-finished Hex		A194 Gr.2H

VALVES	SIZE (IN)	DESCRIPTION	ENDS
Shut-Off	1/2 - 2	150# Brass Ball/Butterfly	Screwed/Soldered
	2-1/2 - 18	150# Butterfly	Flanged
Throttling	1/2 - 2	125# Brass Ball/Butterfly	Screwed/Soldered
	2-1/2 - 12	125# Butterfly	Flanged
Check	1/2 - 2	125# Bronze Swing Check	Screwed/Soldered
	2-1/2 - 12	125# IBBM Swing Check	Flanged

Grooved Piping Application Schedule				
	Application	Design Temperature Range	Maximum Pressure	Acceptable Pipe/Coupling (See Note Below)
1.	Heating/air conditioning	-30 to 230 degrees F	300 psig	A (up to 2-1/2") B (up to 2-1/2")
Note - Pipe/Coupling Types:				
A.	Standard weight steel pipe.			Refer to Section 23 05 03
B.	Copper.			Refer to Section 23 05 09

END OF SECTION 23 21 13

SECTION 23 31 13 – METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the furnishing and installation of sheet metal ductwork and appurtenances:
 - 1. As indicated on the Drawings.
 - 2. As specified herein.
 - 3. As required to provide a complete and operational air distribution system.
 - 4. As necessary for the proper and complete performance of the Work.
 - 5. Including all hangers, supports and anchors.

1.3 DESIGN AND PERFORMANCE REQUIREMENTS

- A. Provide all hangers, supports, braces and connections as required to meet the restraint requirements of Michigan Building Code and in accordance with the guidelines of the SMACNA Restraint Manual.
- B. Comply with the requirements of Division 23 Section "Sound and Vibration Control for HVAC" for vibration isolation of ductwork.

1.4 REFERENCES

- A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
 - 1. ASHRAE Guidelines:
 - a. 2016 HVAC Systems and Equipment - Chapter 19 - "Duct Construction."
 - b. 2017 Fundamentals - Chapter 21 - "Duct Design."
 - c. ASHRAE 62.1, current version.
 - 2. ASTM Specifications:
 - a. A480 - General Requirements for Flat-Rolled Stainless Steel and Heat-Resisting Steel Plate, Sheet, and Strip.
 - b. A653 - Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - c. A924 - General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
 - d. B209 - Aluminum and Aluminum - Alloy Sheet and Plate.
 - 3. ASTM Standard Test Methods:
 - a. A90 - Weight of coating on Zinc-Coated (Galvanized) Iron or Steel Articles.
 - b. C731 - Extrudability, after Packaging, Aging, of Latex Sealants.
 - c. D2202 - Slump of Sealants.
 - 4. NFPA Standards:
 - a. 90A - Installation of Air Conditioning and Ventilating Systems.
 - b. 90B - Installation of Warm Air Heating and Air Conditioning Systems.
 - c. 91 – Standard for Exhaust Systems for Conveying of Materials.
 - 5. SMACNA Guidelines:
 - a. "HVAC Duct Construction Standards, Metal and Flexible," 1985 Edition.
 - 6. UL Standards: 181 - Factory Made Air Ducts and Connectors.

1.5 SYSTEM DESCRIPTION

- A. Duct sizes indicated on Drawings are net clear inside dimensions.

B. Duct Construction Pressure Classifications:

	Duct System	SMACNA Pressure Classification
1.	Supply duct downstream of terminal units	1" W.G.
2.	Supply duct upstream of terminal units	3" W.G.
3.	Return duct	1" W.G.

1.6 SUBMITTALS

- A. Manufacturer's Data: Sequential parts list for each part.
1. Name of Manufacturer.
 2. Part name and model number.
 3. Dimensions.
- B. Shop Drawings: Construction details for special fabricated parts.
- C. Duct Pressure Test:
1. Written procedure for leak testing installed supply and return ductwork system 30 days prior to testing.
 2. Duct pressure test report.

1.7 QUALITY ASSURANCE

- A. Fabrication and Installation Personnel Qualifications:
1. Trained and experienced in the fabrication and installation of the materials and equipment.
 2. Knowledgeable of the design and the reviewed Shop Drawings.
- B. Regulatory Agencies Requirements:
1. All state and local codes and ordinances.
 2. Owner's insurer.
 3. Flexible ductwork shall comply with:
 - a. UL listed - Class 1 Air Duct Material, Standard 181.
 - b. NFPA Standard 90A - Flame spread: 25, Smoke developed: 50.

1.8 DELIVERY, STORAGE AND HANDLING

- A. All materials shall be delivered in original, unbroken, brand marked containers or wrapping as applicable.
- B. Handle and store materials in a manner which will prevent deterioration or damage, contamination with foreign matter and damage by weather or elements in accordance with Manufacturer's directions.
- C. Reject damaged, deteriorated or contaminated material and immediately remove from the Site. Replace rejected materials with new materials at no additional cost to Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Duct Connection Systems:
1. Ductmate Industries, Inc.
 2. Lindab, Inc.
- B. Flexible Duct:
1. Flexmaster USA, Inc., Type 3 uninsulated or 3M insulated as specified.
 2. General Environment Corporation.
 3. Wiremold Company.

- C. Prefabricated Fittings:
 - 1. United McGill Corporation.
 - 2. Buckley Air Products, Inc.
 - 3. Eastern Sheet Metal, Inc.
 - 4. LaPine Metal Products.
 - 5. Lindab, Inc.
 - 6. Semco.
 - 7. Universal Spiral Air.
- D. Manufactured ductwork and fittings shall be of one Manufacturer to ensure tight fit of ductwork and components.
- E. Manufacturer's Stamp:
 - 1. Manufacturer's stamp shall be on the outside of the ductwork.
 - 2. Stamp shall be clean and clear, indicating the metal gage.

2.2 MATERIALS

- A. Galvanized Steel:
 - 1. Galvanized steel of lock-forming quality with minimum ASTM A653, G90 zinc coating, both sides in accordance with ASTM A90.
 - 2. Use for all ductwork systems unless noted otherwise.
- B. Acceptable Fasteners:
 - 1. Rivets, bolts, or sheet metal screws.
 - 2. Stainless steel.
- C. Tapes:
 - 1. High pressure rated, non-hardening, water resistant and fire-resistant.
 - 2. Compatible with duct material.
- D. Sealants:
 - 1. Fire and Smoke Hazard Rating:
 - a. As tested by ASTM E84, NFPA 255, or UL 723.
 - b. Not to exceed: Flame spread 25, smoke developed 50.
 - 2. Exterior Mastic Sealant: Certified to pass 600 hours QUV; or equivalent weather testing.
 - 3. Comply with ASTM C731 and D2202.
 - 4. Specifically formulated for sealing the field joints.
 - 5. UL listed.
 - 6. Hardcast, Inc., Iron Grip 601, Flex Grip 550, Duct Seal 321.
- E. Hangers:
 - 1. Galvanized steel band iron.
 - 2. Rolled angle and 3/8-inch minimum galvanized steel rod.
- F. Wall Supports:
 - 1. Galvanized steel band iron.
 - 2. Fabricated angle bracket.

2.3 FABRICATION

- A. General: Construct rectangular, round and flat oval ductwork and fittings in accordance with the SMACNA HVAC Duct Construction Standards, Metal and Flexible, current edition.

- B. Transitions: Make every change in size or shape of duct with taper not exceeding 20 degrees.
- C. Connections:
 - 1. Make connections to equipment as indicated on Drawings or called for by these Specifications.
 - 2. For rectangular connections, crimp fabric to sheet metal and fasten sheet metal to ducts by screws 2-inch on center.
 - 3. Flexible Ductwork Connections:
 - a. Securely fasten flexible duct to round sheet metal ducts or duct collars with stainless steel or zinc-coated iron draw bands with worm gear fastener.
 - b. Flexible duct 10-inch diameter or less, installed on 1-inch W.G. pressure classification duct may be attached with nylon cable ties.
 - c. Fabric shall not be stressed other than by air pressure.
- D. Elbows and Tees:
 - 1. Maintain centerline radius of 1-1/2 times duct width in plane of turn wherever possible.
 - 2. Provide short radius fittings with a minimum of 2 turning vanes full length of turn or square elbows with multiple blade airfoil turning vanes set at 45 degree angle.
OR
 - 3. Provide rectangular mitered elbows with acoustic turning vanes as indicated on the Drawings. Refer to Division 23 Section "Sound and Vibration Control for HVAC" for acoustic turning vanes.
 - 4. Where mitered elbows are not indicated on the Drawings: Maintain centerline radius of 1-1/2 times duct width in plane of turn.
- E. Turning Vanes and Distribution Devices: Where registers, grilles or diffusers are located less than 5 equivalent duct diameters from the main duct, provide necessary distribution grids or turning vanes to ensure even distribution of air over the entire face of the outlet.
- F. Obstructions:
 - 1. Wherever a pipe or other obstruction passes through a duct (this condition is to be avoided if possible), pass the obstacle through an airfoil sleeve in the duct.
 - 2. Increase duct area at the obstruction if more than 20% of duct area is displaced by obstruction.
 - 3. Streamline sleeve to maintain angles at duct size changes at 20 degree angle.
- G. Provide necessary plastering frames and drawbands required.
- H. Branch Ducts:
 - 1. Construct with full radius elbow turning into a transition section in the main duct.
 - 2. Provide with damper and quadrant as specified in Division 23 Section "Dampers."

2.4 MANUFACTURED UNITS

- A. Turning Vanes:
 - 1. Hem the leading edge of vanes in ducts over 20-inch width with 1/2-inch fold-back.
 - 2. Reinforce turning vanes in ducts over 24-inch diameter with rods or sectional construction to limit unsupported length to 24 inches.
 - 3. 20 gage, minimum.
 - 4. Use in rectangular elbows with R/D ratio of less than 1.5.
 - 5. Double wall.
- B. Takeoffs from Round 1-inch Pressure Classification Duct:
 - 1. Made with factory fabricated lateral type fittings.
 - 2. At an angle of no more than 45 degrees.
 - 3. As manufactured by United McGill Corp., Model SRL; or approved equal.
 - 4. In accordance with detail on Drawing.

- C. Flexible Duct:
 - 1. Construction:
 - a. Liner of laminated aluminum foil/fiberglass/aluminated polyester.
 - b. Aluminum helix bonded to liner.
 - c. 1-inch thick, 1 pound/cubic foot insulation.
 - d. Seamless copolymer vapor barrier jacket.
 - e. Rated for pressure class of system in which duct is used.
 - 2. Maximum flexible duct length shall not exceed 5 feet, maximum flex duct turn not to exceed 45 degrees.
- D. Manufactured Ductwork Connection Systems:
 - 1. General:
 - a. In lieu of SMACNA Duct Construction Standards, Contractor may use an alternative engineered connection system such as Ductmate, "Spirosafe" by Lindab; or approved equal.
 - b. Designed to provide equivalent reinforcing and pressure characteristics.
 - 2. Description:
 - a. Duct, gasket, and fitting providing an airtight outer pressure shell.
 - b. The construction shall have mechanical means to maintain positive or negative pressure requirement, or both, and rigidity equivalent to SMACNA joints and metal gages.
 - 3. Duct Material:
 - a. Outer Shell: Galvanized steel.
 - b. Metal Gage: As required to meet pressure classification indicated.
 - 4. Fittings:
 - a. As indicated on Drawing and of same Manufacturer as duct section.
 - b. Sized to slip fit into the duct sections, without sharp projections for noise and airflow disturbances.
- E. Round Ductwork:
 - 1. Duct Material:
 - a. Outer Shell: Galvanized steel.
 - b. Inner Liner: Perforated galvanized steel.
 - c. Metal Gage: As required to meet pressure classification indicated.
 - 2. Insulation: Comply with the requirements of Division 23 Section "Sound and Vibration Control for HVAC" for internal duct liner.
 - 3. Fittings:
 - a. As indicated on Drawing and of same Manufacturer as duct section.
 - b. Sized to slip fit into the insulated duct sections, without spaces for air erosion of insulation or sharp projections for noise and airflow disturbances.
 - c. Butt joints are not suitable for the inner liner of double wall duct.

2.5 DUCT ACCESS DOORS

- A. Manufacturers:
 - 1. Prefco.
 - 2. Pottorff.
 - 3. Ventfabrics, "Ventlock."
 - 4. Greenheck.
- B. Provide In Ductwork:
 - 1. Wherever necessary for proper access to instruments, controls, fire dampers, motorized dampers, coils and equipment.
 - 2. For convenient inspection, maintenance and replacement.
 - 3. Reinforce openings on sides with material or ductwork in which doors are installed.
- C. Construction:
 - 1. Two-piece 22 gage minimum pan construction, consisting of outer side crimped over inner dished side.
 - 2. Continuous piano hinge and not less than 2 heavy cam latches. A removable type door is acceptable only where there is inadequate clearance for a hinged door.
 - 3. Contact surfaces of doors covered with heavy dense felt securely fastened in place to make doors air tight.
 - 4. Insulated or soundproofed with same materials as ducts or casings where located.
 - 5. Ruskin ADH22 or ADC22; or equal.

2.6 SOURCE QUALITY CONTROL

- A. Certified Testing:
1. Suppliers of manufactured round and oval ductwork shall have on file with Engineer certified copies of test data made by an independent United States laboratory covering pipe and fittings as manufactured by that Supplier.
 2. Spiral Pipe Test Data:
 - a. Cover leakage rate, bursting strength, collapsing strength, seam strength and friction loss.
 - b. Friction loss test data shall cover both the duct and the assembled coupling joints.
 - c. This friction loss data shall be equal to or less than the friction loss data used in the design of this system.
 3. The fitting test data shall cover the friction loss tests of all fittings used on the project.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General:
1. Install ductwork and accessories to provide a system free from buckling, warping, breathing, vibration, rattling, or whistling.
 2. Lap ducts in direction of air flow with longitudinal seams locked and hammered tight.
 3. Provide flat "S" cleats on all exposed traverse duct connections in finished areas.
 4. Install ducts straight with building walls where possible and exposed duct tight against roof or walls where possible.
 5. Ducts shall be air-tight, rigid, securely hung or bracketed in position.
 6. At the end of an uninsulated section or run, where internally insulated duct connects to uninsulated spiral duct or fitting, fire damper or flex, install an insulation end fitting to bring the outer shell down to nominal size.
 7. Install screws and rivets of such length that they do not interfere with the operation of manual or automatic dampers.
 8. Provide 1-inch long metal nosing around entire duct perimeter at all exposed and leading edges of internal acoustic ductwork lining.
- B. Protection of System:
1. Cap the ends of sheet metal ductwork, including the roof openings, registers and diffuser openings with temporary sheet metal caps during all stages of construction in order to keep system clean.
 2. If permanent heating and cooling equipment is used prior to Substantial Completion, protection of ductwork systems shall comply with Division 23 Section "General HVAC Provisions."
- C. Hanging Duct:
1. Allow swing in long direction of duct for movement.
 2. Double nut hanger rods.
- D. Duct Anchoring:
1. Galvanized sheet metal hanger straps attached to construction.
 2. Angle metal screwed to the ductwork.
- E. Turning Vanes:
1. Use in rectangular mitered elbows with R/D ratio of less than 1.5 and elsewhere as indicated.
 2. Install evenly spaced along elbow diagonal with leading and trailing edges aligned to sides of duct.
 3. Install vanes on 3-3/4-inch centers.
 4. Elbows Where Duct Changes Size:
 - a. Mount vanes individually (not on premanufactured vane runners).
 - b. Ensure that leading and trailing edges align parallel to sides of duct.

- F. Joint Sealing of Duct Systems:
1. Except where using gasketed duct connection systems, seal ductwork in accordance with SMACNA Class A:
 - a. Seal ductwork including supply, return, mixed, outdoor, and exhaust air systems.
 - b. For Round and Flat Oval Ductwork:
 - 1) Apply approved sealant to the male end of the couplings and fittings.
 - 2) After the joint is slipped together, place sheet metal screws 1/2-inch from the joint bead for mechanical strength.
 - 3) Apply sealer to the outside of joints including longitudinal joints, extending 1-inch on each side of the joint.
 - 4) Cover screw heads.
 - c. For Rectangular Ductwork:
 - 1) Apply approved sealant to transverse and longitudinal joints.
 - 2) Extend sealant a minimum of 1-inch on each side of joint.
 - d. Follow sealant Manufacturer's directions for application, storage and cure time.
 - e. Ductwork located outside shall be air and watertight.
 2. Manufactured Connection Systems:
 - a. Acceptable in accordance with Paragraph 2.1.
 - b. Seal flanged joints with neoprene rubber gaskets.
- G. Appearance: Where exposed ducts pass through walls or floors: Refer to Division 23 Section "Penetrations for HVAC."

3.2 HANGING AND SUPPORT

- A. All Ducts:
1. Support in a secure manner.
 2. Subject to Engineer's approval.
 3. In compliance with Michigan Building Code.
- B. In accordance with Section IV of the SMACNA HVAC Duct Construction Standards.
- C. Unacceptable work shall be removed and replaced at no additional cost to Owner.

3.3 FIELD QUALITY CONTROL

- A. Duct Systems to be Tested:
1. Supply ducts.
 2. Return ducts.
- B. Pressure Testing:
1. Pressurize the installed duct system to a test pressure 50% over the designated SMACNA pressure classification.
 2. Measure air leakage at the test pressure by an orifice type of flow meter which has been individually calibrated against a primary standard and this calibrated curve permanently attached to the orifice tube assembly.
 3. If the system is tested in sections, add the leakage rates to give the performance of the whole system.
 4. Total allowable leakage of the system shall not exceed 1.0% of the air handling capacity of the system.
 5. Correct Objectionable Noise:
 - a. Even if the system passes the leakage rate criteria.
 - b. To the satisfaction of Engineer.
 6. Apply duct tape over sealed joints prior to testing, if the system is to be tested before the recommended sealer curing time has elapsed.
- C. Perform testing in accordance with a printed procedure reviewed by Engineer.
- D. Notify Engineer 1 week prior to duct pressure test to allow Engineer the option to be available to observe testing.

- E. Pressurization Control:
1. Protection against duct overpressurization or underpressurization during testing is the responsibility of Contractor.
 2. Verify that control, variable air volume, balancing, and fire dampers are open.
 3. Verify that pressure relief panels or controls are operational.

END OF SECTION 23 31 13

SECTION 23 33 13 – DAMPERS

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, but is not limited to, the major items listed below:
 - 1. Fire dampers.
 - 2. Control dampers.
- B. Division of Work:
 - 1. In accordance with the General Conditions, Contractor is responsible for dividing the Work among the Subcontractors and Suppliers and for delineating the Work to be performed by specific trades.
 - 2. The following are suggestions as to how the Work may be divided. This is not a complete list of all the Work:
 - a. Mechanical Subcontractor:
 - 1) Install control dampers.
 - 2) Provide manual dampers.
 - b. Temperature Control Subcontractor:
 - 1) Furnish control dampers, linkages and operators unless specifically noted otherwise on Drawings.
 - 2) Install linkages and operators on dampers.

1.3 REFERENCES

- A. Except as herein specified or as indicated on the Drawings, the Work of this Section shall comply with the following:
 - 1. NFPA 90A - Air Conditioning and Ventilating Systems.
 - 2. SMACNA Publications:
 - a. Fire, Smoke and Radiation Damper Installation Guide for HVAC systems.
 - b. HVAC Duct Construction Standards - Metal and Flexible.
 - 3. ASTM:
 - a. E84 - Test for Surface Burning Characteristics of Building Materials.
 - b. E477 - Test Method for Measuring Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated Silencers.
 - 4. UL:
 - a. 555 - Fire Dampers.
 - b. 555C - Ceiling Dampers.
 - c. 555S - Leakage Rated Dampers for Use in Smoke Control Systems.

1.4 SUBMITTALS

- A. Manufacturer's Literature:
 - 1. Submit For:
 - a. Fire dampers.
 - b. Duct access doors and panels.
 - c. Control dampers.
 - 2. Required Information:
 - a. General:
 - 1) Dimensions.
 - 2) Details of construction and installation.
 - 3) Name of Manufacturer.
 - 4) Model.

- b. Control Damper:
 - 1) Air pressure drop.
 - 2) Leakage rate.
 - 3) Performance data as tested in accordance with AMCA Standards.
 - B. Operation and Maintenance Manuals: For each type of VAV damper.
 - 1. Equipment function, normal operating characteristics and limiting conditions.
 - 2. Assembly, installation, alignment, adjustment and checking instructions.
 - 3. Operating instructions for start-up, routine and normal operating, regulation and control, and shutdown and emergency conditions.
 - 4. Lubrication and maintenance instructions.
 - 5. Guide to "troubleshooting."
- 1.5 QUALITY ASSURANCE
- A. Fabrication and Installation Personnel Qualifications:
 - 1. Trained and experienced in the fabrication and installation of the materials and equipment.
 - 2. Knowledgeable of the design and the reviewed Shop Drawings.
 - B. Regulatory Agencies Requirements:
 - 1. UL: Fire dampers shall conform to UL 555 and bear the UL label.
 - 2. Installation and materials shall be in accordance with:
 - a. All state and local codes and ordinances.
 - b. Owner's insurer.
- 1.6 SEQUENCING AND SCHEDULING
- A. Installation of control components at the Manufacturer's factory or in the field is optional only to the extent that schedule is not adversely affected.

PART 2 - PRODUCTS

2.1 AIRFLOW REGULATING DAMPERS

- A. Manufacturers:
 - 1. Dampers:
 - a. American Warming and Ventilating, Inc.
 - b. Ruskin.
 - c. Louvers and Dampers, Inc.
 - d. Greenheck.
- B. Provide accessible, manually operable dampers:
 - 1. At branch duct take-offs.
 - 2. At diffuser run-out take-offs.
 - 3. Downstream of duct coils.
 - 4. As indicated on the Drawings by the manual balancing damper symbol.
- C. Dampers for Round Duct:
 - 1. For 8-inch and smaller, premanufactured dampers equal to Hart & Cooley 608/66 series.
 - 2. Field Fabricate Dampers:
 - a. Blade:
 - 1) Galvanized steel.
 - 2) Two gages heavier than duct in which installed.
 - b. Pivot rod continuous, 3/8-inch minimum for 12 inches and larger, 1/4-inch for under 12-inch size.
 - c. Hardware:
 - 1) For dampers less than 12 inches round, provide a dial regulator set consisting of 1 dial regulator, 1 square end bearing and 1 spring end bearing; equal to Durodyne Set No. KS-145 or KS145L.

- 2) For dampers larger than 10 inches round, provide a dial regulator set consisting of 1 dial regulator, 1 square end bearing and 1 spring end bearing equal to Durodyne Set No. KSR-195 or KSR-195L.

D. Dampers for Rectangular Duct:

1. Field Fabricate Single Blade Dampers:
 - a. Blade:
 - 1) Galvanized steel.
 - 2) Two gages heavier than duct in which installed.
 - 3) 12-inch maximum height.
 - b. Pivot Rod:
 - 1) 3/8-inch pins up to 18-inch wide.
 - 2) 1/2-inch continuous rod over 18-inch wide.
2. Dampers with Vertical Dimension Over 12 Inches:
 - a. Use opposed blade type.
 - b. Blade:
 - 1) 18-gage minimum galvanized steel.
 - 2) 12-inch maximum blade height.
 - 3) Hardware.

2.2 FIRE DAMPERS

A. Manufacturers:

1. Prefco.
2. Ruskin.
3. Greenheck.
4. Louvers and Damper, Inc.

B. General Requirements:

1. Dynamic rated.
2. Fusible link actuated at 165 °F.
3. Type B, 100% minimum free duct area with blade out of airstream.
4. Installation of Type "A" fire dampers in an oversized duct is not an acceptable substitute for Type "B".
5. UL Classified Fire Resistance Rating: 1-1/2 hours.
6. Size dampers at grilles same size as grille unless otherwise noted.

C. Provide where indicated on the Drawings and at code required locations in rated walls, floors and roofs.

D. Test fire dampers in accordance with:

1. UL Standard 555 or;
2. A nationally recognized, qualified testing laboratory approved by the local authority:
 - a. Bearing the approved label of that laboratory.
 - b. Installed in accordance with test installation.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:

1. Install duct accessories in conformance with:
 - a. The Shop Drawings reviewed by Engineer.
 - b. SMACNA HVAC Duct Construction Standards and Fire, Smoke and Radiation Damper Installation Guide.
 - c. These specifications where different from SMACNA.
 - d. Manufacturer's written instructions.
2. Locate branch dampers used for air flow regulation as close as possible to main trunks.
3. Dampers shall not rattle or generate airborne noise of any kind regardless of damper position.
4. Dampers located upstream of coils shall not interfere with uniform velocity profile at coil face.

5. Locate and orient duct accessories according to Manufacturer's instructions relative to nearby fittings, elbows, and fans.
 6. Verify that dampers move freely through their entire stroke without binding.
- B. Access:
1. Concealed duct accessories requiring inspection, service or maintenance shall be accessible.
 2. Provide acceptable means of access.
 3. Ensure that damper operator handles are not covered by insulation.

END OF SECTION 23 33 13

SECTION 23 36 00 – AIR TERMINAL UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the furnishing and installation of all variable air volume (VAV) terminal units.
- B. Cash Allowances: Work listed below to be completed by the temperature control system (T.C.S.) Subcontractor will be paid for from a cash allowance as specified in Division 01 Section "Cash Allowances" and performed by a T.C.S. contractor selected by Engineer.
- C. Division of Work:
 - 1. In accordance with the General Conditions, Contractor is responsible for dividing the Work among the Subcontractors and Suppliers and for delineating the work to be performed by specific trades.
 - 2. The following are suggestions as to how the Work may be divided. This is not a complete list of all the work:
 - a. Mechanical Subcontractor:
 - 1) Furnish and install VAV terminal units in ductwork system and provide hangers and support.
 - b. Temperature Control Subcontractor:
 - 1) Provide control components:
 - a) Furnish to VAV terminal unit Manufacturer.
 - b) Complete field installation and calibrate.

1.3 SYSTEM DESCRIPTION

- A. General:
 - 1. The assemblies shall be pressure independent and be able to reset to any airflow between 0 and a maximum cataloged cfm.
 - 2. Devices using cfm limits are not acceptable.
 - 3. Units shall be capable of morning warm-up operating control sequence.
- B. Design and Performance Requirements:
 - 1. Air leakage less than 2% at 0.5 inches w.c. static pressure.
 - 2. Control (pneumatic) air usage less than 0.02 SCFM at 20 psig.
 - 3. Space NC less than 35 at 2000 fpm inlet velocity.

1.4 SUBMITTALS

- A. Shop Drawings: For all terminal units.
 - 1. General:
 - a. Dimensions.
 - b. Details of construction and installation.
 - c. Name of Manufacturer.
 - d. Model.
 - 2. For Each Unit:
 - a. Identify by schedule Tag No.
 - b. Air pressure drop at maximum position for specified airflow.
 - c. Acoustic data at specified maximum and minimum airflows.
 - d. Coil performance data.
 - e. Fan performance data.
 - f. Electrical characteristics and project specific wiring diagrams including controls wiring.

- B. Operation and Maintenance Manuals: For each type of VAV terminal unit.
 - 1. Equipment function, normal operating characteristics and limiting conditions.
 - 2. Assembly, installation, alignment, adjustment and checking instructions.
 - 3. Operating instructions for startup, routine and normal operating, regulation and control, and shutdown and emergency conditions.
 - 4. Lubrication and maintenance instructions.
 - 5. Guide to "troubleshooting".
 - 6. Parts lists and predicted life of parts subject to wear.

1.5 QUALITY ASSURANCE

- A. Fabrication and Installation Personnel Qualifications:
 - 1. Trained and experienced in the fabrication and installation of the materials and equipment.
 - 2. Knowledgeable of the design and the reviewed Shop Drawings.
- B. Regulatory Agencies Requirements:
 - 1. The entire unit including heating coils shall be UL listed and labeled.
 - 2. All insulation in accordance with:
 - a. UL 181 for erosion.
 - b. NFPA 90A for fire and smoke.
 - 3. Installation shall comply with:
 - a. All state and local codes and ordinances.
 - b. Owner's insurer.

1.6 SEQUENCING AND SCHEDULING

- A. Coordinate with sheet metal Subcontractor for scheduling of terminal unit installation so as to not delay the job.
- B. Installation of control components at the Manufacturer's factory or in the field is optional only to the extent that schedule is not adversely affected.

1.7 WARRANTY

- A. Warranty shall cover all component parts for a period:
 - 1. Not less than 36 months.
 - 2. Beginning from date of shipment.
- B. Manufacturer shall bear all costs:
 - 1. For establishing and defining cause of unit's failure to perform as specified.
 - 2. For correcting or replacing all nonperforming units.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Nailor.
- B. Kreuger.
- C. Titus.
- D. Price.
- E. Siemens.

2.2 MANUFACTURED UNITS

- A. Casing:
 - 1. Minimum 22 gage galvanized steel.
 - 2. Internally Lined:
 - a. Comply with the requirements of Division 23 Section "Duct Insulation" for internal lining material.
 - b. 1-inch closed cell insulation.
 - c. 4 pound duct density.
 - d. Foil faced mylar lined.
 - e. Cut edges shall be sealed with metal barriers.
 - 3. Full bottom access door.
- B. Damper:
 - 1. Galvanized steel or aluminum center pivot single blade or concentric sliding valve.
 - 2. Gasketed for positive closure.
 - 3. Rustproof self-lubricating bearings.

2.3 COMPONENTS

- A. Terminal Control Components - Electronic:
 - 1. Airflow Sensor and Transducer:
 - a. Multi-point airflow pick-up to provide a factory piped differential pressure signal to an airflow transducer assembly.
 - b. The pick-up shall maintain air accuracy of (\pm) 5% of the normal operating range of the terminal as a minimum.
 - c. Integral flow taps and a calibration chart shall be provided with each unit.
 - 2. Terminal Damper Actuator - Electronic:
 - a. Direct coupled actuator used to control the primary air damper of the terminal control unit.
 - b. Constant current and torque limiting.
 - c. The actuator shall be factory mounted, wired and installed by the terminal unit Manufacturer.
 - d. Fully compatible with the electronic control signal for the T.C.S.
 - e. The actuator shall be capable of providing a minimum of 35-inch pounds of torque.
 - f. Capable of going from full open to full closed (or vise versa) in a maximum of 60 seconds.
 - 3. Terminal Box Controller Module: Refer to Division 23 Section "Instrumentation and Control for HVAC" for controller module requirements.
 - 4. Terminal Damper Actuator:
 - a. Direct coupled actuator used to control the primary air damper of the terminal control unit.
 - b. The actuator shall be capable of providing a minimum of 35-inch pounds of torque.
 - c. Capable of going from full open to full closed (or vise versa) in a maximum of 60 seconds.
 - d. Pneumatic cylinder type.
 - e. 5 - 10 psig spring range.
 - 5. Volume Controller:
 - a. Pressure independent.
 - b. Independent adjustment of minimum and maximum CFM setpoints.
 - c. Direct or reverse acting as required by control sequence.
 - d. Maximum 1.3 SCFH air consumption.

2.4 ACCESSORIES

- A. Hot Water Coils: Comply with the requirements of Division 23 Section "Hydronic Piping."

2.5 TERMINAL CONTROL UNIT POWER REQUIREMENTS

- A. All air terminal units shall be designed for single point power connections.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. As indicated on the Drawings.
- B. In accordance with Manufacturer's installation instructions.

END OF SECTION 23 36 00

SECTION 23 37 00 – AIR OUTLETS AND INLETS

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 furnishing and installation of all air inlet and outlet devices.
- B. Division of Work: In accordance with the General Conditions, Contractor is responsible for dividing the Work among the Subcontractors and Suppliers and for delineating the work to be performed by specific trades.

1.3 REFERENCES

- A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
 - 1. AMCA Publications: Standard 511 - Certified Ratings Program for Air Control Devices.

1.4 SUBMITTALS

- A. Manufacturer's Literature: For all items specified herein.
 - 1. General:
 - a. Dimensions.
 - b. Details of construction and installation.
 - c. Name of Manufacturer.
 - d. Model.
 - 2. Performance at Scheduled Airflow:
 - a. Maximum supply outlet throw value based on 50 fpm terminal velocity.
 - b. Maximum air pressure drop in inches water gage.
 - c. Maximum noise criteria (NC) level.

1.5 QUALITY ASSURANCE

- A. Fabrication and Installation Personnel Qualifications:
 - 1. Trained and experienced in the fabrication and installation of the materials and equipment.
 - 2. Knowledgeable of the design and the reviewed Shop Drawings.

PART 2 - PRODUCTS

2.1 REGISTERS, GRILLES, DIFFUSERS

- A. Manufacturers:
 - 1. Titus.
 - 2. Price
 - 3. Kreuger.
 - 4. Nailor.
- B. General Construction Features:
 - 1. Refer to the Drawings for styles, types and design and materials.
 - 2. Return registers and grilles shall have fixed fins.
 - 3. Provide opposed blade, key operated dampers with registers.
 - 4. Provide sponge rubber gaskets at mounting flanges.
 - 5. Fit units with concealed mounting screws.

- 6. Frame:
 - a. Provide factory manufactured frame to allow proper mounting to surface in which installed, i.e., plaster, concrete, T-bar, splined ceiling, etc.
 - b. Coordinate each case with architectural Drawings.
- C. Finish:
 - 1. Manufacturer's standard paint; color selected by Architect.
 - 2. Anodized acceptable where standard for specific item.
 - 3. Off-white color for suspended ceiling installations, except where noted as black.
- D. Accessories:
 - 1. Provide where indicated or required.
 - 2. Equalizing grid.
- E. Manufacturer/model numbers are scheduled on Drawings to indicate performance criteria, appearance style and quality of materials.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Follow Manufacturer's instructions, subject to Engineer's approval.
- B. Install registers, grilles and diffusers only after finish painting has been completed.
- C. Install fixed vane return and exhaust grilles with angle of vanes perpendicular to normal line-of-sight.

3.2 ADJUSTING

- A. Set pattern controllers on slot diffusers and set vanes on adjustable diffusers to provide air flow patterns as indicated on the Drawings.

3.3 PAINTING

- A. Unlined Ductwork:
 - 1. Where visible behind registers, grilles and diffusers.
 - 2. Apply flat black paint:
 - a. 2 coats.
 - b. In accordance with Division 09 – Finishes.

END OF SECTION 23 37 00

SECTION 26 05 00 - COMMON WORK RESULTS FOR ELECTRICAL

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. Electrical equipment coordination and installation.
 - 2. Sleeves for raceways and cables.
 - 3. Sleeve seals.
 - 4. Grout.
 - 5. Common electrical installation requirements.

1.3 REFERENCES

- A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with
 - 1. NECA 1 - Standards Practices for Good Workmanship in Electrical Construction.
 - 2. NEC – National Electrical Code (NFPA 70)

1.4 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.

1.5 SUBMITTALS

- A. Product Data: For sleeve seals.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials in original, unbroken, brand marked containers or wrapping as applicable.
- B. Handle and store materials in a manner which will prevent deterioration, damage, contamination with foreign matter, and damage by weather or elements, and according to Manufacturer's directions.
- C. Store materials indoors and protect from weather. When necessary to store outdoors, elevate materials above grade and enclose with durable, weathertight wrapping.
- D. Reject damaged, deteriorated or contaminated material and immediately remove from the Site. Replace rejected materials with new materials at no additional cost to Owner.

1.7 COORDINATION

- A. Coordinate arrangement, mounting, and support of electrical equipment:
 - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
 - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
 - 3. To allow right-of-way for piping and conduit installed at required slope.
 - 4. So connecting raceways, cables, wireways, and cable trays will be clear of obstructions and of the working and access space of other equipment.

- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Sections.

PART 2 - PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

- A. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Sleeves for Rectangular Openings: Galvanized sheet steel.
 - 1. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than 50 inches and no side more than 16 inches, thickness shall be 0.052 inch.
 - b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches and 1 or more sides equal to, or more than, 16 inches, thickness shall be 0.138 inch.

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, provide products by one of the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
 - e. Proco Products, Inc.
 - 2. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
 - 3. Pressure Plates: Carbon steel.
 - 4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating f length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.3 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Comply with NECA 1 and NEC.
- B. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- C. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in a manner as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- D. Right of Way: Give to piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Extend sleeves installed in floors 2 inches above finished floor level.
- G. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable, unless otherwise indicated on the Drawings.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint.
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials.

3.3 FIRE-RATED-ASSEMBLY PENETRATIONS

- A. Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Sections.

3.4 SLEEVE-SEAL INSTALLATION

- A. Use 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.

3.5 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Sections.

END OF SECTION 26 05 00

SECTION 26 05 20 - CONDUCTORS AND CABLES – 600V AND BELOW

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 furnishing and installation of all electrical conductors, cables, splices, and connectors.
- B. Major Systems Include:
 - 1. 600V and below feeders and electrical distribution.
 - 2. Branch circuit wiring.
 - 3. System wiring.

1.3 REFERENCES

- A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the standards of the following organizations as applicable to materials, construction and testing of wire cables:
 - 1. NEMA - National Electrical Manufacturer Association Standards.
 - 2. IEEE Standards.
 - 3. Insulated Cable Engineers Association - Standards.
 - 4. ASTM Standards.
 - 5. NEC - National Electric Code

1.4 QUALITY ASSURANCE

- A. Fabrication and Installation Personnel Qualifications:
 - 1. Trained and experienced in the fabrication and installation of the materials and equipment.
 - 2. Knowledgeable of the design and the reviewed submittals.
- B. Manufacturers: Firms regularly engaged in the manufacture of electrical conductor and cable products of the types and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver all materials in original, unbroken, brand marked containers or wrapping as applicable.
- B. Handle and store materials in a manner which will prevent deterioration or damage, contamination with foreign matter, damage by weather or elements, and in accordance with Manufacturer's directions.
- C. Store materials indoors and protect from weather. When necessary to store outdoors, elevate materials above grade and enclose with durable, watertight wrapping.
- D. Reject damaged, deteriorated, or contaminated materials and immediately remove from the Site. Replace rejected materials with new materials at no additional cost to Owner.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Except as otherwise indicated, provide conductors, cables, and connectors of Manufacturer's standard materials, as indicated by published product information; designed and constructed as recommended by the Manufacturer and as required for the installation.
- B. Power Wire:
 - 1. All conductors and cables shall be new with a minimum wire size of No. 12 AWG. Manufacturer's name, type, and size shall be permanently marked on the outer covering at regular intervals and delivered in complete coils or reels.
 - 2. Provide factory fabricated conductors of size, rating, material, and type as indicated for each service. Where not indicated, provide proper selection as determined by installer to comply with installation requirements and with NEC standards, from only following types and conductors:
 - a. Type THHN/THWN, 600 Volt, 75/90 Degrees C Rated with Nylon Jacket: Stranded copper for all sizes.
 - b. Bare Conductors: Stranded copper for all sizes.
- C. Control Cable: No. 14 AWG minimum, type THHN/THWN, plenum rated.
- D. Power Wiring Cable Accessories: For Connectors:
 - 1. Wing nuts by Ideal.
 - 2. Stan-Kon by Thomas & Betts.
 - 3. Scotchlox Spring by Minnesota Mining & Manufacturing Company.
 - 4. Compression Type 53200 by Thomas & Betts.
 - 5. Hydent by Burndy.
 - 6. Insulated multi-cable mechanical connector blocks by Polaris, or Ilsco.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General:
 - 1. Install electrical conductors, cables, and connectors as indicated on the Drawings, in accordance with the Manufacturer's written instructions, the applicable requirements of NEC and the National Electrical Contractors Association's "Standard of Installation" and in accordance with recognized industry practices to ensure that products serve the intended functions.
 - 2. Conductors and cables shall be sized in accordance with the Drawings or, in the absence thereof, in accordance with NEC requirements. Except and indicated herein, conductor sizes greater than No. 12 AWG are indicated on the Drawings.
 - 3. Provide dedicated ungrounded conductor (neutral) for each 20A, 120V circuit.
- B. Voltage Drop Compensation:
 - 1. Provide No. 10 AWG conductors in lieu of No. 12 AWG conductors to compensate for voltage drop as follows:
 - a. For each 277V, 20 ampere branch circuit that exceeds 200 feet in length between the branch circuit panelboard and the last outlet.
 - b. For each 120V, 20 ampere branch circuit that exceeds 100 feet in length between the branch circuit panelboard and the last outlet.
 - 2. When conductor size is increased to compensate for voltage drop, provide equipment grounding conductor increased in size in accordance with NEC.
- C. Installation Procedures:
 - 1. Install conductors so insulation is not damaged. Replace all conductors that are damaged.
 - 2. Install conductors and cables only in code conforming raceway.
 - 3. Pull conductors together where more than 1 conductor is being installed in a raceway.
 - 4. Use heat shrink tubing for all instrument signal cable terminations.

5. Use manufacturer-approved pulling compound or lubricant, where necessary. Compound shall not deteriorate conductor and insulation. Compounds shall be UL listed.
6. Use a pulling means, including fish tape, cable or rope, and basket-weave wire/cable grips, that will not damage the raceway or the wire.
7. Keep conductor splices to a minimum.
8. Install splices and taps which have equivalent or better mechanical strength and insulation as the conductor.
9. Use splice and tap connectors which are compatible with the conductor material.
10. Make all joints, splices, and connections only at accessible junction or outlet boxes, never inside conduit or fitting. Make splices in No. 10 AWG and smaller wire with insulated spiral mechanical connectors.
11. Make splices in No. 8 AWG and larger copper wire with compression type mechanical connectors.
12. Insulate all joints at splices with "Scotch" brand electrical pressure sensitive tape to 150% of conductor insulation value.
13. Make conductor length for parallel feeds identical.
14. Where exposed cables are installed, cables shall be installed parallel and perpendicular to exposed structural members and building lines.
15. Do not lace, strap or tie feeder or branch circuit conductors together in panels, switchboards, variable speed drives, motor control centers, automatic transfer switches, boxes, and wireways.
16. Feeders and service entrance conductors entering electrical equipment shall be adequately secured with cable cleats.
17. Use color coded conductors as follows:
 - a. Phases: Black-red-blue (under 150V to ground).
 - b. Phases: Brown-orange-yellow (over 150V to ground).
 - c. Neutral: White identified (feeders); White (branch circuits).
 - d. Ground: Green identified (feeders); Green (branch circuits).
18. Support conductors in vertical raceways in accordance Division 26 Section "Hangers and Supports for Electrical Systems."
19. Outlets:
 - a. Leave at least 6 inches of free conductor at all outlets except where conductors are intended to loop without joints through outlets for fixtures or wiring device hook-ups.
 - b. Free ends and loops at boxes and enclosures shall be pushed back into boxes and protected by blank cover plates or other means until interior painting and decorating work is completed.
20. Lights and outlets shall be grouped on circuits as indicated on the Drawings. Different types of circuits such as feeders, branch circuits, control circuits, and signal circuits, shall not be mixed in common conduit runs, but shall be run separately, although more than 1 circuit of the same system may be run in common conduit runs.
21. Fire Alarm Circuits: Power limited, fire-protective signaling circuit cable in raceway, cable tray or conduit.

3.2 FIELD QUALITY CONTROL

- A. General:
 1. Prior to energization, check conductors and cables for continuity of circuitry and for short circuits. Correct malfunctions when detected.
 2. Subsequent to conductor and cable hook-ups, energize circuitry and demonstrate functioning in accordance with requirements.

END OF SECTION 26 05 20

SECTION 26 05 27 - GROUNDING AND BONDING

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 furnishing and installation of a complete and continuous grounding system.

1.3 DESIGN AND PERFORMANCE REQUIREMENTS

- A. All equipment, raceway systems, interior wiring systems with neutrals, receptacles, and power outlets, motors and motorized equipment shall be grounded.

1.4 QUALITY ASSURANCE

- A. Fabrication and Installation Personnel Qualifications:
 - 1. Trained and experienced in the fabrication and installation of the materials and equipment.
 - 2. Knowledgeable of the design.
- B. Grounding system shall be in accordance with the current National Electrical Code.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: A portion of the required materials for grounding systems are specified in the Division 26 – Electrical Sections.

PART 3 - EXECUTION

3.1 DISTRIBUTION SYSTEM GROUNDING

- A. Circuit Grounding: Install grounding bushings, grounding studs, and grounding jumpers at distribution centers, pull boxes, and panelboards.
- B. Bonding Jumpers:
 - 1. Provide green insulation, size correlated with overcurrent device protecting the wire, attached to grounding bushings on conduits, to lugs on boxes, and other enclosures.
 - 2. Bond to neutral only at service neutral bar.
- C. FMC and LTFMC: Install separate grounding conductor in FMC and LTFMC. Connect each end to a grounding bushing.
- D. Receptacles and Power Outlets: Ground receptacles and power outlets to the conduit system with a Type THHN green grounding conductor sized in accordance with NEC Article 250 and connected between the device grounding screw and outlet box.
- E. Metallic Conduit: When grounding conductors are enclosed in metallic conduit, the conduit shall be bonded to the grounding conductors at both ends.
- F. Ground motor bases and frames by pulling a separate conductor in with the motor feeder.

- G. Expansion Joints: Install a bonding jumper around expansion fittings in metallic conduit to maintain ground continuity.

3.2 FIELD QUALITY CONTROL

- A. Tests:
 - 1. Measured resistance of grounding electrode system to ground shall be 5 Ohms or less. Perform Earth Ground Resistance (Fall of Potential) tests and provide additional grounding electrodes to grounding electrode system until measured resistance to ground is 5 ohms or less.
 - 2. Transmit test results to Engineer.

END OF SECTION 26 05 27

SECTION 26 05 29 - 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 furnishing and installation of hangers and supports for electrical equipment and systems.

1.3 DEFINITIONS

- A. Electrical Supports: Angles, channels, brackets, and mounting accessories for supporting all conduit, luminaires, switches, and other electrical equipment which are hung or mounted above floor.

1.4 DESIGN AND PERFORMANCE REQUIREMENTS

- A. This Section defines general criteria for the selection and installation of supporting devices, but does not cover all types specifically required for the Project.
- B. Choose or design supporting devices in accordance with these general criteria.

1.5 QUALITY ASSURANCE

- A. Fabrication and Installation Personnel Qualifications:
 - 1. Trained and experienced in the fabrication and installation of the materials and equipment.
 - 2. Knowledgeable of the design and the reviewed submittals.
- B. Regulatory Agencies Requirements:
 - 1. Provide supporting devices listed by Underwriters' Laboratory for their application as installed.
 - 2. Comply with National Electrical Code (NFPA 70) as applicable to construction, installation, and requirements for supporting devices.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver all materials in original, unbroken, brand marked containers or wrapping as applicable.
- B. Handle and store materials in a manner which will prevent deterioration or damage, contamination with foreign matter, damage by weather or elements, and in accordance with Manufacturer's directions.
- C. Store materials indoors and protect from weather. When necessary to store outdoors, elevate materials above grade and enclose with durable, watertight wrapping.
- D. Reject damaged, deteriorated, or contaminated material and immediately remove from the Site. Replace rejected materials with new materials at no additional cost to Owner.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Conduit Supports:
 - 1. Single Runs: Galvanized conduit straps or ring bolt type hangers with spring clips. Do not use plumber's perforated straps.
 - 2. Multiple Runs: Conduit rack with 25% spare capacity.
 - 3. Vertical Runs: Channel support with conduit fittings.
 - 4. Manufacturers:
 - a. Cooper B-Line; a division of Cooper Industries
 - b. ERICO International Corporation.
 - c. Allied Support Systems; Power-Strut Unit.
 - d. GS Metals Corp.
 - e. Michigan Hanger Co., Inc.; O-Strut Div.
 - f. National Pipe Hanger Corp.
 - g. Thomas & Betts Corporation.
 - h. Unistrut; Tyco International, Ltd.
 - i. Wesanco, Inc.
 - j. Or equal.
- B. Mounting, Anchoring, and Attachment Components
 - 1. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened Portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - 2. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened Portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - 3. Manufacturers:
 - a. Hilti, Inc.
 - b. ITW Construction Products.
 - c. MKT Fastening, LLC.
 - d. Or equal.
- C. Supports for Conductors in Vertical Conduit:
 - 1. Install in compliance with NEC article 300.19.
 - 2. 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.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General:
 - 1. Layout to maintain headroom and neat mechanical appearance, and to support equipment loads.
 - 2. Secure Engineer's approval before welding or bolting to steel framing or anchoring to concrete structure.
 - 3. Where equipment is to be suspended from cast-in-place concrete construction, set approved concrete inserts in formwork to receive hanger rods. Where equipment is to be suspended from metal deck and beam or joist construction, support equipment from beams or joists only.

END OF SECTION 26 05 29

SECTION 26 05 34 - RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the furnishing and installation of conduits and fittings for electrical wiring.

1.3 QUALITY ASSURANCE

- A. Fabrication and Installation Personnel Qualifications:
 - 1. Trained and experienced in the fabrication and installation of the materials and equipment.
 - 2. Knowledgeable of the design.
- B. Regulatory Agencies Requirements:
 - 1. ACI – American Concrete Institute – Standards pertaining to conduits embedded in concrete (Section 6.3 in ACI 318 – Building Code Requirements for Structural Concrete and Section 6.3 in ACI 350R – Environmental Engineering Concrete Structures.)
 - 2. NEMA – National Electrical Manufacturer's Association – Standards pertaining to raceways.
 - 3. NEC – National Electric Code – As applicable to construction and installation of conduit system.
 - 4. Provide conduit which is listed and labeled by Underwriters' Laboratories.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Deliver all materials in original, unbroken, brand marked containers or wrapping as applicable.
- B. Handle and store materials in a manner which will prevent deterioration or damage (e.g., bending, end damage, finish scoring), contamination with foreign matter, damage by weather or elements, and in accordance with Manufacturer's directions.
- C. Store materials indoors and protect from weather. When necessary to store outdoors, elevate materials above grade and enclose with durable, watertight wrapping. Provide color coded end cap thread protectors on exposed threads of threaded metal conduit.
- D. Reject damaged, deteriorated, or contaminated material and immediately remove from the Site. Replace rejected materials with new materials at no additional cost to Owner.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Rigid Steel Conduit (RSC): Galvanized steel, heavy wall conduit with threaded fittings, 3/4-inch trade size minimum, insulated bushings.
- B. Electrical Metallic Tubing (EMT):
 - 1. Thin wall, hot galvanized, steel tubing, 3/4-inch trade size minimum with insulated throat steel connector.
 - 2. Fittings: Steel Compression or set screw (die cast fittings are expressly prohibited).

- C. Surface Metal Raceway (SMR):
 - 1. Two-piece steel raceway including a base and snap-on cover. Manufacturer: Wiremold, or equal. Provide type as indicated on the drawings.
 - 2. UL listed.
 - 3. Fittings, couplings, junction boxes, and accessories as required. Color to match raceway.
 - 4. Provide all necessary components for a complete, functioning, SMR system, including fittings, devices, straps, etc for line voltage and low voltage components.
- D. Flexible Metal Conduit (FMC): 3/4-inch trade size minimum with galvanized steel flexible conduit insulated throat steel connectors.
- E. Liquid Tight Flexible Metal Conduit (LTFMC): 3/4-inch trade size minimum with galvanized steel flexible conduit with flexible, moisture-proof PVC jacket and liquid tight connectors.
 - 1. In the mechanical room areas, LTFMC fittings shall be PVC coated.
- F. Joint Compound for RSC: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.
- G. Conduit Hubs for RSC:
 - 1. Suitable for environment served.
 - 2. Grounding screw.
 - 3. O-ring gasket.
 - 4. Material: stainless steel Type 316.
 - 5. Manufacturer:
 - a. Cooper Myers Hubs.
 - b. Thomas & Betts.
 - c. Killark.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Unless otherwise specified or indicated on the Drawings, conceal conduit to the extent possible.
 - 1. In finished areas where conduit cannot physically be concealed due to existing conditions, provide surface metal raceway. Finished areas are generally, but not always: above grade, heated spaces with finished walls (e.g., painted, drywall, etc.), finished floors (e.g., painted concrete, carpet, tile, etc.), and finished ceilings (e.g., drywall, suspended ceiling grids, wood, etc.).
 - 2. Conduit shall not be concealed within tank walls, slabs, or ceilings.
 - 3. Do not conceal conduit in Corrosive Locations.
- B. Exposed conduit permitted in:
 - 1. Mechanical and Electrical equipment rooms.
 - 2. Rooms without finished ceilings (overhead only).
 - 3. Unfinished rooms.
- C. Install conduit products in accordance with:
 - 1. The Manufacturer's written instructions.
 - 2. Applicable requirements of NEC and National Electrical Contractors Association's "Standard of Installation."
 - 3. Recognized industry practices to ensure that products serve intended function.
- D. Conduit Joints: Cut square, reamed smooth and drawn up tight.
- E. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joint. Follow compound manufacturer's written instructions.

- F. Bends:
 - 1. Number per run for conduit that support feeder and branch circuits: Do not exceed the equivalent of 4 quarter bends (360 degrees) between pull points.
 - 2. Number per run for conduit that supports data/communications cabling: Do not exceed the equivalent of 2 quarter bends (180 degrees) between pull points.
 - 3. Make bends and offsets so as not to reduce the inner diameter of the conduit.
 - 4. To the extent possible, avoid using large junction boxes as 90 degree junctions.
- G. Routing:
 - 1. Concealed Conduits: Run in a direct line with long sweep bends and offsets.
 - 2. Exposed Conduits: Run parallel to, and at right angles to, building lines.
 - 3. Run continuous from outlet to outlet and from outlets to cabinets, pull or junction boxes.
 - 4. Secure to all boxes and cabinets with locknuts and bushings in such a manner that each system is electrically continuous throughout.
- H. Cap conduit ends to prevent entrance of foreign materials during construction.
- I. Provide insulated bushings on all threaded conduit run terminations and where entering the bottom of open-bottom switchboards, transformers, and similar equipment.
- J. Where entering the bottom of open-bottom equipment (i.e., switchboards, panelboards, transformers, and similar equipment) conduit shall not be installed flush with the floor/equipment pad and shall not rise more than 3 inches above the bottom of the enclosure.
- K. Conduit entering control panels shall not obstruct internal components and shall allow for neat and workmanlike wire management.
- L. Completely install all conduit systems before installing conductors.
- M. Support:
 - 1. Adequately support conduit from structural elements of the building.
 - 2. Do not drill or tap structural building steel without approval from Engineer.
 - 3. Do not rest conduit on, nor support it from, ceiling suspension systems, ceiling tiles or mechanical equipment including, but not necessarily limited to ductwork and fans.
 - 4. Conduit shall be supported in accordance with the NEC and Division 26 Section "Hangers and Supports for Electrical Systems."
- N. Provide conduit expansion couplings where conduits cross building or structure expansion joints.
- O. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200 pound (90 kg) tensile strength. Label and leave at least 12 inches of slack at each end of pull wire.
- P. FMC and LTFMC Installation:
 - 1. Provide separate grounding conductor in accordance with Division 26 Section "Grounding and Bonding."
 - 2. Connection to light fixtures shall not exceed 6 feet in length within an accessible ceiling and 3 feet in length where exposed. Connection to solenoids, pressure switches, motors, fans, HVAC equipment, and similar equipment shall not exceed 3 feet in length.
- Q. Firestopping: Firestop all conduit penetrations of fire rated barriers by using approved material to ensure integrity of the rating

3.2 CONDUIT SCHEDULE

- A. Feeders, Branch Circuits and System Conduits:
 - 1. Above Slab or Grade:
 - a. Exposed Conduit Below 10'-0" AFF: RSC or IMC where subject to physical damage. EMT where not subject to physical damage.
 - b. Exposed Conduit Above 10'-0" AFF: EMT.
 - c. Concealed In Walls: EMT or FMC.
 - d. Concealed Above Ceiling: EMT.
 - e. Corrosive Locations (Mechanical Rooms): PVC coated RSC.
- B. Data/communications conduits in dry locations not subject to physical damage and not installed underground nor in or below concrete: EMT.
 - 1. Data/communication conduits shall be bonded.
 - 2. Data/communication sleeves, provide plastic bushings.
 - 3. Data/communication conduits shall be 3/4-inch minimum.
- C. Connection To Equipment:
 - 1. Lighting Fixtures and Control Devices (including, but not necessarily limited to solenoids, pressure switches, and field instruments):
 - a. Dry Locations: FMC.
 - b. Wet or Damp Locations: LTFMC.
 - c. Corrosive Locations (Mechanical Rooms): LTFMC with PVC coated fittings.
 - 2. Vibrating Equipment (including, but not necessarily limited to motors and transformers):
 - a. Motors:
 - 1) Dry Locations: FMC.
 - 2) Wet or Damp Locations: LTFMC.
 - 3) Corrosive Locations (Mechanical Rooms): LTFMC with PVC coated fittings.
 - b. Transformers at Dry Locations: FMC.
- D. Provide separate raceway systems for:
 - 1. Normal power wiring.
 - 2. Data/communication wiring.
 - 3. Fire alarm system wiring.
 - 4. A.C. signal and control wiring.
 - 5. Low voltage signal and control wiring.

END OF SECTION 26 05 34

SECTION 26 05 35 - 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. This Section includes the furnishing and installation of all electrical boxes and the major items listed below:
 - 1. Outlet boxes.
 - 2. Junction boxes.
 - 3. Pull boxes.

1.3 REFERENCES

- A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
 - 1. NEMA - National Electrical Manufacturer's Association: Standards as applicable to nonmetallic fittings for underground installation.
 - 2. NECA - National Electrical Contractor's Association's: Applicable portions of "Standard of Installation".

1.4 QUALITY ASSURANCE

- A. Fabrication and Installation Personnel Qualifications:
 - 1. Trained and experienced in the fabrication and installation of the materials and equipment.
 - 2. Knowledgeable of the design and the reviewed submittals.
- B. Regulatory Agencies Requirements:
 - 1. Provide boxes which are listed and labeled by Underwriters' Laboratories.
 - 2. NEC - National Electrical Code (NFPA 70) - As applicable to construction and installation of electrical boxes.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver all materials in original, unbroken, brand marked containers or wrapping as applicable.
- B. Handle and store materials in a manner which will prevent deterioration or damage, contamination with foreign matter, damage by weather or elements, and in accordance with Manufacturer's directions.
- C. Store materials indoors and protect from weather. When necessary to store outdoors, elevate materials above grade and enclose with durable, watertight wrapping.
- D. Reject damaged, deteriorated, or contaminated materials and immediately remove from the Site. Replace rejected materials with new materials at no additional cost to Owner.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Interior Outlet Boxes:
 - 1. Galvanized steel outlet boxes of the type, shape, and size, including depth of box, to suit each respective location and installation; constructed with stamped knockouts in back and sides, and with threaded holes with screws for securing box covers or wiring devices.

2. In areas requiring exposed RNMC, provide nonmetallic outlet boxes of type, shape and size to suit each location. Each box is to have conduit hubs with removable plugs and a non-metallic cover. Each box shall be compatible with RNMC.
- B. Interior Outlet Box Accessories:
 1. As required for each installation, including mounting brackets, wallboard hangers, extension rings, fixture studs, cable clamps, and metal straps for supporting outlet boxes. Accessories shall be compatible with outlet boxes being used and meet the requirements of individual wiring situations.
 2. Choice of accessories is installer's option.
- C. For Ceilings: 4-inch octagonal boxes for receiving 3 or less 1/2-inch conduits.
- D. For Flush Mounting In Walls:
 1. 4-inch square boxes with matching plaster cover for single or 2 gang outlets.
 2. For larger boxes use solid type or special units.
 3. In masonry, use deep boxes.
- E. Surface Mounted: 4-inch square.
- F. Junction and Pull Boxes: Sheet steel junction and pull boxes, with screw-on covers; of the type and shape and size to suit each respective location and installation; with welded seams and equipped with stainless steel nuts, bolts, screws, and washers. Dry interior location boxes shall have baked enamel finish. Damp location and exterior boxes shall have galvanized finish.
- G. Flush Mounted Pull Boxes: Provide overlapping covers with flush-head cover retaining screws, prime coated.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General:
 1. Install electrical boxes as indicated, in compliance with NEC requirements and in accordance with the Manufacturer's written instructions and recognized industry practices to ensure that the boxes and fittings serve the intended purposes.
 2. Provide knockout closures to cap unused knockout holes where blanks have been removed.
 3. Locate boxes and conduit bodies so as to ensure accessibility of electrical wiring.
 4. Secure boxes rigidly to the substrate upon which they are being mounted, or solidly embed boxes in concrete or masonry.
 5. Mount outlet boxes flush in areas other than mechanical rooms, electrical rooms, and above removable ceilings.
 6. Adjust position of outlets in finished masonry walls to suit masonry course lines.
 7. Do not install boxes back-to-back in same wall. Coordinate cutting of masonry walls to achieve neat openings for boxes.
 8. Do not use sectional or handy boxes unless specifically requested.
 9. For boxes mounted in exterior walls install insulation behind outlet boxes to prevent condensation in boxes.
 10. For outlets mounted above counters, benches, and backsplashes, coordinate location and mounting heights with built-in units. Adjust outlet mounting height to agree with required location for equipment served.
 11. Outlet boxes in finished areas shall be located as indicated on the Drawings and so set that the face plates will be flush with the finish on which it is mounted. Where 2 or more devices of any kind are set side by side, set them in gang boxes unless otherwise noted on the Drawings.
 12. Locate pull boxes and junction boxes above removable ceilings or in electrical rooms, utility rooms, or storage areas such that boxes will be accessible after completion of building.
 13. All boxes shall have covers installed at completion of construction.

END OF SECTION 26 05 35

SECTION 26 09 23 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the furnishing and installation of all lighting control devices listed below:
 - 1. Occupancy sensors (wall and ceiling mounted) and related power packs.
 - 2. Photo sensors (daylight harvesting).
 - 3. Ballast load transfer control relay devices (UL924).

1.3 SUBMITTALS

- A. Shop Drawings: Provide the following information for each type of lighting control device.
 - 1. Name of Manufacturer.
 - 2. Model number.
 - 3. Details of construction and installation.
 - 4. Assembly drawings, including elevations, plans, sections, and dimensions.
 - 5. Project Specific Point-To-Point Wiring Diagrams:
 - a. Diagrams shall clearly identify all field wiring requirements.
 - b. Connection points shall be identified by terminal number.
 - 6. Project specific floor plans, including all occupancy sensor types, photo sensor type locations, as recommended by Manufacturer.
 - 7. Color and finish.
 - 8. Options and accessories.
- B. Installation Instructions: For lighting control devices.
- C. Manufacturer's Certification: For lighting control devices:
 - 1. Sworn statement that the equipment furnished complies with this Specification.
 - 2. Written approval of installation.
- D. Installation and Maintenance Manuals: For lighting control devices.
 - 1. Equipment function, normal operating characteristics, and limiting conditions.
 - 2. Assembly, installation, alignment, adjustment, and checking instructions.
 - 3. Operating instructions for start-up, routine and normal operating, regulation and control, shutdown, and emergency conditions.
 - 4. Maintenance instructions.
 - 5. Guide to "troubleshooting."
 - 6. Parts list and predicted life of parts subject to wear.
 - 7. Project specific outline and cross-sections, assembly drawings, engineering data, and wiring diagrams. Wiring diagrams shall reflect final, as-installed conditions and include wire numbers.
 - 8. Test data and performance curves.

1.4 QUALITY ASSURANCE

- A. Fabrication and Installation Personnel Qualifications:
 - 1. Trained and experienced in the fabrication and installation of the materials and equipment.
 - 2. Knowledgeable of the design and the reviewed submittals.
- B. Manufacturer:
 - 1. At least 5 years experience with approved systems.
 - 2. Provide Owner training on system operation.

- C. Components: All equipment shall be UL listed.

1.5 WARRANTY

- A. In accordance with the warranty provisions defined in the General Conditions and Supplementary Conditions: Includes all lighting control systems.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver all materials in original, unbroken, brand marked containers or wrapping as applicable.
- B. Handle and store materials in a manner which will prevent deterioration or damage, contamination with foreign matter, damage by weather or elements, and in accordance with Manufacturer's directions.
- C. Store materials indoors and protect from weather.
- D. Reject damaged, deteriorated, or contaminated materials and immediately remove from the Site. Replace rejected material with new material at no additional cost to Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Occupancy Sensors:
 - 1. Lutron.
 - 2. Wattstopper.
 - 3. Hubbell.
 - 4. Sensor Switch.
 - 5. All occupancy sensors shall be produced by the same Manufacturer.

2.2 MATERIALS

- A. General: Furnish and install lighting control devices as indicated on the Drawings.
- B. Low Voltage Wiring:
 - 1. For low voltage wiring, provide wire type as recommended by the Manufacturer.
 - 2. Adhere to manufacturer's recommendations as to maximum wire length and maximum quantity of relays per switch.
- C. Line Voltage Wiring: No. 12 AWG minimum.
- D. Occupancy Sensors:
 - 1. Provide occupancy sensors as indicated herein and on the Drawings.
 - 2. System Components:
 - a. Ultrasonic occupancy sensors.
 - b. Passive infrared occupancy sensors.
 - c. Dual technology occupancy sensors.
 - d. All Occupancy Sensors Shall Include:
 - 1) Self adjusting type based on algorithm for maximum performance Adjustable time delay 30 seconds to 15 minutes.
 - 2) Adjustable unit sensitivity.
 - 3) UL and CBA listed.
 - 4) 5 year warranty.
 - 5) Mounting brackets or boxes as required for each space application.

- e. Each Ceiling Mounted Sensor Shall Include:
 - 1) Power pack and/or slave packs as required.
 - 2) Additional isolated relay contact for use by the room mechanical systems.
 - 3) Manual off override if indicated.
 - 4) LED indicates motion detection.
- f. Device quantities and locations as indicated on the Drawings.
- g. Wiring: As indicated on the Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General:
 - 1. Install lighting control devices as indicated on the Drawings.
 - 2. Install all lighting control devices in accordance with Manufacturer's recommendations.

3.2 FIELD QUALITY CONTROL

- A. Contractor Field Service:
 - 1. Provide qualified personnel to perform, schedule and coordinate: Terminate and label all wiring.

3.3 CLEANING

- A. Clean all lighting control system devices at Substantial Completion.

3.4 ADJUSTING

- A. Set time delay and sensitivity for all occupancy sensors in accordance with Manufacturer's written instructions based on room type.

END OF SECTION 26 09 23

SECTION 26 27 26 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the furnishing and installation of all wiring devices and the major items listed below:
 - 1. Receptacles.
 - 2. Switches.
 - 3. Wall plates.
 - 4. Box covers.

1.3 REFERENCES

- A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
 - 1. NEMA - National Electrical Manufacturer's Association - Standards for general and specific purpose wiring devices WD-1, WD-s.
 - 2. Federal Specifications WC-596 and WS-896.
 - 3. Underwriter Laboratories (UL) Standard 498.

1.4 SUBMITTALS

- A. Shop Drawings: For wiring devices.
 - 1. Name of Manufacturer.
 - 2. Model number.
 - 3. Details of construction and installation
 - 4. Electrical specifications and ratings.
 - 5. Dimensional data.
 - 6. Color and finish.

1.5 QUALITY ASSURANCE

- A. Regulatory Agencies Requirements:
 - 1. NEC - National Electrical Code (NFPA 70) as applicable to construction and installation of electrical wiring devices.
 - 2. UL Labels. Provide wiring devices which have been tested and are listed and labeled by Underwriters' Laboratories.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver all materials in original, unbroken, brand marked containers or wrapping as applicable.
- B. Handle and store materials in a manner which will prevent deterioration or damage, contamination with foreign matter, damage by weather or elements, and in accordance with Manufacturer's directions.
- C. Store materials indoors and protect from weather. When necessary to store outdoors, elevate materials above grade and enclose with durable, watertight wrapping.
- D. Reject damaged, deteriorated, or contaminated materials and immediately remove from the Site. Replace rejected materials with new materials at no additional cost to Owner.

PART 2 - PRODUCTS

2.1 WIRING DEVICES

- A. General:
 - 1. Provide factory-fabricated wiring devices in type, color, and electrical rating as indicated below or as noted on the drawings.
 - 2. Where type and grade are not indicated, proper selection shall be determined by installer to fulfill the wiring requirements and to comply with NEC and NEMA standards for wiring devices.
- B. Manufacturers: Provide equal products by one of the following Manufacturers for switches and receptacles specified:
 - 1. Arrow Hart - Cooper Wiring Devices.
 - 2. Leviton.
 - 3. Hubbell Wiring Systems.
 - 4. Pass and Seymour – Legrand.
- C. Convenience Receptacles:
 - 1. Ratings: 20 amp, 125V, heavy duty specification grade.
 - 2. Provisions: Back and side wiring, grounding screw.
 - 3. Wraparound Mounting Strap: 260 brass, 0.05-inch thick. Device Color: To be selected during submittal.
 - 4. Manufacturer: Hubbell 5362 Series.
- D. Ground Fault Circuit Interrupter Receptacles:
 - 1. Ratings: 20 amp, 125V, specification grade.
 - 2. Provisions: Feed through protection.
 - 3. Device Color: To be selected during submittal.
 - 4. Manufacturer: Hubbell GF-5362 Series.
- E. Wall Plates:
 - 1. Number: Provide a single (switch or duplex outlet) wall plate for wiring devices grouped at each location.
 - 2. Attachment: Provide metal screws for securing plates to devices, screw heads colored to match finish of plate.
 - 3. Construction:
 - a. Stainless Steel: 0.04-inch thick, Type 302 satin finished stainless steel, accurately die cut, protected with release paper.
 - b. Cast Metal: Die cast profile, ribbed for strength, flash removed, painted with gray enamel, furnished complete with 4 mounting screws with gaskets.
 - 4. Plate Application:
 - a. When surface mounted device boxes are utilized, the plate shall match the box (i.e., a 4 square box shall require a raised device cover, an FS or FD box shall require an FS or FD device cover, and a PVC coated box shall require a PVC coated cover, etc.)
 - b. Flush Mounting Devices: Beveled type with smooth edge:
 - 1) Finished Areas: Stainless steel.
 - 2) Unfinished Areas: Galvanized steel.
 - c. Surface Mounted Devices in Unfinished Process Spaces: Galvanized steel.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General:
 - 1. Install wiring devices in accordance with:
 - a. The Drawings.
 - b. Manufacturer's written instructions.
 - c. Applicable requirements of NEC and National Electrical Contractors Association's "Standard of Installation".
 - d. Recognized industry practices to ensure that products serve intended function.
 - 2. Delay installation of devices until wiring is completed.

3. Install receptacles and switches only in electrical boxes which are clean and free from excess building materials and debris.
 - B. Receptacles:
 1. Locate approximately as indicated on the Drawings, long dimension vertical, with grounding pole at top.
 2. Centerline generally at 18 inches above floor on a tile or block joint unless otherwise indicated on the Drawings. When mounting height exceeds 27 inches above floor, mount horizontally with grounding pole at left.
 3. Refer to architectural Drawings for specific location requirements for architectural details when located above counters (long dimension horizontal), and for centering to meet architectural conditions.
 4. Refer to mechanical Drawings for coordination with mechanical equipment, radiation, fin tube, grilles, and diffusers.
 5. Provide bonding jumper from outlet to box.
 - C. Multi-Outlet Assemblies:
 1. Mount 2 inches above countertop backsplash. Where there is no cabinetry, mount 18 inches above finished floor.
 2. In multi-circuited outlet assemblies, configure so that adjacent outlets are not on the same circuit.
 - D. Wall Plates:
 1. Install coverplates on all wiring devices
 2. Plate shall cover entire wall opening.
- 3.2 FIELD QUALITY CONTROL
- A. Testing: Test wiring devices to ensure electrical continuity of grounding connections, and test after energizing circuitry, to demonstrate compliance with requirements.
- 3.3 PROTECTION OF WALL PLATES AND RECEPTACLES
- A. Upon installation of wall plates and receptacles, advise Subcontractors regarding proper and cautious use of convenience outlets. At time of Substantial Completion, replace those items which have been damaged, including those burned and scored by faulty plugs.

END OF SECTION 26 27 26

SECTION 26 50 00 - LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the furnishing and installation of all lighting and the major items listed below:
 - 1. Interior luminaires.
 - 2. Drivers.
 - 3. LEDs integral to luminaires.
 - 4. Exit signs.
 - 5. Luminaire supporting systems.

1.3 REFERENCES

- A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
 - 1. ANSI-UL Standards:
 - a. 924 - Emergency Lighting and Power Equipment.
 - b. 1449, Surge Protective Devices.
 - c. 1598 – Luminaires.
 - d. 8750 – Light Emitting Diode (LED) Equipment for Use in Lighting Products.
 - 2. NFPA:
 - a. 70 – National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
 - b. 101 – Life Safety Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction.
 - 3. FCC Rules.
 - 4. Illuminating Engineering Society of North America (IES):
 - a. LM-79 – Electrical and Photometric Measurements of Solid-State Lighting Products.
 - b. LM-80 – Measuring Lumen Maintenance of LED Light Sources.
 - c. TM-15 – Luminaire Classification System for Outdoor Luminaires.
 - d. TM-21 – Projecting Long Term Lumen Maintenance of LED Light Sources.
 - 5. LED Lighting Facts:
 - a. Submission Requirements:
 - 1) (<http://www.lightingfacts.com/About/Content/Manufacturers/SubmissionRequirements>).
 - 6. Energy Star:
 - a. Energy Star TM-21 Calculator, rev. 08.28.14 or latest (www.energystar.gov/TM-21Calculator).

1.4 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI Color Rendering Index.
- C. Fixture: See “Luminaire.”
- D. IP: International Protection or Ingress Protection Rating
- E. LED: Light-emitting diode.
- F. Lumen: Measured output of lamp and luminaire, or both.

- G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.
- H. Useful Life (For LED Luminaire Light Source) - The operating hours before reaching 70% of the initial rated lumen output (L70) with no catastrophic failures under normal operating conditions. This is also known as 70% "Rated Lumen Maintenance Life" as defined in IES TM-80.

1.5 SUBMITTALS

A. Shop Drawings:

- 1. For luminaires, submit the following:
 - a. Luminaire designation.
 - b. Name of Manufacturer.
 - c. Model number.
 - d. Details of construction and installation.
 - e. Dimensions and rough-in requirements.
 - f. Voltage.
 - g. Photometric data and adjustment factors based on laboratory tests.
 - h. Ballast / Driver Data:
 - 1) Name of Manufacturer.
 - 2) Model number.
 - 3) Operating characteristics.
 - i. Wiring diagrams.
 - j. Color and finish.
 - k. Options and accessories.
- 2. For Interior LED Luminaires, submit the following:
 - a. Life, output (lumens, CCT, and CRI), and energy efficiency data.
 - b. LED Luminaire – IES LM-79 Test Report.
 - c. LED Luminaire – IES LM-80 Test Report.
 - d. Provide long term lumen maintenance projections for each LED luminaire in accordance with IES TM-21. Data used for projections shall be obtained from testing in accordance with IES LM-80. According to IES TM-21, "Reported" values are restricted to 5.5x or 6x (depending on sample size) the duration of IES LM-80 testing, whereas "Calculated" (i.e., projected) values are unrestricted. Manufacturer shall indicate whether TM-21 data is "Reported" or "Calculated".

B. Certificates:

- 1. Luminaire Useful Life Certificate: Submit certification from the manufacturer indicating the expected useful life of the luminaires provided. The useful life shall be directly correlated from the IES TM-80 test data using procedures outlined in IES TM-21. Thermal properties of the specific luminaire and local ambient operating temperature and conditions shall be taken into consideration.

C. Operation and Maintenance Manuals: For Luminaires.

- 1. Equipment function, normal operating characteristics, and limiting conditions.
- 2. Assembly, installation, alignment, adjustment, and checking instructions.
- 3. Operating instructions for start-up, routine and normal operating, regulation and control, shutdown, and emergency conditions.
- 4. Maintenance instructions.
- 5. Guide to "troubleshooting."
- 6. Parts list and predicted life of parts subject to wear.
- 7. Project specific outline and cross sections, assembly drawings, engineering data, and wiring diagrams.
- 8. Test and performance curves.

D. Record Drawings: Submit 2 copies to Owner identifying maintenance and lamp replacement requirements.

1.6 QUALITY ASSURANCE

A. Fabrication and Installation Personnel Qualifications:

- 1. Trained and experienced in the fabrication and installation of the materials and equipment.
- 2. Knowledgeable of the design and the reviewed submittals.

B. All equipment shall be UL listed.

1.7 WARRANTY

- A. In accordance with the warranty provisions defined in the General Conditions and Supplementary Conditions:
 - 1. LED Luminaires:
 - a. Provide 5 year manufacturer warranty for all LED luminaires, including drivers, luminaire housing, wiring, and connections.
 - b. Loss of 10% or more of light output from the LED sources in an LED luminaire during the warranty period constitutes luminaire failure.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver all materials in original, unbroken, brand marked containers or wrapping as applicable.
- B. Handle and store materials in a manner which will prevent deterioration or damage, contamination with foreign matter, damage by weather or elements, and in accordance with Manufacturer's directions.
- C. Store materials indoors and protect from weather. When necessary to store outdoors, elevate materials above grade and enclose with durable, watertight wrapping.
- D. Reject damaged, deteriorated, or contaminated material and immediately remove from the Site. Replace rejected materials with new materials at no additional cost to Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acuity Brands (Lithonia, Fluxwork, Gotham, etc.).
- B. Eaton (Cooper, Lumark, Metalux, Surelite, etc.).

2.2 LUMINAIRE TYPES

- A. Furnish products as indicated in Luminaire Schedule on the Drawings.
- B. Substitutions: In accordance with Division 01 Section "Product Substitution Procedures."

2.3 MATERIALS

- A. General:
 - 1. Furnish luminaires with all trims and accessories required for the various types of ceiling and wall construction.
 - 2. All drivers shall have an "A" sound rating, where available.
 - 3. Provide "damp" or "wet" location labels on all luminaires installed outdoors and in damp or wet interior locations.
 - 4. All recessed luminaires shall be thermally protected.
 - 5. All troffers shall be painted after fabrication.
 - 6. Exterior LED luminaires shall be rated for operation within an ambient temperature range of -40-degrees C to 40-degrees C.
 - 7. Interior LED luminaires shall be rated for operation at an average ambient temperature of 25 degrees C.
- B. Exit Signs:
 - 1. Description: Internally illuminated exit signs with LEDs, unless otherwise indicated; complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.
 - 2. Provide exit signs as indicated on the Luminaire Schedule.
 - 3. Exit signs shall have minimum of 6-inch high letters.
 - 4. Number of faces: Single or double as indicated or as required for the installed location.
 - 5. Directional Arrows: As indicated or as required for the installed location.

- C. LED Luminaires:
1. Correlated Color Temperature (CCT) shall be in accordance with NEMA ANSI ANSLG C78.377 – Specifications for the Chromaticity of Solid State Lighting Products.
 2. LED Power Supply Units (Drivers): Minimum efficiency shall be 85%.
 3. Exterior LED Luminaires shall meet the performance requirements specified in ANSI C136.2 for electrical immunity, using the enhanced combination wave form test level (10kV/5kA).
 4. Provide 0 to 10V dimming driver as indicated on the Luminaire Schedule. Dimming range shall be 100% to 10% of rated lamp lumens, unless otherwise noted on the Luminaire Schedule.
 - a. Shall be rated to operate between ambient temperatures of -22 degrees F and 104 degrees F.
 - b. Shall be designed to operate on the voltage system to which they are connected.
 - c. Operating frequency shall be 60 Hz.
 - d. Power factor (PF) shall be greater than or equal to 0.90.
 - e. Shall be RoHS-compliant.
 - f. Shall be mounted integral to luminaire. Unless indicated otherwise, remote mounting of power supply is not allowed.
 5. LED Luminaire Surge Protection: Provide surge protection integral to luminaire to meet C Low waveforms as defined by IEEE C62.41.2, Scenario 1, Location Category C.
 6. LED color temperature shall be consistent throughout the project, as indicated in the luminaire schedule.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that outlet boxes are installed in proper locations at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.
- B. Verify that suitable support frames are installed where required.
- C. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.
- D. Verify that conditions are satisfactory for installation prior to starting Work.

3.2 PREPARATION

- A. Examine all pertinent details (architectural and otherwise) in the Contract Documents that are relevant to the installation of luminaires.
- B. Provide extension rings to bring outlet boxes flush with finished surfaces.
- C. Remove all dirt, debris, plaster, and other foreign materials from outlet boxes.

3.3 INSTALLATION

- A. General:
1. Install surface mounted, recessed, or semi-recessed luminaires to maintain the alignment, spacing, layout, and general arrangement indicated on the Drawings.
 2. Obtain approval of Engineer for all proposed changes that may be required due to field conditions and/or to avoid conflicts with Work by other trades.
 3. Install all luminaires in accordance with Manufacturer's recommendations.
 4. Equip all luminaires with the specified quantity of functional lamps prior to Substantial Completion.
 5. Install all wiring for emergency lighting and exit signs in a raceway system independent from other building wiring.

- B. Coordination:
 - 1. Coordinate locations of recessed and surface mounted luminaires in ceiling systems with Division 09.
 - 2. Locate luminaires according to the reflected ceiling Drawings, if furnished.
 - 3. Coordinate location of luminaires in Mechanical HVAC and Plumbing areas with other trades.
 - 4. Notify Engineer of field conditions that contradict Drawings or Specifications prior to beginning work.
 - 5. Coordinate space conditions that contradict or conflict with Work by other trades before installing luminaires.
- C. Mounting and Support:
 - 1. Recessed Luminaires:
 - a. Wire luminaires that are mounted in or on the underside of lay-in ceilings with flexible conduit to an outlet box on the rigid conduit system above, such that the rigid conduit system does not interfere with the removal of lay-in ceiling panels or luminaires.
 - b. Do not support luminaires directly on ceiling panels.
 - c. Install a minimum of four ceiling support system rods or wires for each luminaire. Locate rods or wires not more than 6 inches from the corners of each luminaire
 - d. Support Clips: Fasten to each luminaire and to ceiling grid members at or near each luminaire corner with clips that are UL listed for the application.
 - e. Securely mount luminaires and electrical boxes to elements of the building structure such that luminaires will be square, plumb, and rigid; and will not fall or sag, and will not cause the suspended ceiling system to fall or sag.
 - f. Install at least one independent support rod or wire from structure to a tab on each luminaire. Wire or rod shall have a breaking strength equal to the weight of luminaire plus a safety factor of 3.
 - g. Provide all additional means (metal plates, etc.) necessary to support luminaires that would put excessive stress on the ceiling system.
 - 2. Surface Mounted Luminaires:
 - a. Securely mount luminaires and electrical boxes to elements of the building structure such that luminaires will be square, plumb, and rigid; and will not fall or sag, and will not cause the ceiling system to fall or sag.
 - b. Provide all additional means (metal plates, plywood backing, expansion bolts, toggle bolts, etc.) necessary to support luminaires that would put excessive stress on the ceiling system.
 - 3. Pendant Mounted Luminaires:
 - a. Securely mount luminaires and electrical boxes to elements of the building structure such that luminaires will be square, plumb, and rigid and in alignment with other fixtures and parallel or perpendicular to the building structure.
 - b. Coordinate luminaire installation with piping, ductwork, etc. including supports and drivers when they are not integral.

3.4 FIELD QUALITY CONTROL

- A. Test all luminaires and lighting controls for proper operation.
- B. All luminaires shall operate properly.
- C. Adjusting and Aiming:
 - 1. All final adjusting and aiming of luminaires (such as focusing all adjustable luminaires) shall be done during the night hours. Contractor shall prearrange time with Engineer so Engineer can be present. Final adjustments shall be made as directed in field by Engineer.
 - 2. Replace all defective luminaires immediately prior to Substantial Completion.

3.5 CLEANING

- A. Clean all luminaire trims, exposed housings, doors, lenses, and reflectors immediately prior to Substantial Completion.

END OF SECTION 26 50 00

SECTION 27 13 00 – COMMUNICATIONS INFRASTRUCTURE

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

- A. Furnish and install, as indicated on the Drawings and hereinafter specified, a complete and satisfactory extension of the existing data system.
- B. All requirements shall strictly adhere to the Wayne State Standards for Communications Infrastructure – 29 July 2019.
 - 1. <https://tech.wayne.edu/docs/wsu-communications-standards.pdf>

1.3 SUBMITTALS

- A. All shop drawings shall be submitted in groupings of similar and/or related items (cable and connectors, equipment cabinets and racks, etc.). Incomplete submittal groupings will be returned unchecked.
- B. Provide detailed layout shop drawings (on transparent media) of backbone and horizontal cabling distribution, pathways, equipment room layouts, details and related information necessary of installation and maintenance. After review by the Engineer and WSU C&IT, a copy of Drawings will be stamped and returned to the Contractor.
- C. Submit for approval all telecommunications systems or equipment but not limited to the items listed below. Where items are referred to by symbolic designation on the Drawings and Specifications, all submittals shall bear the same designation. Refer to other sections of the Specifications for additional requirements.
 - 1. Structured cabling system components.
 - 2. Structured cable system raceways and supports.
 - 3. Labeling equipment.
 - 4. Conduit, inner duct, junction and pull boxes.
 - 5. Surface raceway components.
 - 6. Data network system components.

1.4 APPLICABLE STANDARDS

- A. Unless specifically indicated otherwise in this document, all telecommunications infrastructure shall be design in accordance with the following standards including all appropriate addendums and revisions:
 - 1. ANSI/TIA-568-C Commercial Building Telecommunications Cabling Standard.
 - 2. ANSI/TIA-606-B Administration Standard for Commercial Telecommunications Infrastructure.
 - 3. ANSI J-STD-607-B Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications.
 - 4. ANSI/TIA-758 Customer Owned Outside Plant Telecommunications Cabling Standard.
 - 5. ANSI/TIA 569-C.
 - 6. Customer Owned Outside Plant Telecommunications Cabling Standard.
 - 7. BICSI Telecommunications Distribution Methods Manual (TDMM).
 - 8. BICSI Telecommunications Cabling Installation Manual (TCIM).
 - 9. ANSI/TIA 569-C Commercial Building Standards for Telecommunications Pathways and Spaces.

1.5 SCOPE

A. General:

1. The intent of these specifications is to provide a reference document for the expansion of an existing data infrastructure system.
2. Demolish all data cabling, slated for demolitions, back to the indicated data closet.
 - a. All demolition of existing telecommunications cable, equipment and materials shall be specified by C&IT and done by this contractor unless otherwise indicated. Include all items such as, but not limited to, cable, patch panels, devices, and wiring back to the source, called out on the drawings and as necessary whether such items are actually indicated on the drawings or not in order to meet NFPA requirements.
 - b. In general, demolition of old low voltage communications cabling work is indicated on the Drawings, however, the Contractor shall visit the job site to determine the full extent and character of this work. All existing voice and data jacks demolished need to be documented. A room number, jack number (if still there), approximate location in the room and the communication room where it terminated need to be identified. This information must be returned to C&IT IOPS Networking Engineering Group.
 - c. None of the recovered material shall be reused in the new work.
 - d. Where new walls and/or floors are installed which interfere with existing telecommunications outlets, devices, etc., this Contractor shall adjust, extend and reconnect such items as required to maintain continuity of same.
 - e. All electrical work in altered and unaltered areas shall be run concealed wherever possible. Use of surface metal raceway or exposed conduits will be permitted only where approved by the Architect/Engineer and as specifically indicated on the Drawings.
3. The system shall be designed to support 1Gbps Ethernet to the desktop over CAT6E copper cabling.

B. Installation:

1. Horizontal, Accessible Ceiling Spaces:
 - a. Provide j-hooks down corridors whenever possible.
 - b. Route main cable runs through accessible corridor spaces and drop off into each room from the main runs.
 - c. Do not route main cable trays or cable bundles through classrooms or offices.
 - d. Maintain 12 inches minimum between cable tray and LED or fluorescent lighting.
 - e. Terminate cable to the nearest communication room on the same floor.

C. Work in Existing Buildings:

1. Adequately protect and preserve all existing and newly installed work. Promptly repair any damage to same at this Contractor's expense.
2. Consult with the Owner's Project Coordinator and C&IT Project Coordinator as to the methods of carrying on the work so as not to interfere with the Owner's operation any more than absolutely necessary. Accordingly, all telecommunications services shall be kept in operation as long as possible and the services shall only be interrupted at such time as will be designated by the Owner's representative.

D. Coordination: If there is a general contractor, the general contractor is responsible for the construction schedule. All work activities are to be coordinated with the general contractor.

E. Chases and Recesses: Chases and recesses shall be provided by the architectural trades, but this Contractor shall be responsible for coordinating their accurate location and size.

F. Sleeves:

1. Provide and install Hilti Speed Sleeve model CP-630 or EZ path fire stop system wherever conduits or cabling pass through fire rated walls, floors or cables pass through openings in walls.
2. Sleeves are used in standard walls and floors with no fire rating. All sleeves through the floor are to extend 4 inches above floor, unless otherwise noted. Provide escutcheons at each sleeve in finished areas and adequate spacing between sleeves to accommodate escutcheons.

- G. Cleaning:
 - 1. All debris shall be removed daily as required to maintain the work area in a neat, orderly condition.
 - 2. Final cleanup shall include, but not be limited to, cleaning all telecommunications equipment spaces, devices, cover plates, and removing all scrap cable and debris from pathways.

1.6 QUALITY ASSURANCE

- A. Fabrication and Installation Personnel Qualifications:
 - 1. Trained and experienced in the fabrication and installation of the materials and equipment.
 - 2. Knowledgeable of the design and the reviewed submittal.
- B. Contractor Bid Eligibility Qualifications:
 - 1. The installing contractor for each communications system shall have a minimum of 5 years of experience with the types of systems specified. The company and employee must be certified to install, test and warranty the product specified. This certification must be produced at the WSU mandatory pre-bid meeting, prior to a bid submittal. **No exception to this will be allowed.**
 - 2. The installing contractor may be asked to submit a reference list consisting of a minimum of 3 to 5 installations of equivalent size and complexity of this Contract. The reference list shall contain the following information for each installation:
 - a. Name of project, square footage, location and brief description of systems.
 - b. Date of completed installation.
 - c. Contact name and phone number of facility representative.
 - d. Total bid amount of each system installed.
 - e. Final contract amount of each system installed, including all change orders and bulletins.
 - 3. The installing contractor shall submit with the bid the names and registration numbers of members of the firm that have a valid membership and are certified with BICSI as Registered Communications Distribution Designers (RCDD). This Contractor shall identify at least one RCDD assigned to this Project in the bid and must be an employee of that company.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Deliver all materials in original, unbroken, brand marked containers or wrapping as applicable.
- B. Handle materials in a manner which will prevent deterioration or damage, contamination with foreign matter, damage by weather or elements, and in accordance with Manufacturer's directions.
- C. Store materials indoors and protect from weather. When necessary to store outdoors, elevate materials above grade and enclose with durable, watertight wrapping.
- D. Reject damaged, deteriorated, or contaminated materials and immediately remove from the Site. Replace rejected materials with new materials at no additional cost to Owner.

1.8 DESIGN VALIDATION

- A. The bidding, shop drawing submittal, procurement of materials, the installation as-builts, and record documents shall be reviewed and overseen by the RCDD(s) assigned to the Project.
- B. The Contractor's bid, shop drawing submittals, as-builts and record documents shall bear the valid seal of the RCDD(s) assigned to this Project.
- C. All calculations, shop drawings, testing, certification and as-built documents shall be directly supervised by the licensed technician/engineer assigned to the Project.
- D. The subcontractor must provide the general contractor a copy of the manufacturer's certification that the subcontractor is currently certified to install, test and warranty the proposed system prior to a bid submittal. See Section 27110, 7.5A and section 27010, 1.16A. The Owner reserves the right to have the non-certified subcontractor removed from the job.

PART 2 - PRODUCTS

2.1 MATERIAL

- A. Manufacturer: Provide products manufactured by one of the following Manufacturers, or equal:
 - 1. Aiphone.
 - 2. Rauland.
- B. Provide cable and connectors only from WSU preferred manufacturers list.
- C. Always install Category "6E (enhanced)" UTP cable.
- D. Terminate on its own patch panel in equipment rack.
 - 1. Cable shall be Green.
- E. Data Outlet:
 - 1. Jacks shall be orange located in the outlet bottom position (vertical) or the outlet right position (horizontal).
 - 2. Provide two gray patch cords per data outlet..
- F. Jack Labeling:
 - 1. Workstation Data Jack:
 - a. [Room Number] or [Cubicle Number]- [Function + multiple jack in room number].
 - 1) Ex: 222-V01, 222-D01, 222-V02, 222-D02, 223-V01, 223-D01, etc.
- G. Cabling System Performance:
 - 1. General:
 - a. Cabling system performance shall meet or exceed current industry standards and/or manufacturers' specifications as specified herein.
 - b. The cable installed in the walls, connectors, jack, patch panels, and patch cords must be the same manufacture and model that forms the complete cabling system channel. The total system shall meet the performance criteria described below.
 - c. The cable and connector devices shall be certified compatible by the manufacturer of each component to meet the performance criteria described below. Submit manufacturer's certification with submittals.
 - d. The referenced standards describing the performance below shall include all revisions, clarifications and bulletins to the original standard referenced as well as any standards cross-referenced.
 - e. The referenced standards describing the performance below shall apply to backbone cable, horizontal cabling and connecting hardware performance requirements as well as installation standards and techniques and field testing and verification of performance.
 - f. A plenum category 5 (CAT5E) cabling in a 25 pair cable bundle is to be utilized for voice (Analog Gateway connected telephone) building backbone riser only.
 - g. Category 5 performance is defined by ANSI/TIA 568-C for 100-ohm UTP cables and associated connecting hardware whose transmission characteristics are specified up to 100 MHz.
 - h. Category 6 enhanced (CAT6E) cabling shall be utilized for all voice, data, wireless access points and security camera horizontal wiring. For WSU projects, any one of the following five CAT6E structured cabling system products are acceptable:
 - 1) Hubbell NEXTSPEED Cat 6 enhanced.
 - 2) Superior-Essex/Ortronics NextGain Cat6EX.
 - 3) Leviton-BerkTek Lanmark-2000.
 - 4) Beldon DataTwist 600e.
 - 5) CommScope Uniprise 7504 Cat6E.
 - i. Category 6e performance is defined by the manufacturers of the above cabling products.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Testing and Documentation:
 - 1. Testing Criteria:
 - a. Comply with TIA testing requirements.
 - b. To be done by the cabling installation contractor. They must be certified to install the product line chosen. No exception to this will be allowed.
 - c. All items tested must comply with manufacturer testing requirements and specifications.
 - d. Test results will demonstrate compliance with all parameters of manufacturer's stated performance.
 - 2. Documentation:
 - a. Upon completion, before final payment, the following must be provided:
 - 1) Provide the manufacturer warranty certificate upon completion.
 - 2) Provide 1 electronic copy of test results in PDF file format.
 - 3) No exception to this will be allowed.
- B. Circuits: Provide 120 volt, single phase circuits for the equipment housing where indicated on Drawings and connect to circuits indicated on Drawings.
- C. Identification: All wiring in splice or terminal cabinets shall be properly identified.
- D. Workmanship: All wiring and termination shall be done in a neat and workmanlike manner, to the satisfaction of the Engineer and Owner.
- E. Location: All equipment shall be located in approximate locations where indicated on Drawings. Check architectural and mechanical Drawings before locating rough-in to avoid conflicts with other equipment.
- F. Hook-Up: All connections shall be made according to the manufacturer's wiring diagrams. Follow manufacturer's recommendations.

3.2 SYSTEM CHECKOUT

- A. General
 - 1. The Contractor shall show satisfactory evidence upon request that he maintains a fully equipped service organization capable of furnishing adequate maintenance to entire intercommunications system, including factory replacement parts.
 - 2. The Contractor shall be prepared to offer a contract for the maintenance of the system after the guarantee period.

END OF SECTION 27 13 00

SECTION 28 31 00 – FIRE DETECTION AND ALARM

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 modification of an existing fire alarm system to obtain complete and functional building fire detection and alarm system.
- B. Division of Work:
 - 1. In accordance with the General Conditions, Contractor is responsible for dividing the Work among the Subcontractors and Suppliers and for delineating the work to be performed by specific trades. The following are suggestions as to how the Work may be divided. This is not a complete list of all the work:
 - a. Electrical Subcontractor:
 - 1) Coordinate equipment.
 - 2) Install and wire all system components.

1.3 REFERENCES

- A. Except as herein specified or as indicated on the Drawings, the work of the Section shall comply with the following:
 - 1. NFPA Standards:
 - a. NFPA 70 - 2011 National Electric Code, including Part 8 amendments.
 - b. NFPA 72 - 2013 National Fire Alarm Code.
 - c. NFPA 101- 2012 Life Safety Code.
 - d. NFPA 13 - 2013 Installation of Sprinkler Systems.
 - 2. UL Standards
 - a. UL 864 - Control Units for Fire Protective Signaling Systems.
 - b. UL 268 - Smoke Detectors for Fire Protective Signaling Systems.
 - c. UL 521 - Heat Detectors for Fire Protective Signaling Systems.
 - d. UL 464 - Audible Signaling Appliances.
 - e. UL 1971 - Signaling Devices for the Hearing-Impaired.
 - f. UL 1481 - Power Supplies for Fire Protective Signaling Systems.
 - g. UL 1635 - Digital Alarm Communicator System Units.
 - 3. State Office of Fire Safety – State of Michigan.
 - 4. WSU Office of Fire Safety
 - 5. Federal Codes and Regulations.
 - 6. Americans with Disabilities Act (ADA).
 - 7. International Standards Organization (ISO):
 - a. ISO-9000.
 - b. ISO-9001.

1.4 SYSTEM DESCRIPTION

- A. Modify the existing fire detection and alarm system and fire alarm system devices as indicated on Drawings and this specification. This specification describes an addressable Fire Detection and alarm signaling system. The control panel shall be an intelligent device addressable, analog detecting, low voltage and modular, with digital communication techniques, in full compliance with all applicable codes and standards. The features and capacities described in this specification are required as a minimum for this project and shall be furnished by the successful contractor

1.5 DESIGN AND PERFORMANCE REQUIREMENTS

- A. System shall be programmed to provide early detection of fire, to notify building occupants, notify the WSU Public Safety Office, summon local fire department, override HVAC operation, and activate auxiliary systems to inhibit the spread of smoke and fire and to facilitate the safe evacuation of building occupants.
- B. The system shall include all required hardware, raceways, interconnecting wiring and software to accomplish the requirements of this specification and the contract drawings, whether or not specifically itemized herein.
- C. All equipment furnished shall be new and the latest state-of-the-art products of a single manufacturer, engaged in the manufacturing and sale of analog fire detection devices for over ten years.
- D. The system as specified shall be supplied, installed, tested and approved by the local Authority Having Jurisdiction, and turned over to the owner in an operational condition.
- E. In the interest of job coordination and responsibilities, the installing contractor shall contract with a single supplier for fire alarm equipment, engineering, programming, inspection and tests, and shall be capable of providing a "UL Listing Certificate" for the complete system.

1.6 GENERAL

- A. The system shall be a complete, electrically supervised fire detection and notification system, with a microprocessor based operating system having the following capabilities, features, and capacities.
- B. Activation of any system fire, security, supervisory, trouble, or status initiating device shall cause the following actions and indications at all network Person Machine Interfaces using basic graphics and multiple detail screens.
 - 1. Fire Alarm Condition:
 - a. Audible and visual notification alarm circuit zone control.
 - b. Status indicators for sprinkler system water-flow and valve supervisory devices.
 - c. Any additional status or control functions as indicated on the drawings, including but not limited to: emergency generator functions, fire pump functions, door unlocking and security with bypass capabilities.
 - d. Sound an audible alarm and display a custom screen/message defining the building in alarm and the specific alarm point initiating the alarm in a graphic display.
 - e. Log into the system history archives all activity pertaining to the alarm condition.
 - f. Print alarm condition on system printer.
 - g. Sound the ANSI 117-1 signal with synchronized audible and synchronized strobes throughout the facility.
 - h. Audible signals shall be silenced from the fire alarm control panel by an alarm silence switch. Visual signals shall be programmable to flash until system reset or alarm silencing, as required.
 - i. A signal dedicated to sprinkler system water flow alarm shall not be silenced while the sprinkler system is flowing at a rate of flow equal to a single head.
 - j. The alarm information shall be displayed on a graphic annunciator located where shown on drawing.
 - k. Activation of any smoke detector in a single elevator lobby or an elevator equipment room shall, in addition to the actions described, cause the recall of that bank of elevators to the 1st floor and the lockout of controls. In the event of recall initiation by a detector in the first floor lobby, the recall shall be to the alternate floor as determined by the AHJ.
 - l. Where indicated on drawings, heat detectors in elevator shaft and machine rooms shall activate an elevator power shunt trip breaker. The heat detectors shall be rated at a temperature below the ratings of the sprinkler heads in respective locations to insure that the power shall be shut off before activation of sprinkler system.
 - m. System operated duct detectors as per local requirements shall accomplish HVAC shut down.

1.7 SUBMITTALS

- A. Shop Drawings: For all system components.
 - 1. Data sheet indicating model number, performance specifications and dimensional data, color and finish.
 - 2. Details of construction and installation.
 - 3. Name of manufacturer.
 - 4. Full system schematic.
 - 5. Wiring details.
 - 6. Point-to-point wiring diagram showing all equipment.
 - 7. Battery calculations. Battery size shall be a minimum of 125% of the calculated requirement.
 - 8. Floor plan indicating fire alarm system devices only.
 - 9. Dimension plan indicating all items located inside fire alarm control panel. Plan should indicate future space.
 - 10. Indicate all features indicated in this specification which are not included in the manufacturer's equipment. Label these items as "Exceptions to the Specifications".
 - 11. NAC circuit design shall incorporate a 15% spare capacity for future expansion.
 - 12. Power supply rating justification showing power requirements for each of the system power supplies. Power supplies shall be sized to furnish the total connected load in a worst-case condition plus 25% spare capacity.
 - 13. Voltage drop calculations for wiring runs demonstrating worst-case condition.
- B. Layout drawings (plans) identifying all fire detection and alarm system devices. Plans shall be to scale and indicate mounting height for each device. Complete drawings covering the following shall be submitted by the contractor for the proposed system:
 - 1. Floor plans in a CAD compatible format at a scale of 1/8"=1'-0" showing all equipment and raceways, marked for size, conductor count with type and size, showing the percentage of allowable National Electric Code fill used.
 - 2. Provide a fire alarm system function matrix as referenced by NFPA 72, Figure A-7-5.2.2 (9). Matrix shall illustrate alarm input/out events in association with initiation devices. Matrix summary shall include system supervisory and trouble output functions. Include any and all departures, exceptions, variances or substitutions from these specifications and/or drawings at time of bid.

1.8 QUALITY ASSURANCE

- A. Fabrication and Installation Personnel Qualifications:
 - 1. Trained and experienced in the fabrication and installation of the materials and equipment.
 - 2. Knowledgeable of the design and the reviewed submittals.
 - 3. NICET Level 2 certified.
- B. Manufacturer:
 - 1. At least 5 years experience with approved systems.
 - 2. Having authorized service facility within 150 miles of Site.
- C. Components: All components shall be UL listed for intended use.
- D. Manufacturer's Services:
 - 1. Manufacturer's Certificate:
 - a. Submit for installed system.
 - b. Required Assurances:
 - 1) Confirmation of final inspection.
 - 2) Installation conforms to Specifications and Manufacturer's requirements.
 - 2. Provide Owner training program.

1.9 DELIVERY, STORAGE AND HANDLING

- A. Deliver all materials in original, unbroken, brand marked containers or wrapping as applicable.

- B. Handle and store materials in a manner which will prevent deterioration or damage, contamination with foreign matter, damage by weather or elements, and in accordance with Manufacturer's directions.
- C. Store materials indoors and protect from weather. When necessary to store outdoors, elevate materials above grade and enclose with durable, watertight wrapping.
- D. Reject damaged, deteriorated, or contaminated materials and immediately remove from the Site. Replace rejected material with new materials at no additional cost to Owner.

1.10 WARRANTY

- A. The Contractor shall warranty all materials, installation and workmanship for 1 year from date of acceptance, unless otherwise specified.
- B. A copy of the Manufacturer's warranty shall be provided with close-out documentation and included with the operation and installation manuals.
- C. The System Supplier shall maintain a service organization with adequate spare parts stock within 75 miles of the installation.
- D. Any defects that render the system inoperative shall be repaired within 24 hours of the owner notifying the contractor.

1.11 CLOSE OUT

- A. Close out submittals shall include:
 - 1. Project specific operating manuals covering the installed fire detection and alarm system.
 - 2. Manufacturer's data sheets and installation manuals/instructions for all equipment supplied.
 - 3. Owner's instruction and operation manual.
 - 4. Record drawings consisting of: a scaled plan of each building showing the placement of each individual item of the fire detection and alarm system as well as raceway size and routing, junction boxes, and conductor size, quantity, and color in each raceway.
 - 5. All drawings must reflect point to point wiring.
 - 6. All drawings shall be provided in standard .DXF format. A vellum plot of each sheet shall also be provided.
 - 7. The application program listing for the system as installed at the time of acceptance by the building owner and/or local AHJ (disk, hard copy printout, and all required passwords).
 - 8. Provide the name, address, and telephone of the authorized factory representative.
 - 9. A filled out Record of Completion similar to NFPA 72, 1999 edition figure 1-6.2.1.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Provide products manufactured by one of the following Manufacturers:
 - 1. Siemens Industry, Inc.
 - a. The existing system is Siemens Desigo Fire Safety Intelligent Voice Communication System; installed in 2015.
 - 2. No alternates will be acceptable.

2.2 CONTROL PANEL

- A. The control panel shall include all required hardware, software and site specific system programming to provide a complete and operational system.

- B. The control panel shall include the following circuits:
 - 1. Class B initiating device circuits.
 - 2. Class B signaling line circuits.
 - 3. Class B notification appliance circuits.
- C. The control panel(s) operational priority shall assure that life safety takes precedence among the activities coordinated by the control panel.

2.3 NOTIFICATION APPLIANCES

- A. Speaker / Strobes:
 - 1. SE-MC-W: SE Horn: Multi-Candela White
 - 2. SE-HMC-W: SE Horn: Hi Multi-Candela White
 - 3. SE-CW: SE Horn: Ceiling White
 - 4. SE-MC-CW: SE Horn: Multi-Candela White
 - 5. Strobes shall provide synchronized flash outputs.
 - 6. Wall mounted strobe Candela ratings of 15cd, 30cd, 60cd, 75cd, 110cd. Candela ratings shall be determined by equipment supplier.
 - 7. Ceiling mounted strobe Candela ratings of 15cd, 30cd, 75cd, 90cd, 115cd, 150cd, and 177cd Candela ratings shall be determined by equipment supplier.

PART 3 - EXECUTION

3.1 WIRING

- A. All wiring shall be in accordance with Manufacturer's written recommendations and shall meet all applicable code requirements.
- B. All wiring shall be copper.
- C. No. 16 AWG minimum for signaling line circuits (SLCs)
- D. No. 14 AWG THHN minimum for audible and visual notification appliance circuits (NACs).
- E. No. 12 AWG THHN minimum for line voltage.
- F. Install wiring partially in metal raceways in accordance with Division 26 Section "Raceways for Electrical Systems." Provide junction boxes and conduit sleeves to main corridor areas. Install wiring in conduit sleeves to above ceiling in corridor areas. Wiring in corridor areas does not need to be installed in conduit. Provide cable tray, cable supports, nylon straps as required to properly support cabling in accordance with code .
- G. Cable type shall be FPLP, FPLR.

3.2 EQUIPMENT INSTALLATION

- A. Audio/Visual Alarm Indicating Devices: Mount at 80 inches above the highest floor level within space or 6 inches below the ceiling, whichever is lower. Unless otherwise indicated, install bells and horns on flush-mounted back boxes with the device operating mechanism concealed behind a grille. Combine audible and visible alarms at the same location into a single unit.

3.3 GROUNDING

- A. Ground equipment and conductor and cable shields. For audio circuits, minimize to the greatest extent possible ground loops, common mode returns, noise pickup, cross talk, and other impairments. Provide 5 ohm ground at main equipment location. Measure, record, and report ground resistance.

3.4 FIELD QUALITY CONTROL

- A. All fire alarm equipment and components that are removed during demolition shall be collected, stored and delivered to a location on the campus as directed by the owner.
- B. All intelligent analog addressable devices shall be tested for current address, sensitivity, and user defined message.
- C. All wiring shall be tested for continuity, shorts, and grounds before the system is activated.
- D. All test equipment, instruments, tools, and labor required to conduct the tests shall be made available by the installing contractor.
- E. The system including all its sequence of operations shall be demonstrated to the Owner, his representative, and the local fire inspector. In the event the system does not operate properly, the test shall be terminated. Corrections shall be made and the testing procedure shall be repeated until it is acceptable to the Owner, his representatives and the fire inspector.
- F. At the final test and inspection, a factory trained representative of the system manufacturer shall demonstrate that the system functions properly in accordance with these specifications. The representative shall provide technical supervision, and participate during all of the testing for the system.
- G. All fire alarm testing shall be in accordance with National Fire Alarm Code, NFPA 72 - 1999, Chapter 7.
- H. A letter from the Contractor attesting to the full compliance with construction documents and current codes and standards. The letter shall certify that the system is installed entirely in accordance with the system manufacturer's recommendations and within the limitations of the required listings and approvals, that all system hardware and software has been visually inspected and functionally tested by a manufacturer's certified representative, and that the system is in proper working order.
- I. Maintain the existing fire alarm system until the new system is completely functional.
- J. Upon acceptance of the new fire alarm system, provide complete demolition of the existing system, including all wall repairs, ceiling repairs, cover plates, cutting, patching, painting, etc.

END OF SECTION 28 31 00